NPDES/SDS Permit Application

Volume II – Mine Site

Prepared for
Poly Met Mining, Inc.

July 2016 (initial submittal)

October 2017 (updated)

4300 MarketPointe Drive, Suite 200
Minneapolis, MN 55435
952.832.2600
www.barr.com

NPDES/SDS Permit Application
Volume II – Mine Site

July 2016 (initial submittal)

October 2017 (updated)

Contents

List of Tables

List of Large Tables

List of Large Figures

List of Appendices

List of Acronyms and Abbreviations

Acronym or Abbreviation	Description
Application	NPDES/SDS Permit Application
BMP	Best Management Practice
CPS	Central Pumping Station
FEIS	Final Environmental Impact Statement
FTB	Flotation Tailings Basin
MCL	Maximum Concentration Limit
MDNR	Minnesota Department of Natural Resources
MEPA	Minnesota Environmental Policy Act
MPCA	Minnesota Pollution Control Agency
MPP	Mine to Plant Pipelines
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
OSLA	Overburden Storage and Laydown Area
OSP	Ore Surge Pile
PolyMet	Poly Met Mining, Inc.
Project	NorthMet Project
RTH	Rail Transfer Hopper
SDS	State Disposal System
sMCL	Secondary Maximum Concentration Limit
SWPPP	Stormwater Pollution Prevention Plan
TSS	Total Suspended Solids
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WWTS	Waste Water Treatment System

Minnesota Pollution Control Agency
520 Lafayette Road
St. Paul, MN 55155-4194

Permit Application Checklist for Industrial Wastewater

NPDES/SDS Permit Program

National Pollutant Discharge Elimination System (NPDES)/
State Disposal System (SDS)

Doc Type: Permit Application

MPCA use only
Permit Number
Date Received (MM/DD/YYYY)

Industrial Process Wastewater is wastewater which, during the manufacturing or processing, comes into direct contact with, or is left over from production of a raw material, intermediate product, finished product, byproduct or waste product.

This checklist is intended to help permit applicants determine the correct forms to submit as part of a complete permit application package. The Minnesota Pollution Control Agency (MPCA) will review the application materials for completeness and notify the applicant within 30 business days of receipt whether the application is incomplete or complete enough for processing.

Print or type application: Before submitting an application, make a photocopy of this form and all other application materials for your records. The MPCA will review the application for completeness and provide an official response to the permittees within 30 days of receipt of all necessary application materials.

Permit application assembly: To expedite the processing and review of your application, put this form and any other applicable permit application checklists for other waste types at the beginning of your submittal package. Please place all other application forms in order as listed on the back of this form. Do not place forms and checklists in an appendix as this makes it difficult and time consuming for staff to locate them.

Completeness instructions: The MPCA will not process an application without properly completed forms. ***All sections of required forms must be completed.*** If portions do not apply to this facility, please indicate using "n/a" or explain why it doesn't apply. For permit reissuance, all forms information must also be completed in full even if the information requested is not changing from the existing permit. This allows the MPCA to quickly verify that the existing information is correct.

Facility name: NorthMet Mine Site Permit No.: MN TBD

Reason for Application (check all that apply): ☒ New permit ☐ Permit Modification ☐ Permit Reissuance
☐ Resubmittal of an application determined to be incomplete.
(Include copies of all returned forms with a resubmittal.)

Does this action include construction activities: ☒ Construction is proposed as part of the permit action.
☐ No construction is proposed as part of this permit action.

Form Submittal

Submit two (2) complete copies of the permit application package. At least one (1) copy must be a hard copy. The other may be an electronic copy. **The completed form is to be returned to:**

Attn: Fiscal Services – 6th floor
Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, MN 55155-4194

Assistance

If you have any questions regarding the selection of the proper forms or how to complete the required information, contact the MPCA staff assigned to your facility. Staff is assigned by regions and a director of regional staff can be located at: http://www.pca.state.mn.us/index.php/about-mpca/mpca-overview/agency-structure/mpca-offices/mpca-offices.html

You may also contact the MPCA at:

- In Metro Area 651-296-6300
- Outside Metro Area: 800-657-3864
- E-mail to: askpca@state.mn.us.

Application Forms Selection (Check all boxes that apply and include the completed form with the submittal.)

Listed below are application forms and required submittals that may be required for a typical industrial wastewater treatment facility application. All required forms must be completed in-full and included with the submittal. The MPCA cannot process an application that does not include all of the required application forms. All forms, instructions, and additional information can be found on the MPCA website at http://www.pca.state.mn.us/enzq915. **Check all boxes that apply. Include a copy of all completed application forms with the submittal.**	For MPCA use only		
	Received	**Incomplete**	**Complete**
Required for all water quality permits For Transmittal Form: Refer to Volume I of this Permit Application.			
☒ Transmittal Form (wq-wwprm7-03) http://www.pca.state.mn.us/index.php/view-document.html?gid=6275	☐	☐	☐
☒ Application Fee as specified on the Transmittal Form	☐	☐	☐
☒ Certification Signature as specified on Transmittal Form	☐	☐	☐
Required for all new permits and modifications with a change in design flow			
☐ MPCA Design Flow and Loading Determination Guidelines for Wastewater Treatment Facilities, Table 2, Worksheet (wq-wwtp#5.20) http://www.pca.state.mn.us/index.php/view-document.html?gid=13505	☐	☐	☐
Major NPDES facilities and/or Categorical NPDES facilities			
☐ U.S. Environmental Protection Agency (EPA) Application Form 1 (10 pages of instructions, 16 pages total) http://www.pca.state.mn.us/index.php/view-document.html?gid=7024	☐	☐	☐
☐ EPA Application Form 2C (5 pages of instructions, 25 pages total) http://www.pca.state.mn.us/index.php/view-document.html?gid=7025	☐	☐	☐
Discharge to surface water (for major and minor facilities)			
☐ Industrial Surface Water Discharge of Process Wastewater Application (wq-wwprm7-20) http://www.pca.state.mn.us/index.php/view-document.html?gid=7027	☐	☐	☐
Non-contact cooling water			
☐ Industrial Non-Contact Cooling Water Application (wq-wwprm7-28) http://www.pca.state.mn.us/index.php/view-document.html?gid=7043	☐	☐	☐
Discharge to land			
☐ Industrial Land Discharge of Process Wastewater (wq-wwprm7-21) http://www.pca.state.mn.us/index.php/view-document.html?gid=7029	☐	☐	☐
☐ Industrial Land Application of Industrial By-products Application (wq-wwprm7-27)	☐	☐	☐
Discharge to municipal wastewater treatment facility			
☐ Industrial Pretreatment Discharge to a Municipal Wastewater Treatment Facility Application (wq-wwprm7-23) http://www.pca.state.mn.us/index.php/view-document.html?gid=7033	☐	☐	☐
Treatment facilities using stabilization ponds			
☒ Municipal and Industrial Pond Attachment (wq-wwprm7-11) http://www.pca.state.mn.us/index.php/view-document.html?gid=7002	☐	☐	☐
Stormwater management for wastewater treatment permit holders			
☐ Industrial Stormwater Multi-Sector NPDES/SDS Permit Application (wq-wwprm7-60a) http://www.pca.state.mn.us/index.php/view-document.html?gid=19364 Instructions for Industrial Stormwater Permit Application Attachment to NPDES/SDS permit (wq-wwprm7-60b) http://www.pca.state.mn.us/index.php/view-document.html?gid=19368	☐	☐	☐
Additional attachments			
☐ Additional Station Location Attachment (wq-wwprm7-49) http://www.pca.state.mn.us/index.php/view-document.html?gid=7049	☐	☐	☐
☒ Additional Chemical Additives Attachment (wq-wwprm7-48) http://www.pca.state.mn.us/index.php/view-document.html?gid=7051	☐	☐	☐
Supplemental information (This information may be information required on one, or more of the forms listed above, such as a map. A single map that provides all the information required from multiple forms may be acceptable. A separate copy of each form is not required.)			
☒ Topographic map.	☐	☐	☐
☒ A schematic drawing or treatment process flow diagram showing all treatment components, direction of flow, compliance monitoring station locations, and discharge locations.	☐	☐	☐

☒ List any additional documents, reports, plans, or attachments included as part of the application package. (Common types of supplemental information may include maps, process flow diagrams, facility plans, engineering reports, plans and specifications, technical checklists and other reports related to the facility or proposed project.) Refer to Volume II Table of Contents	☐	☐	☐
Other waste types Some facilities may also include other waste types that are not covered by this checklist. Facilities with multiple types of wastes should review the other permit application checklists to determine if additional forms and attachments may be required.			
☐ Permit Application Checklist for Municipal/Domestic Wastewater (wq-wwprm7-04a)	☐	☐	☐
☐ Permit Application Checklist for Miscellaneous Waste Types (wq-wwprm7-04c)	☐	☐	☐
☐ Permit Application Checklist for Water Treatment (wq-wwprm7-04d)	☐	☐	☐

Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, MN 55155-4194

Municipal and Industrial Pond Attachment

NPDES/SDS Permit Program

Doc Type: Permit Application

The National Pollutant Discharge Elimination System (NPDES)/State Disposal System (SDS) Permit Program regulates wastewater discharges to land and surface waters. This attachment applies to municipal and industrial facilities with a pond system (i.e. primary, secondary, polishing, equalization, anaerobic, contaminated runoff, etc.).

Complete the attachment by typing or printing in black ink. Attach additional sheets as necessary. For more information, please contact the Minnesota Pollution Control Agency (MPCA) at: In Metro Area: 651-296-6300 or Outside Metro Area: 800-657-3864.

Permittee name: Poly Met Mining, Inc. **Permit number:** MN TBD

Geology/Hydrogeology Information

1. Provide a description of the soil beneath or in the vicinity of the ponds. Use information from soil surveys or from existing soil borings or well logs if available. (Ex.: 8 feet (ft.) of fine sand underlain by 10 ft, of silty clay.)

   Refer to question #1 on attached table

2. What is the depth below ground surface of the water table at the pond site? Refer to question #2 on attached table ft.

   How many feet below ground surface is the bottom of the pond? Refer to question #2 on attached table ft.

3. What is the depth to bedrock at the pond site? ☒ <10 ft. ☒ 10-20 ft. ☒ 20-50 ft. ☐ >50 ft. Refer to question #3 on attached table

4. What is the bedrock type (Ex.: limestone, sandstone, etc.)? Refer to question #4 on attached table

5. What is the proximity to the ponds of private water supply wells? ☐ < ¼ mile ☐ ¼ - 1 mile ☒ >1 mile

6. Describe the approximate number, type and depth of private water wells in the general vicinity of the ponds (3 mile radius). (Ex.: most (#?) wells generally drilled to greater than 50 ft., however, several shallow (20 ft.) sand point wells also present.)

   The Minnesota Well Index includes two wells listed for domestic use within a 3-mile radius of the proposed ponds at the Mine Site: Unique Well IDs 23237 and 23239. These two wells were drilled for PolyMet and are listed as temporarily sealed. Well ID 23237 is 715 ft deep and Well ID 23239 is 498 ft deep.

   There are no other known private water supply wells within a 3-mile radius of the proposed ponds.

7. Are the ponds located in a designated Wellhead Protection Area? ☐ Yes ☒ No

8. Are monitoring wells present at the pond site? ☒ Yes ☐ No

   If yes, please submit a topographic or equivalent map showing well locations with respect to the pond system. Refer to Large Figure 6 of Volume I

   Have any wells shown adverse impacts (Ex.: high nitrate or chloride concentrations)? ☐ Yes ☒ No

   If yes, please describe the adverse impacts: Not applicable; baseline groundwater quality observed in monitoring wells in the vicinity of the proposed Mine Site represents natural background levels rather than adverse impacts.

9. What is the proximity to the ponds of any nearby surface waters? (Ex.: Minnesota River located ¼ mile to the north.).

   Refer to question #9 on attached table

Pond Information

10. Please indicate the types of ponds that are present at the facility. (Check all that apply)

    ☒ Primary ☐ Secondary ☐ Polishing ☒ Equalization

☐ Aerated ☐ Anaerobic ☐ Cooling ☒ Contaminated runoff
☐ Irrigation holding ☐ Ash handling ☒ Other: Refer to question #10 on attached table for specific descriptions

11. Please complete the following table for each pond at the facility.

Pond type	Max operating depth (ft.)	Min operating depth (ft.)	Mean operating depth (ft.)	Acreage at mean operating depth	Days of detention time (design flow)	Year each pond was constructed
Refer to question #11 on attached table						

12. What is the source of the acreage information in question 11 above? (Ex: as built plans and specs, engineering survey, etc.)

Permit level design

13. Has the pond system ever been repaired or upgraded? ☐ Yes ☒ No If yes, what year? N/A

If yes, please describe what the upgrade included: N/A

14. Has the pond system ever been dredged? ☐ Yes ☒ No If yes, what year? N/A

If yes, please describe the method of dredge material disposal: N/A

15. What type of pond liner is present? ☐ Clay ☒ Synthetic/Vinyl ☐ Bentonite ☒ Other: Refer to question #15 on attached table

16. Is the pond system ever operated at a depth so that the freeboard is less than 3 feet? ☒ Yes ☐ No

If yes, please describe the situation and identify how often it occurs: Refer to question #16 on attached table

17. What is the relationship between current wastewater flows and pond designed hydraulic capacity?

☐ below capacity ☐ at or near capacity ☐ above capacity Not applicable; no current wastewater flows

18. Are there any drain tiles (designed or pre-existing) located in the vicinity of or beneath the pond system? ☐ Yes ☒ No

If yes, please submit a topographic or equivalent map showing the drain tile locations and a description of each. (The map and description should include but not be limited to: the drain tile location in relation to the pond system; the drain tile location in relation to the irrigation field *[if applicable]*; each drain tile discharge location; and, each discharge location station identification code *[if applicable]*.)

19. Please list the calendar month total influent and effluent flow in million gallons for each of the past 12 months (*not applicable for municipal facilities*).

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Influent	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Effluent	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

20. What is the average annual influent $CBOD_5$? N/A mg/L

21. Are there known or potential sources of toxic pollutants (metals, Volatile Organic Compounds [VOCs] such as, trichloroethylene, chloroform, methyl tert-butyl ether [MTBE], benzene, etc.)? ☒ Yes ☐ No

If yes, please describe: Potential toxic pollutants (with modeled minimum to maximum 90^{th} percentile concentrations):

Silver (4.97E-5 to 0.148 mg/L), Aluminum (1.41E-3 to 821 mg/L), Arsenic (2.91E-3 to 1.29 mg/L), Beryllium (1.55E-4 to 0.14 mg/L), Cadmium (7.73E-5 to 0.283 mg/L), Cobalt (8.05E-4 to 25.8 mg/L), Chromium (7.15E-4 to 0.108 mg/L), Copper (7.38E-3 to 12.8 mg/L), Nickel (3.64E-3 to 72.9 mg/L), Lead (1.07E-4 to 0.548 mg/L), Antimony (6.89E-4 to 4.76 mg/L), Selenium (5.79E-4 to 0.426 mg/L), Thallium (5.19E-5 to 1.17E-2 mg/L), Zinc (3.56E-3 to 34.3 mg/L)

The presence of such pollutants is one of the reasons why water from these ponds will be treated at the WWTS mine water treatment trains and routed to the FTB for reuse, rather than discharged.

22. Is the pond system located in karst topography? ☐ Yes ☒ No

If yes and if your facility is listed in the 1993 Administrative Order requiring the preparation of a contingency plan, please ensure your facility has an updated contingency plan on file.

Review the attachment and ensure all requested items are submitted with this attachment.
Please make a copy for your records.
Refer to the *Transmittal Form* for mailing instructions.

Attachment to Municipal and Industrial Pond Attachment form

Municipal and Industrial Pond Attachment Question	Mine Site Mine Water Pond							
	S23-1	MW-S23-1	S23-2	S23-3	MW-S23-3	S4	MW-S4	SOSP
Geology / Hydrogeology Information								
1. Provide a description of the soil beneath or in the vicinity of the ponds.	Glacial Till	Glacial Till	Glacial Till; Peat	Glacial Till; Peat	Glacial Till; Peat	Glacial Till; Peat	Glacial Till; Peat	Glacial Till
	Upland Shallow Loamy Dry(1)	Upland Shallow Loamy Dry; Lowland Organic Acid to Neutral(1)	Upland Shallow Loamy Dry; Lowland Organic Acid to Neutral(1)	Upland Shallow Loamy Dry; Lowland Organic Acid to Neutral(1)	Upland Shallow Loamy Dry; Lowland Organic Acid to Neutral(1)	Lowland Organic Acid to Neutral(1)	Upland Shallow Loamy Dry; Lowland Organic Acid to Neutral(1)	Upland Shallow Loamy Dry(1)
2. What is the depth below ground surface of the water table at the pond site? (feet)	0 to 6.5	0 to 6.5	0 to 9.0	0 to 16.5	0 to 16.5	0 to 7.5	0 to 7.5	0 to 6.5
How many feet below ground surface is the bottom of the pond? (feet)	10.0 to 18.5	10.0 to 18.5	9.0 to 18.5	9.0 to 18.0	9.0 to 18.0	6.0 to 15.0	6.0 to 15.0	21.5 to 29.5
3. What is the depth to bedrock at the pond site? (<10 ft / 10-20 ft / 20-50 ft / >50 ft)	<10 ft or 10-20 ft	<10 ft or 10-20 ft	<10 ft	<10 ft or 10-20 ft	<10 ft or 10-20 ft	10-20 ft	10-20 ft	<10 ft or 10-20 ft
4. What is the bedrock type?	Duluth Complex	Duluth Complex	Duluth Complex	Duluth Complex	Duluth Complex	Duluth Complex	Duluth Complex	Duluth Complex
9. What is the proximity to the ponds of any nearby surface waters?	approx. 100 ft south to wetland	approx. 100 ft south to wetland	approx. 330 ft south to wetland	approx. 110 ft south to wetland	approx. 120 ft south to wetland	approx. 40 ft west to wetland	approx. 90 ft south to wetland	approx. 390 ft south to wetland
	approx. 2,850 ft south to Partridge River	approx. 2,730 ft south to Partridge River	approx. 2,400 ft south to Partridge River	approx. 1,030 ft south to Partridge River	approx. 1,270 ft south to Partridge River	approx. 3,470 ft north to Partridge River	approx. 3,380 ft north to Partridge River	approx. 3,860 ft south to Partridge River
Pond Information								
10. Please indicate the types of ponds that are present at the facility. (Primary / Aerated / Irrigation holding / Secondary / Anaerobic / Ash handling / Polishing / Cooling / Equalization / Contaminated runoff / Other)	Stockpile Drainage	Stockpile Drainage - Overflow	Stockpile Drainage	Stockpile Drainage	Stockpile Drainage - Overflow	Stockpile Drainage	Stockpile Drainage - Overflow	Stockpile Drainage
11. Max operating depth in feet	9.5	12.5	8.5	7.5	7.5	7	7	10
Min operating depth in feet	1	1	1	1	1	1	1	1
Mean operating depth in feet	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Acreage at mean operating depth (Acreage given at high water elevation)	2.1	3.0	1.9	0.9	1.1	2.0	1.6	1.1
Days of detention time (design flow)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Year pond will be constructed	Mine Year 1	Mine Year 1	Mine Year 3	Mine Year 6	Mine Year 6	Mine Year 1	Mine Year 1	Mine Year 1
15. What type of pond liner is present? (Clay / Synthetic/Vinyl / Bentonite / Other)	Geomembrane	Geomembrane	Geomembrane	Geomembrane	Geomembrane	Geomembrane	Geomembrane	Geomembrane
16. Is the pond system ever operated at a depth so that the freeboard is less than 3 feet? (Yes / No)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
If yes, please describe the situation and identify how often it occurs:	Extreme event (>100-year storm)	Extreme event (>100-year storm)	Extreme event (>100-year storm)	Extreme event (>100-year storm)	Extreme event (>100-year storm)	Extreme event (>100-year storm)	Extreme event (>100-year storm)	Extreme event (>100-year storm)

Footnote:

(1) Based on predominant U.S. Forest Service (USFS) ecological land types and ecological land type phases

Attachment to Municipal and Industrial Pond Attachment form

Municipal and Industrial Pond Attachment Question	Mine Site Mine Water Pond						
	MW-SOSP	MW-HRC	MW-HRE	MW-HRW	MW-HRN	MW-RTH	MW-OSLA
Geology / Hydrogeology Information							
1. Provide a description of the soil beneath or in the vicinity of the ponds.	Glacial Till	Glacial Till	Glacial Till	Glacial Till	Glacial Till; Peat	Glacial Till	Glacial Till
	Upland Shallow Loamy Dry[(1)]	Upland Shallow Loamy Dry[(1)]	Lowland Loamy Wet; Upland Shallow Loamy Dry[(1)]	Upland Shallow Loamy Dry[(1)]	Upland Shallow Loamy Dry; Lowland Organic Acid to Neutral[(1)]	Upland Shallow Loamy Dry[(1)]	Lowland Loamy Wet; Upland Shallow Loamy Dry[(1)]
2. What is the depth below ground surface of the water table at the pond site? (feet)	0 to 6.5	3.0 to 9.0	0 to 7.0	1.0 to 5.5	0 to 5.5	0 to 3.5	0 to 0.5
How many feet below ground surface is the bottom of the pond? (feet)	21.5 to 29.5	9.0 to 16.5	6.0 to 16.5	0.0 to 6.0	4.0 to 10.5	0.0 to 6.0	4.5 to 7.0
3. What is the depth to bedrock at the pond site? (<10 ft / 10-20 ft / 20-50 ft / >50 ft)	<10 ft or 10-20 ft	<10 ft	<10 ft	<10 ft	<10 ft or 10-20 ft	10-20 ft	20-50 ft
4. What is the bedrock type?	Duluth Complex	Duluth Complex	Duluth Complex	Duluth Complex	Duluth Complex	Duluth Complex	Duluth Complex
9. What is the proximity to the ponds of any nearby surface waters?	approx. 380 ft south to wetland	approx. 470 ft north to wetland	approx. 160 ft north to wetland	approx. 1230 ft south to wetland	approx. 200 ft east to wetland	approx. 210 ft south to wetland	approx. 230 ft south to wetland
	approx. 3,940 ft south to Partridge River	approx. 4,280 ft south to Partridge River	approx. 3,370 ft south to Partridge River	approx. 2,630 ft southwest to Unnamed Creek	approx. 6,690 ft south to Partridge River	approx. 2,840 ft south to Partridge River	approx. 1,840 ft southwest to Unnamed Creek
Pond Information							
10. Please indicate the types of ponds that are present at the facility. (Primary / Aerated / Irrigation holding / Secondary / Anaerobic / Ash handling / Polishing / Cooling / Equalization / Contaminated runoff / Other)	Stockpile Drainage - Overflow	Haul Road Drainage	Haul Road Drainage	Haul Road Drainage	Haul Road Drainage	Rail Transfer Hopper Drainage	Overburden Storage and Laydown Area Drainage
11. Max operating depth in feet	10	12	12	6.5	7	4	9
Min operating depth in feet	1	1	1	1	1	1	1
Mean operating depth in feet	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Acreage at mean operating depth (Acreage given at high water elevation)	0.8	0.9	1.3	0.8	0.9	0.3	6.5
Days of detention time (design flow)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Year pond will be constructed	Mine Year 1	Mine Year 1	Mine Year 1	Mine Year 2	Mine Year 2	Mine Year 1	Mine Year 1
15. What type of pond liner is present? (Clay / Synthetic/Vinyl / Bentonite / Other)	Geomembrane	Geomembrane	Geomembrane	Geomembrane	Geomembrane	Geomembrane	Geomembrane
16. Is the pond system ever operated at a depth so that the freeboard is less than 3 feet? (Yes / No)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
If yes, please describe the situation and identify how often it occurs:	Extreme event (>100-year storm)	Extreme event (>100-year storm)	Extreme event (>100-year storm)	Extreme event (>100-year storm)	Extreme event (>100-year storm)	Designed to operate with 1 foot of freeboard with pump operating during 100-year storm	Extreme event (>25-year storm)

Footnote:

(1) Based on predominant U.S. Forest Service (USFS) ecological land types and ecological land type phases

Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, MN 55155-4194

Industrial Chemical Additives Attachment

NPDES/SDS Permit Program

Doc Type: Permit Application

The National Pollutant Discharge Elimination System (NPDES)/State Disposal System (SDS) Permit Program regulates wastewater discharges to land and surface waters. This is an attachment to the Industrial Applications for facilities with multiple chemical additives.

Complete the attachment by typing or printing in black ink. Attach additional sheets as necessary. For more information, please contact the Minnesota Pollution Control Agency (MPCA) at: In Metro Area: 651-296-6300 or Outside Metro Area: 800-657-3864.

Permittee name: Poly Met Mining, Inc. **Permit number:** MN TBD

Chemical	**Purpose**	**Location of chemical addition in process** (e.g., to raw water supply, at greensand filter, before RO unit #2, etc.)	**Amount/duration/frequency of addition** (i.e., continuous or slug dosing. If slug dosing give amount/duration and frequency of addition; e.g., slug dosing 13.5 gal/3hours, once every two weeks)	**Average rate of use** (weight or volume per day)	**Maximum rate of use** (weight or volume per day)
Magnesium Chloride Aqueous Solution (Dustgard) (Primary)	Dust suppressant	Haul roads and stockpiles, if needed	For average use: main roads will be sprayed twice per year and minor roads once per year For maximum use: roads will be sprayed 3 times per year	104,428 gallons/day (208,856 gallons/year)	104,428 gallons/day (313,284 gallons/year)
Aqueous Amorphous Polymer Solution (BT-468) (Potential Substitute)	Dust suppressant	Haul Roads	For average use: main roads will be sprayed twice per year and minor roads once per year For maximum use: roads will be sprayed 3 times per year	104,428 gallons/day (208,856 gallons/year)	104,428 gallons/day (313,284 gallons/year)
Roadsaver® -C (Potential Substitute)	Dust suppressant	Haul roads	For average use: main roads will be sprayed twice per year and minor roads once per year For maximum use: roads will be sprayed 3 times per year	94,934 gallons/day (189,869 gallons/year)	94,934 gallons/day (284,803 gallons/year)
Roadsaver® (Potential Substitute)	Dust suppressant	Haul roads	For average use: main roads will be sprayed twice per year and minor roads once per year For maximum use: roads will be sprayed 3 times per year	104,428 gallons/day (208,856 gallons/year)	104,428 gallons/day (313,284 gallons/year)
Durasoil (Potential Substitute)	Dust suppressant	Haul roads	For average use: main roads will be sprayed twice per year and minor roads once per year For maximum use: roads will be sprayed 3 times per year	104,428 gallons/day (208,856 gallons/year)	104,428 gallons/day (313,284 gallons/year)
Gorilla-Snot (Potential Substitute)	Dust suppressant	Haul roads	For average use: main roads will be sprayed twice per year and minor roads once per year For maximum use: roads will be sprayed 3 times per year	104,428 gallons/day (208,856 gallons/year)	104,428 gallons/day (313,284 gallons/year)
Soiltac (Potential Substitute)	Dust suppressant	Haul roads	For average use: main roads will be sprayed twice per year and minor roads once per year For maximum use: roads will be sprayed 3 times per year	52,214 gallons/day (104,428 gallons/year)	52,214 gallons/day (156,642 gallons/year)
Coherex (Potential Substitute)	Dust suppressant	Haul roads	For average use: main roads will be sprayed twice per year and minor roads once per year For maximum use: roads will be sprayed 3	104,428 gallons/day (208,856 gallons/year)	104,428 gallons/day (313,284 gallons/year)

			times per year		
Calcium Chloride (Primary)	De-icer	Walkways, haul roads	No average use planned. For maximum use: used, as needed, based on recommended application rates (if needed, this will be a winter application)	NA	TBD, based on recommend ed application rates

***Remember to attach the *Material Safety Data Sheets*, complete product labels and any other information on chemical composition, aquatic toxicity, human health, and environmental fate for each chemical additive.**

Please make a copy for your records.

Refer to the *Transmittal Form* for mailing instructions.

Chemicals listed as potential substitutes are not intended to be used at the average and maximum rates of use unless the primary chemical additive is unavailable.

1.0 Introduction

This volume, Volume II of the National Pollutant Discharge Elimination System (NPDES) / State Disposal System (SDS) Permit Application (Application) for Poly Met Mining, Inc.'s (PolyMet) NorthMet Project (Project), focuses on the Mine Site. Refer to Section 2.0 of Volume I for discussion of the permitting approach for this Application as it applies to the Mine Site.

Table 1-1 provides a high-level overview of the Mine Site.

Table 1-1 Mine Site Summary

Mine Site Summary	
Purpose	To provide a steady and reliable supply of ore to the Process Plant; to dispose of mine waste (rock and overburden) in a manner that results in compliance with safety and environmental regulations; and to manage associated water in a manner that results in compliance with applicable water quality standards and applicable stormwater requirements at appropriate compliance points.
Location	The Mine Site is located at the NorthMet copper-nickel-PGE deposit, approximately six miles south of the city of Babbitt and eight miles east of the Project Plant Site (Large Figure 1).
Facility description	The Mine Site will include the following Project features: • three mine pits (the East Pit, West Pit, and Central Pit) • ore handling facilities, including an Ore Surge Pile (OSP) and a Rail Transfer Hopper (RTH) • Category 1, 2/3, and 4 Waste Rock Stockpiles and the OSP with engineered systems to manage precipitation that will run off of or percolate through the stored waste rock (such as liners, covers, and a groundwater containment system) • an Overburden Storage and Laydown Area (OSLA) to provide space to sort and store unsaturated mineral overburden and peat used for construction and reclamation • mine water collection systems and an Equalization Basin Area to collect *mine water* from the mine pits, the stockpiles, the ore handling facilities, OSLA, construction areas, and the driving surface of haul roads • a Central Pumping Station (CPS), Construction Mine Water Pumping Station, and Mine to Plant Pipelines (MPP) to transport *mine water* from the Mine Site to the Plant Site • stormwater management systems • supporting infrastructure (such as roads, electrical supply, rail connections, and the Mine Site Fueling and Maintenance Facility) Over the life of the mine, three mine pits will be developed: the East Pit, West Pit, and Central Pit. The Central Pit will not exist until Mine Year 11, which is beyond the scope of this initial permit application. During the period of initial permit coverage, ore will be mined from the East Pit beginning in Mine Year 1(1) and from the West Pit beginning in Mine Year 2. During this period, the more reactive waste rock will be placed in temporary stockpiles and the less reactive waste rock will be placed in a permanent stockpile. The overall Mine Plan, including the Mine Site's development and mining activities, is described in the NorthMet Project Mine Plan (Reference (1)).
Mine water management and discharge	No direct discharge to the environment. *Mine water* (as defined in Table 1-2) will be collected at the Mine Site and routed to the Waste Water Treatment System (WWTS) via the MPP. Construction *mine water* and OSLA runoff will be collected and routed to the Flotation Tailings Basin (FTB) at the Plant Site via the MPP or, after Mine Year 11, to the East and Central Pits for pit flooding.
Sewage management and infrastructure	No direct discharge to the environment. *Sewage* (as defined in Table 1-2) from the Mine Site will be collected and transported to the Plant Site for treatment at the Plant Site Sewage Treatment System. Refer to Section 2.2 of Volume IV for discussion of the Plant Site Sewage Treatment System.

Mine Site Summary	
Stormwater management and discharge	*Stormwater* (as defined in Table 1-2): • will be separated from *mine water* and controlled through a system of ditches, dikes, and ponds; and • will discharge off-site either directly or after being routed through on-site sedimentation ponds to reduce total suspended solids (TSS)
Estimated commission	Initial infrastructure will be constructed during an estimated 18-24 month construction phase and mining will commence in Mine Year 1[(1)].

Italicized terms are defined in Table 1-2.

(1) Mine Year 1 will begin on the first day of production blasting within the open pit at the Mine Site.

This volume is organized in four sections:

Section 1.0 Provides an overview of the Mine Site and provides the water definitions specific to the volume.

Section 2.0 Describes water management and infrastructure at the Mine Site, including existing conditions, *mine water*, *sewage*, and *stormwater* management and infrastructure, adaptive management, chemical additives, progressive reclamation, and an overview of the reclamation, closure, and postclosure maintenance phases.

Section 3.0 Summarizes the proposed monitoring plan for the Mine Site.

Section 4.0 Describes how the Mine Site complies with the groundwater nondegradation rule (Minnesota Rules, part 7060.0500).

In accordance with Minnesota Rules, part 6132.0200, the Mine Site has been designed "to control possible adverse environmental effects of nonferrous metallic mineral mining, to preserve natural resources, and to encourage planning of future land utilization" and mining will be "conducted in a manner that will reduce impacts to the extent practicable, mitigate unavoidable impacts, and ensure that the mining area is left in a condition that protects natural resources and minimizes to the extent practicable the need for maintenance." The design of the Mine Site includes systems for managing water in a manner that results in compliance with applicable water quality standards at appropriate compliance points (Section 1.1 of Reference (2)). The water management systems have been designed to achieve compliance based on modeling of expected water quantity and quality; additionally, plans have been developed for adaptive management (Sections 2.0 and 3.0 of Reference (3)) and Section 6.4 of Reference (2)) and contingency mitigation (Section 6.5 of Reference (2)) as deemed necessary to maintain compliance (refer to Section 2.5 of this volume for further discussion).

Water management includes collection and management of *mine water* and Mine Site *sewage* and separation of *stormwater* from *mine water*. The flow of water associated with the Mine Site is included on Large Figure 4 in Volume I, which depicts the general flow of water throughout the Project. Refer to Sections 2.2 through 2.4 of this volume for further details on the management of *mine water*, *sewage*, and *stormwater*.

Table 1-2 provides definitions for the terms *mine water*, *sewage*, *industrial stormwater*, *construction stormwater*, and *non-contact stormwater*, as well as notes regarding the definitions' application to specific facets at the Mine Site.

Separate applications will be submitted requesting:

- authorization to discharge *stormwater* associated with construction activities at the Mine Site under the Minnesota NPDES/SDS Construction Stormwater General Permit (Construction Stormwater General Permit)
- authorization to discharge *stormwater* associated with industrial activities at the Mine Site under the Minnesota NPDES/SDS Industrial Stormwater General Permit (Industrial Stormwater General Permit)

Refer to Section 2.4 of this volume for further details on the management of *stormwater* during operations.

Table 1-2 Project Water Definitions

Project-Specific Term	Project-Wide Definition[1]	Mine Site Specifics
Mine Water	Water collected by the mine water management systems, including precipitation, runoff, groundwater, and other water collected from areas of the Mine Site and routed from the Mine Site to the Waste Water Treatment System (WWTS) or Flotation Tailings Basin (FTB) via the Mine to Plant Pipelines (MPP) and, in later years, routed to the East and Central Pits for pit flooding.	Water that has contacted surfaces disturbed by mining activities, such as drainage collected on stockpile liners, pit dewatering, and runoff contacting ore, waste rock, and Mine Site haul road surfaces. This water is conveyed by pipe to the equalization basins for further conveyance through the MPP to the WWTS. Runoff from construction dewatering of saturated mineral overburden, which is a subset of *mine water* called construction *mine water*, is conveyed by pipe to the Construction Mine Water Basin for further conveyance through the MPP to the FTB. Runoff from the Overburden Storage and Laydown Area (OSLA), which is a subset of *mine water* collected in the OSLA Pond, is conveyed by pipe to the Construction Mine Water Basin for further conveyance through the MPP to the FTB or, in later years, to aid in East and Central Pit flooding.
Sewage	Water collected from sanitary facilities and sedimentation tank and filter backwash waste collected from the Plant Site Potable Water Treatment Plant.	Water collected from Mine Site sanitary facilities, handled in holding tanks, periodically pumped out by a commercial vendor, and transported via truck to the Plant Site for treatment by the Sewage Treatment System.
Industrial Stormwater	*Stormwater* associated with industrial activities[2].	Includes precipitation and runoff from the industrial areas at the Mine Site that is composed entirely of *stormwater* and not combined with other water types. This definition does not include water defined as *mine water*.
Construction Stormwater	*Stormwater* associated with construction activities[3].	During operations, includes precipitation, runoff, and dewatering water from construction areas with the exception of dewatering water from saturated mineral overburden, which is managed as construction *mine water*.
Non-Contact Stormwater	Precipitation and runoff that contacts natural, stabilized, or reclaimed surfaces and has not been exposed to mining activities, construction activities[3], or industrial activities[2].	Includes runoff from natural areas, from on-site features constructed of overburden (unsaturated overburden or peat) once stabilized with permanent cover, and from the reclaimed Category 1 Waste Rock Stockpile.

(1) If two types of waters mix, the mixture is handled as the more actively managed type of water (e.g., a mixture of *non-contact stormwater* and *mine water* is managed as *mine water*). Management of water mixtures will be governed by regulatory requirements.
(2) As defined in Minnesota Rules, part 7090.0080, subpart 6
(3) As defined in Minnesota Rules, part 7090.0080, subpart 4

During environmental review, PolyMet developed numerous Management Plans to provide details of the design, construction, operations, reclamation, closure, and postclosure maintenance phases of the Project. The Management Plans rely on and incorporate the results of Data Packages, which are compilations of technical data and related supporting information.

Information from the above-referenced documents, as well as from this and other permit applications and issued permits, will be incorporated into an operations plan for use during the operations, reclamation, closure, and postclosure maintenance phases of the Project. Refer to Section 1.7 of Volume I for a description of the Project phases.

To help the reviewer navigate the supporting material for Volume II of this Application, Table 1-3 cross-references key Mine Site-related topics, PolyMet Management Plans and Data Packages, sections of this narrative, and permit application requirements.

Note that some terminology associated with the Waste Water Treatment System (WWTS) has changed since the environmental review process was completed and the NPDES/SDS Permit Application was submitted in July 2016. Changes are associated with the relocation of the mine water treatment trains that were previously planned for the Mine Site Waste Water Treatment Facility, which will now be in the Plant Site WWTS, and the relocation of the Mine Site equalization basins, Central Pumping Station (CPS), and Construction Mine Water Basin south of Dunka Road. There is no change to the level of treatment planned for the Project as a result of these relocations. To facilitate the review of documents prepared for the NorthMet Mining Project and Land Exchange Final Environmental Impact Statement (FEIS) (Reference (4)) which are also referenced in this Application, Appendix A explains the WWTS terminology changes.

Table 1-3 Volume II of PolyMet's NPDES/SDS Permit Application Cross-Reference

Facility Topic		Location of Relevant Details:			Permit Application Form	Application Question
		Management Plan / Data Package		NPDES/SDS Volume II		
Existing Conditions		NorthMet Project: Water Management Plan – Mine Site (Reference (2))	Section 1.4	Section 2.1		
Mine Site	Facility Description	NorthMet Project: Project Description (Reference (5))	Section 4.1	Table 1-1		
		NorthMet Project: Mine Plan (Reference (1))	Section 2.0			
		Proposed Waste Water Treatment System (WWTS) Relocations Technical Memorandum (Reference (6))				
	Product Produced	NorthMet Project: Project Description (Reference (5))	Section 4.1.2			
		NorthMet Project: Mine Plan (Reference (1))	Section 4.0			
	Operation Initiated			Table 1-1		
	Water Balance	NorthMet Project: Water Modeling Data Package Volume 1 – Mine Site (Reference (7))	Section 6.1			
Mine Water Management and Infrastructure	Overall	NorthMet Project: Water Management Plan – Mine Site (Reference (2))	Sections 2.1, 4.1, and 4.4.1	Section 2.2		
	Pit Dewatering	NorthMet Project: Water Management Plan – Mine Site (Reference (2))	Section 2.1.3	Section 2.2.1		
	Stockpile Drainage	NorthMet Project: Water Management Plan – Mine Site (Reference (2))	Sections 2.1.4 and 2.1.5	Section 2.2.2		
		NorthMet Project: Rock and Overburden Management Plan (Reference (8))	Sections 2.1, 2.2, and 6.2			
	Mine Water Ponds for Other Infrastructure	NorthMet Project: Water Management Plan – Mine Site (Reference (2))	Sections 2.1.5 and 4.1.6	Section 2.2.3	Municipal and Industrial Pond Attachment (wq-wwprm7-11)	1 through 22
	Equalization Basin Area and Mine to Plant Pipelines (MPP)	NorthMet Project: Water Management Plan – Mine Site (Reference (2))	Sections 2.1.6-2.1.8 and 4.1.1-4.1.3	Section 2.2.4		
	Mechanical Infrastructure Permit Application Support Drawings	NorthMet Project: Water Management Plan – Mine Site (Reference (2))	Attachment B	Appendix A		
	Categories 1, 2/3, and 4 Stockpiles and Ore Surge Pile Design Permit Application Support Drawings	NorthMet Project: Rock and Overburden Management Plan (Reference (8)	Attachment B	Appendix A		
	Category 1 Stockpile Groundwater Containment System Permit Application Support Drawings	NorthMet Project: Rock and Overburden Management Plan (Reference (8))	Attachment C	Appendix A		
	Mine Site and Dunka Road Earthwork Permit Application Support Drawings			Appendix A		
Sewage Management and Infrastructure				Section 2.3		

Facility Topic		Location of Relevant Details: Management Plan / Data Package		Location of Relevant Details: NPDES/SDS Volume II	Permit Application Form	Application Question
Stormwater Management and Infrastructure	Overall	NorthMet Project: Water Management Plan – Mine Site (Reference (2))	Sections 2.2, 4.2, and 4.4.2	Section 2.4		
	Significant Materials			Section 2.4.1		
	Exclusion Dikes	NorthMet Project: Water Management Plan – Mine Site (Reference (2))	Section 2.2.2	Section 2.4.2		
	Stormwater Ditches	NorthMet Project: Water Management Plan – Mine Site (Reference (2))	Section 2.2.3	Section 2.4.3		
	Sedimentation Ponds and Outlets	NorthMet Project: Water Management Plan – Mine Site (Reference (2))	Sections 2.2.4, 4.2, and 4.4.2	Section 2.4.4		
	Mine Site Stormwater Permit Application Support Drawings	NorthMet Project: Water Management Plan – Mine Site (Reference (2)	Attachment C	Appendix A		
	Receiving Waters			Sections 2.4 and 2.4.4		
Adaptive Management and Contingency Mitigation		NorthMet Project: Water Management Plan – Mine Site (Reference (2))	Sections 6.4 and 6.5	Section 2.5		
		NorthMet Project: Adaptive Water Management Plan (Reference (3))	Sections 2.0 and 3.0			
Chemical Additives				Section 2.6	Industrial Chemical Additives Attachment (wq-wwprm7-48)	All
Progressive Reclamation and an Overview of the Reclamation, Closure, and Postclosure Maintenance Phases		NorthMet Project: Rock and Overburden Management Plan (Reference (8))	Section 7.0	Section 2.7		
		NorthMet Project: Mine Plan (Reference (1))	Section 6.0			
		NorthMet Project: Adaptive Water Management Plan (Reference (3))	Sections 2.1.1, 2.2.2, 3.5, 6.2, and 6.3			
Monitoring	Baseline Surface Water Monitoring	NorthMet Project: Water Modeling Data Package Volume 1 – Mine Site (Reference (7))	Sections 4.4.1 and 4.4.4	Section 3.1.1		
		NorthMet Project: Water Management Plan – Mine Site (Reference (2))	Section 1.3.1			
	Baseline Groundwater Monitoring	NorthMet Project: Water Modeling Data Package Volume 1 – Mine Site (Reference (7))	Sections 4.3.3 and 4.3.4	Section 3.1.2	Municipal and Industrial Pond Attachment (wq-wwprm7-11)	8
		NorthMet Project: Water Management Plan – Mine (Reference (2))	Section 1.3.2			
	Proposed Monitoring Plan			Section 3.2		
Groundwater Nondegradation				Section 4.0		

Gray shading indicates no corresponding reference material

2.0 Mine Site Water Management and Infrastructure

This section focuses on water management associated with the Mine Site during operations, specifically during the period covered by this Application (approximately Mine Years 1 through 5). The following sub-sections describe:

- the existing site conditions (Section 2.1)
- the water management systems related to *mine water* (Section 2.2) and *sewage* (Section 2.3)
- the stormwater management systems (Section 2.4)
- the adaptive management approach that can be used to modify Mine Site water management systems in response to site-specific conditions encountered during operations (Section 2.5)
- chemical additives proposed for use at the Mine Site (Section 2.6)
- an overview of plans for progressive reclamation and the reclamation, closure, and postclosure maintenance phases (Section 2.7)

Permit application support drawings for Mine Site water management systems are included in Appendix B.

2.1 Existing Conditions

The Mine Site is currently located on federal lands within an area of the Superior National Forest that has not previously been mined (Section 1.1.1 of Reference (4)). It is part of a large parcel included in the proposed land exchange between PolyMet and the U.S. Forest Service. Under terms of the proposed land exchange, PolyMet will own the Mine Site (Section 3.3.2 of Reference (4)). Portions of the Mine Site are within the municipal limits of the City of Babbitt: they are classified by the City's zoning ordinance as a Mineral Mining district. The Mine Site and existing land use designations are shown on Large Figure 2.

Runoff in the vicinity of the Mine Site drains toward the Partridge River, a tributary of the Upper St. Louis River. Specifically, runoff from most of the Mine Site naturally drains to the south through culverts under Dunka Road and the adjacent mainline railroad, then into the Partridge River downstream of Dunka Road. Runoff from the northernmost portion of the Mine Site generally drains north into One Hundred Mile Swamp and Yelp Creek. These waterbodies form the headwaters of the Partridge River, which meanders around the eastern end of the Mine Site before turning southwest (Section 1.4 of Reference (2)). The existing subwatersheds and associated waterbodies at or near the Mine Site are shown on Large Figure 3. The Mine Site is currently a mixture of forested upland and wetland areas, with the most common wetland types consisting of coniferous bog, shrub swamp, and coniferous swamp (Section 3.1.5 of Reference (9)).

Refer to Sections 3.1.1 and 3.1.2 of this volume for discussion of baseline surface water quality and groundwater quality, respectively.

2.2 Mine Water Management and Infrastructure

This section describes the design and operation of the infrastructure that will be used to manage *mine water* at the Mine Site in accordance with applicable regulations. The initial phases of mine water infrastructure will be constructed prior to Mine Year 1 (which will begin on the first day of production blasting within the open pit at the Mine Site).

As defined in Table 1-2 of this volume, *mine water* includes:

- water that has contacted surfaces disturbed by mining activities, such as drainage collected on stockpile liners, pit dewatering, and runoff contacting ore, waste rock, and Mine Site haul road surfaces; this water will be conveyed by pipe to the equalization basins for further conveyance through the Mine to Plant Pipelines (MPP) to the WWTS

- runoff from construction dewatering of saturated mineral overburden, which is a subset of *mine water* called construction *mine water*, will be conveyed by pipe to the Construction Mine Water Basin for further conveyance through the MPP to the Flotation Tailings Basin (FTB)

- runoff from the Overburden Storage and Laydown Area (OSLA),which is a subset of *mine water* collected in the OSLA Pond, will be conveyed by pipe to the Construction Mine Water Basin for further conveyance through the MPP to the FTB or, in later years, to aid in East and Central Pit flooding

Mine water will be intercepted throughout the Mine Site by ditches, dikes, stockpile foundation liners, and the stockpile groundwater containment system to keep it separate from *stormwater*. *Mine water* will be managed through a system of ditches, sumps, ponds, and pipes. The mine water management system at the end of Mine Years 1, 2, and 11 is conceptually depicted on Large Figure 4, Large Figure 5, and Large Figure 6, respectively. The mine water management system is shown on the Mechanical Infrastructure Permit Application Support Drawings in Appendix B.

Mine water system components at the Mine Site have been designed to route *mine water* by gravity flow to sumps or ponds. With the exception of underdrain sumps, the sumps and ponds have been designed to contain water from a component-specific “design event”. Mine Site mine water infrastructure is designed to handle storm events in excess of those required under the Industrial Stormwater General Permit, which requires industrial stormwater ponds be designed to store and treat a 5-year storm event and eliminate scour and re-suspension for up to the 10-year storm event. In general, the Mine Site mine water system is designed to routinely handle flows associated with the 100-year, 24-hour storm event, with the exception of the OSLA Pond, which is designed to handle flows from the 25-year storm. The system also includes additional protection by incorporating contingency measures (which include both design features and operational plans) to mitigate hazards associated with flows in excess of the 100-year, 24-hour storm.

The design storm events were chosen using best engineering judgment, in consultation with the regulatory agencies, based on the level of risk associated with an overflow and the capital costs and environmental impacts associated with larger facilities (e.g., larger or deeper ponds) that could handle additional capacity. Risk was evaluated qualitatively based on the likelihood of flows larger than the design storm event over the life of the infrastructure and the level of hazard represented by the potential quantity and water quality of the runoff associated with a storm larger than the design storm event.

Large Table 1 summarizes the objectives, design criteria, and rationale used to design the Mine Site mine water infrastructure. The design criteria for the mine water system components are also summarized in Table 2-1 of Reference (2). In order to prevent and mitigate the effects of possible overflows from the mine water systems, an operational plan has been established in the event of an overflow, as summarized in Large Table 1 and further described in Section 4.4.1 of Reference (2).

Refer to the following sources for additional detail on the design and operation of Mine Site mine water infrastructure:

- Section 2.1 of Reference (2) for further discussion of *mine water* management at the Mine Site, including design criteria for the mine water infrastructure
- Section 4.1 of Reference (2) for the operations plan for mine water infrastructure
- Section 4.4.1 of Reference (2) for discussion of the prevention and management of mine water overflows
- Section 6.1 of Reference (7) for the details of the Mine Site water balances

The following sections describe the design and operation of the major components of the mine water management system, which include the components associated with pit dewatering (Section 2.2.1), stockpile drainage (Section 2.2.2), mine water ponds for other infrastructure (Section 2.2.3), and the Equalization Basin Area and MPP (Section 2.2.4).

2.2.1 Pit Dewatering

During mining operations, the water table will be at or near the ground surface within the pit perimeter; therefore, groundwater will flow into the mine pits making it necessary to dewater. Pit inflows will consist of groundwater and runoff from areas within the pits. This water will be directed to sumps within the pits where it will be collected and pumped to the equalization basins for further conveyance to the WWTS at the Plant Site via the MPP. There will be no discharge to groundwater from the mine pits.

Dewatering sumps will be developed as part of mine operations. The pit floors will be sloped toward water collection sumps fitted with pumps and pipelines. The mine water pipelines will convey the water to the equalization basins. The sumps and piping system are conceptually located as shown on Large Figure 4 (Mine Year 1), Large Figure 5 (Mine Year 2), and Large Figure 6 (Mine Year 11).

The size and location of the sumps, pumps, and pipes will change as the pits expand in size and depth, requiring periodic evaluation of the pumping systems. The mine pit pump capacities are designed to remove within 3 days the water resulting from a peak annual snowmelt runoff event (approximately equivalent to the runoff volume expected during a 5-year, 24-hour storm event), and the associated sumps are designed with capacity to hold the remaining volume from the snowmelt runoff event that the pumps have not removed. In the event that a storm exceeds the sump and pump capacity, the lowest level of the pit will be used to store the excess water, with mining operations relocated to higher levels or delayed until water levels are pumped down (Section 2.1.3 of Reference (2)). Refer to Section 2.1.3 of Reference (2) for further discussion of pit dewatering, including discussion of estimated average annual and peak inflow rates and pump and sump capacities.

2.2.2 Stockpile Drainage

Overburden, waste rock, and ore will be stored in stockpiles at the Mine Site. Stockpiles containing Category 1, 2, 3, and 4 waste rock (as defined in Section 4.1.1 of Reference (10)), ore, and saturated mineral overburden will have engineered systems to collect drainage. Unsaturated mineral overburden and peat will generally be stored in stockpiles in the OSLA or used for construction or reclamation. Runoff from the OSLA will be collected in the OSLA Pond. Refer to Sections 2.1 and 6.2 of Reference (8) for estimated quantities of stockpiled materials.

There will be three temporary stockpiles: the Category 2/3 Waste Rock Stockpile, the Category 4 Waste Rock Stockpile, and the Ore Surge Pile (OSP), all with engineered liner systems to collect drainage. Category 2, 3, and 4 waste rock will be placed within the Category 2/3 Waste Rock Stockpile and the Category 4 Waste Rock Stockpile during Mine Years 1 through 11. The layout and liner design of the temporary stockpiles are included with the Categories 1, 2/3, and 4 Stockpiles and Ore Surge Pile Design Permit Application Support Drawings in Appendix B. Saturated overburden may be used in construction applications where it will be placed in a permanently saturated zone, above a geomembrane liner, or as the temporary stockpile soil liner immediately below the geomembrane liner (Section 2.2.3.1 of Reference (8)). Saturated overburden not used for construction will be comingled with the Category 2, 3, and 4 waste rock (Section 2.2.4.1 of Reference (8)). Ore may be temporarily placed in the OSP, with ore moving in and out as needed to meet mine and plant conditions. Although the OSP does not store waste rock, the design of the stockpile liner system is the same as the design of the temporary waste rock stockpiles.

The temporary stockpiles have been designed to comply with Minnesota Rules, part 6132.2200 to provide for the collection of substantially all water, and Minnesota Rules, part 6132.2400 to minimize hydrologic impacts, be structurally sound, and control erosion on the stockpile surface. The temporary stockpiles will include an engineered system comprised of, from the bottom up, a foundation; an underdrain system with sumps, if required; an impermeable composite liner barrier; and an overliner drainage layer with mine water sumps (Section 2.1.3.2 of Reference (8)). Overflow ponds will be located adjacent to the sumps to provide storage by gravity flow of mine water volumes in excess of the sump design volumes (Section 2.1.4.1 of Reference (2)). Each paired sump and overflow pond will be surrounded by dikes and will have a combined capacity for the 100-year, 24-hour mine water yield plus a safety factor in the form of freeboard (Section 2.1.4.1.1 of Reference (2)). For further discussion of design volumes and design criteria, refer to Large Table 1 and Sections 2.1.4.1.1 and 2.1.4.1.2 of Reference (2).

The need for and extent of the temporary stockpile underdrain systems will depend on the elevation of the groundwater below the stockpiles and will be assessed in further geotechnical analysis prior to final design and construction. The underdrain system will be developed, if necessary, to capture and convey shallow foundation groundwater to facilitate construction of the liner system and prevent the development of excess foundation pore pressures below the liner during stockpile loading.

Stockpile drainage collected in the mine water sumps and overflow ponds will be managed as *mine water* and will be pumped to the equalization basins for further conveyance to the WWTS via the MPP. If underdrain sumps are necessary, collected water will be directed to the mine water sumps for conveyance to the equalization basins. It is anticipated that water quality associated with the underdrain sumps will be the same as groundwater quality. Monitoring of these underdrains will be conducted on an ongoing basis as part of the performance monitoring program.

Although outside this permit cycle, it should be noted that, beginning in approximately Mine Year 11, the temporary Category 2/3 and Category 4 Waste Rock Stockpiles and commingled saturated mineral overburden will be relocated for ultimate disposal within the East and Central Pits after mining is completed in each pit. Category 2, 3, and 4 waste rock will also be placed directly in the East and Central Pits after mining is completed in each pit. The temporary OSP will be depleted in Mine Year 20, with the remaining material transported to the Process Plant or disposed of in the East Pit.

The Category 1 Waste Rock Stockpile, the only permanent waste rock stockpile on-site, will contain the majority of the Category 1 waste rock, although some Category 1 waste rock will be used to backfill the Central Pit or East Pit in Mine Years 11 through 20. The Category 1 Waste Rock Stockpile has been designed to comply with Minnesota Rules, parts 6132.2200 and 6132.2400. Minnesota Rules, part 6132.2200 provides for the prevention of substantially all water from moving through or over the mine waste and the collection and disposal of any remaining residual waters. Minnesota Rules, part 6132.2400 requires permanent waste rock stockpiles to minimize hydrologic impacts, be structurally sound, control erosion, promote progressive reclamation, and enhance the survival and propagation of vegetation (Section 2.1.2.1 of Reference (8)). The Category 1 waste rock is not expected to generate acid rock drainage, but may leach heavy metals. Drainage from the Category 1 Waste Rock Stockpile will be collected by a groundwater containment system and conveyed to the equalization basins for further conveyance to the WWTS via the MPP for treatment (Section 2.1.4.2 of Reference (2)). This groundwater containment system will be developed in lieu of a liner system under the stockpile. Section 2.1.2.2 of Reference (8) and the Category 1 Stockpile Groundwater Containment System Permit Application Support Drawings in Appendix B include further information on design of the Category 1 Stockpile Groundwater Containment System.

The OSLA is a temporary storage area for unsaturated overburden and peat that will be used in construction or reclamation. The OSLA will be graded and compacted to direct surface runoff to a pond at the southwestern corner of the area (the OSLA Pond). The grading plan for the OSLA is included with the Mine Site and Dunka Road Earthwork Permit Application Support Drawings in Appendix B. PolyMet has agreed to collect and manage runoff from the OSLA due to concerns about the potential release of mercury from the stored peat (Section 2.1.5.1 of Reference (2)). Specifically, runoff collected in the OSLA Pond will be pumped to the Construction Mine Water Basin for further conveyance to the FTB via the

MPP, or, during East and Central Pit backfilling, used to flood the East and Central Pits. The OSLA Pond is designed to handle the 25-year, 24-hour storm (Large Table 1 and Section 2.1.5 of Reference (2)).

2.2.3 Mine Water Ponds for Other Infrastructure

Lined mine water ponds will provide storage by gravity flow of *mine water* during heavy precipitation or short power outages. In addition to the temporary stockpile sumps and overflow ponds and the OSLA Pond, at least five other mine water ponds will be constructed at the Mine Site, as conceptually shown in Large Figure 4, Large Figure 5, and Large Figure 6 for Mine Years 1, 2, and 11, respectively. These mine water ponds will be as follows:

- the Haul Road East, Haul Road West, Haul Road North, and Haul Road Central Ponds, which will collect runoff from the haul roads
- the Rail Transfer Hopper (RTH) Pond, which will collect runoff from the RTH

The mine water ponds for the haul roads and RTH are designed to contain runoff volumes from the 100-year, 24-hour storm (Large Table 1 and Section 2.1.5 of Reference (2)). For more information regarding the sizing and liner systems of the mine water ponds, refer to Large Table 1 and Section 2.1.5 of Reference (2).

A pump and piping system will convey *mine water* from the haul road ponds and the RTH Pond to the equalization basins for further conveyance to the WWTS via the MPP (Section 2.1.5 of Reference (2)).

2.2.4 Equalization Basin Area and Mine to Plant Pipelines

The Equalization Basin Area is the pond area at the Mine Site (south of Dunka Road) that will contain the High Concentration Equalization Basin, the Low Concentration Equalization Basins 1 and 2, the Construction Mine Water Basin, the CPS, and the Construction Mine Water Pumping Station. The MPP will consist of three pipelines that will convey water between the Mine Site and Plant Site: the Low Concentration Mine Water Pipeline, High Concentration Mine Water Pipeline, and Construction Mine Water Pipeline.

Mine water requiring treatment will be pumped to the Equalization Basin Area where it will be pumped through either the High Concentration Mine Water Pipeline or the Low Concentration Mine Water Pipeline to the WWTS (Section 2.1 of Reference (2)). *Mine water* that does not require treatment besides settling for total suspended solids (TSS) (construction *mine water* and OSLA runoff) will be pumped to the Construction Mine Water Basin at the Equalization Basin Area where settling will occur, then it will be pumped through the Construction Mine Water Pipeline to the FTB (with the exception of any water needed during East and Central Pit flooding operations, starting in approximately Mine Year 11 and thus not covered under this Application) (Section 2.1 of Reference (2)). The Equalization Basin Area, MPP, and WWTS are covered by Volume III of this Application. The design of the MPP is provided in the Mechanical Infrastructure Permit Application Support Drawings in Appendix B.

2.3 Sewage Management and Infrastructure

Sewage at the Mine Site will be handled in holding tanks, periodically pumped out by a commercial vendor, and transported via truck to the Plant Site for treatment at the Plant Site Sewage Treatment System. Refer to Section 2.2 of Volume IV for discussion of the Plant Site Sewage Treatment System.

2.4 Stormwater Management and Infrastructure

This section describes the management of *stormwater* at the Mine Site, including best management practices (BMPs) and the design and operation of the infrastructure that will be used to manage *stormwater* in accordance with applicable regulations.

Consistent with the overall Project approach (Table 1-2 of this volume), *stormwater* at the Mine Site is defined in three categories:

- *construction stormwater*, which consists of *stormwater* associated with construction activities
- *industrial stormwater*, which consists of *stormwater* associated with industrial activities
- *non-contact stormwater*, which consists of precipitation and runoff that contacts natural, stabilized, or reclaimed surfaces and has not been exposed to mining activities, construction activities, or industrial activities

These three categories of *stormwater* will be separated from *mine water* through a system of ditches, dikes, and ponds, as depicted in the Mine Site Stormwater Permit Application Support Drawings in Appendix B. Precipitation and runoff that contact surfaces disturbed by mining activities (such as drainage collected on stockpile liners, pit dewatering, and runoff contacting ore, waste rock, and haul road surfaces), runoff from construction dewatering of saturated mineral overburden, and runoff from the OSLA will be managed as *mine water* rather than *stormwater*, as described in Section 2.2 of this volume.

The initial phases of stormwater infrastructure will be constructed prior to commencement of Project operations. As discussed in Section 1.0 of this volume, a separate application is being submitted requesting authorization to discharge *stormwater* associated with construction activities at the Mine Site under the Construction Stormwater General Permit. While these activities will be associated with the separate Construction Stormwater General Permit program, an overview of PolyMet's plan for management of *construction stormwater* is included here as additional background. *Stormwater* associated with construction activities will be managed with controls and BMPs, including erosion and sediment control measures, construction water management control measures, dust control measures, and construction site restoration practices. Prior to the start of each phase of construction activities, these management measures will be incorporated into a Construction Stormwater Pollution Prevention Plan (SWPPP) based on detailed construction plans and in accordance with Construction Stormwater General Permit requirements. In order to meet the permanent stormwater management requirements of the Construction Stormwater General Permit, additional stormwater features beyond those discussed herein may be included in final engineering designs and subsequently added to the Construction SWPPP.

Also, as discussed in Section 1.0 of this volume, a separate application will be submitted requesting authorization to discharge *stormwater* associated with industrial activities at the Mine Site under the Industrial Stormwater General Permit. While these activities will be associated with the separate Industrial Stormwater General Permit program, an overview of PolyMet's plan for management of *industrial stormwater* is included here as additional background. PolyMet will develop and implement an Industrial SWPPP in accordance with Industrial Stormwater General Permit requirements, which will incorporate and expand upon the discussions in this section.

During operations, *stormwater* (including *construction stormwater*, *industrial stormwater*, and *non-contact stormwater*) on and around the Mine Site will be managed in a manner that reduces potential impacts to mining activities, protects the environment, and maintains existing flow patterns to the extent practicable. *Stormwater* is expected to meet water quality standards either without treatment or after being routed through on-site sedimentation ponds to remove TSS.

As described in the following subsections, *stormwater* flowing on and off the Mine Site will be controlled by natural watershed divides, Mine Site features, and a series of dikes and ditches constructed around the perimeter of the Mine Site, along the mine pit overburden excavation limits, and around the interior of the Mine Site. As shown on Large Figure 4 through Large Figure 6, sedimentation ponds constructed along the perimeter of the Mine Site will reduce TSS from *stormwater* before it is discharged off-site. Receiving waterbodies include the Partridge River and its tributaries.

Mine Site stormwater infrastructure is designed to handle storm events in excess of those required under the Industrial Stormwater General Permit, which requires stormwater ponds be designed to store and treat a 5-year storm event and eliminate scour and re-suspension for up to the 10-year storm event. In general, the Mine Site stormwater system is designed to routinely handle flows associated with the 10-year, 24-hour storm event with many features upsized to avoid impacts up to the 100-year, 24-hour storm. The system also includes additional protection by incorporating contingency measures (which include both design features and operational plans) to mitigate impacts associated with flows in excess of the 100-year, 24-hour storm.

The design storm events were chosen using best engineering judgment, in consultation with the regulatory agencies, based on the level of risk associated with an overflow and the capital costs and environmental impacts associated with larger facilities (e.g., larger or deeper ponds) that could handle additional capacity. Risk was evaluated qualitatively based on the likelihood of flows larger than the design storm event over the life of the infrastructure and the level of impact represented by the potential quantity and water quality of the runoff associated with a storm larger than the design storm event.

Large Table 2 summarizes the objectives, design criteria, and rationale used to design the Mine Site stormwater infrastructure. The overall system capacity will be based on the Mine Site configuration, and the individual segments will be installed when needed, as conceptually shown on Large Figure 4, Large Figure 5, and Large Figure 6, for Mine Years 1, 2, and 11, respectively. In order to prevent and mitigate the effects of possible overflows from the stormwater system, an operational plan has been established in the event of an overflow, as summarized in Large Table 2 and further described in Section 4.4.2 of Reference (2).

2.4.1 Significant Materials

Significant materials are defined by 40 CFR § 122.26(b)(12) as including, but not limited to:

> "raw materials; fuels; materials such as solvents, detergents, and plastic pellets; finished materials such as metallic products; raw materials used in food processing or production; hazardous substances designated under Section 101(14) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); any chemical the facility is required to report pursuant to Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA); fertilizers; pesticides; and waste products such as ashes, slag, and sludge that have the potential to be released with stormwater discharges."

Stormwater may come into contact with significant materials at the Mine Site and will be managed throughout the life of the Project using appropriate BMPs, including engineered controls and spill prevention and response procedures, to reduce or eliminate contact or exposure of pollutants to *stormwater* or remove pollutants from *stormwater*.

2.4.2 Perimeter and Exclusion Dikes

Perimeter dikes will be placed at strategic locations around the perimeter of the Mine Site and around the pit rims. Perimeter dikes will be constructed of silty sand or glacial till excavated during construction of ditches and removal of overburden. The purpose of constructing dikes and ditches near the perimeter of the Mine Site is to minimize the amount of surface water flowing on to the Mine Site, minimize Project impacts to wetlands outside the perimeter of the Mine Site, eliminate *mine water* flowing uncontrolled off the Mine Site, and manage the rate and location of *stormwater* flowing off the Mine Site.

PolyMet will construct ditches along the interior of most of the perimeter dike system to convey *stormwater* adjacent to the dikes, prevent surface runoff from entering the mine pits, intercept *stormwater* prior to reaching mine water areas, and prevent water from pooling in areas where the dikes cut across low areas. The existing ground along some of the site perimeter is already relatively high, which will allow a ditch to capture the surface runoff without a dike. *Stormwater* captured by the ditches will be directed to sedimentation ponds and then routed into a natural drainage system off the Mine Site. The conceptual alignments of the perimeter dikes for Mine Years 1, 2, and 11 are shown on Large Figure 4, Large Figure 5, and Large Figure 6, respectively. For further information regarding the criteria used in selecting perimeter dike alignments and the seepage control measures, refer to Section 2.2.2.1 of Reference (2).

Pit exclusion dikes will be constructed in areas where surface water might otherwise drain into the mine pits. The pit exclusion dikes will be temporary, in place only as long as the mine pit overburden excavation limit is at a specific location. Reconstruction of the dikes will be necessary as the mine pit expands. Dikes will be constructed by pushing up a ridge of soil where needed around the limits of overburden excavation at the pit rim during overburden stripping operations. The intention of the pit exclusion dikes is to intercept and direct surface runoff, not to impede movement of groundwater flow. Section 2.2.2.2 of Reference (2) includes more details regarding the construction of pit exclusion dikes.

2.4.3 Stormwater Ditches

Stormwater ditches will be constructed throughout the Mine Site to route *stormwater* away from areas of mining activity. The stormwater ditches will route *stormwater* off-site, minimizing the amount of *mine water* by separating *stormwater* from mine water areas.

Interior ditches will convey collected *stormwater* to perimeter ditches and sedimentation ponds prior to controlled discharge. The layout of the proposed stormwater system mimics the existing drainage patterns at the Mine Site to the extent practical while meeting the objectives of the system. For further information, refer to Section 2.2.3 of Reference (2).

2.4.4 Sedimentation Ponds and Outlets

Sedimentation ponds around the perimeter of the Mine Site will be used to reduce TSS and to control *stormwater* discharge from the Mine Site. Five stormwater sedimentation ponds are planned for the Mine Site, as conceptually shown on Large Figure 4, Large Figure 5, and Large Figure 6 for Mine Years 1, 2, and 11, respectively. The pond locations were selected to match existing flow patterns to the extent practical and minimize the overall hydrologic impacts to the Partridge River:

- Pond A will be located near the northeastern corner of the Category 1 Waste Rock Stockpile and will direct *stormwater* off-site from the northern and western sides of the stockpile. Pond A will discharge to a wetland complex/drainageway that is tributary to the Partridge River.
- Pond B will be located between the East Pit and northern border of the property, routing *stormwater* to a wetland complex/drainageway that drains to the Partridge River.
- Pond C – West will be located west of the West Pit and will be designed to provide additional flood storage upstream of Pond C – East. This pond is part of the interior stormwater system and does not discharge off-site.
- Pond C – East will be located west of the OSLA and south of the West Pit. This pond discharges under Dunka Road and the railroad through a series of culverts to an unnamed creek that drains to the Partridge River.
- Pond D will be located west of the Category 2/3 Waste Rock Stockpile, east of the OSP, on the northern side of Dunka Road. This pond discharges under Dunka Road and the mainline railroad through a series of culverts to a ditch that drains to the Partridge River.

Ponds A, B, C – East, and D will be constructed prior to the end of Mine Year 1, and Pond C – West will be constructed during Mine Year 2 (Section 2.2.4 of Reference (2)). The sedimentation ponds are designed to reduce sediment in runoff from storms up to the 100-year, 24-hour storm event (Large Table 2 and Section 2.2.4.2 of Reference (2)) and achieve the applicable industrial stormwater benchmark values (Section 2.2.4.1 of Reference (2)). Sedimentation ponds will be inspected annually to determine the depth of sedimentation in the pond and dredged if sediment accumulation reduces the available pond volume below the required design storage capacity (Section 4.2 of Reference (2)).

Primary outlets and emergency outlets for each of the four exterior stormwater sedimentation ponds (Ponds A, B, C – East, and D) will be evaluated and designed on a site-specific basis. Primary outlets will be designed to provide flood attenuation capacity, and the emergency outlets will be designed to pass flows larger than the design values used to size the sedimentation pond. Stormwater sedimentation Ponds A and B will have their outlets fitted with controls to temporarily shut off discharge from the Mine Site or onto the Mine Site under Partridge River flooding conditions (Section 4.4.2 of Reference (2)).

Sections 2.2.4, 4.2, and 4.4.2 of Reference (2) contain more detailed information regarding sedimentation ponds and outlets.

2.5 Adaptive Management

The Mine Site water management systems have been designed to achieve compliance based on modeling of expected water quantity and quality. As described in Section 1.6 of Volume I, if water quality objectives are not met by these engineering controls, PolyMet will use an adaptive management approach, as necessary, to improve performance. As part of the adaptive management approach at the Mine Site, studies will first be undertaken to determine the root cause of the problem. Second, the design or operation of existing (or planned) Project engineering controls will be modified to remedy the root cause. Third, if modifying the design or operation of Project engineering controls is not sufficient, then contingency mitigation actions will be taken. Fourth, outcomes will be monitored and may be evaluated with water modeling. This process is meant to be iterative and will be repeated as necessary. The process for implementing adaptive management at the Mine Site is described in Section 6.4 of Reference (2) and Sections 2.0 and 3.0 of Reference (3).

Section 6.5 of Reference (2) presents feasible contingency mitigation actions available to address the following situations at the Mine Site:

- a pattern of overflows from mine water sumps or ponds;
- compliance issues in groundwater downgradient of lined infrastructure or the mine pits; and
- West Pit water quality is worse than expected.

2.6 Chemical Additives

Chemical additives, specifically chemical dust suppressants, will be used to control fugitive dust emissions from haul roads within the Mine Site and to prevent sedimentation and entrainment of dust in *stormwater* and nearby water bodies. Chemical dust suppression will be used to bind the dust to the haul roads. Dust suppressants are typically applied approximately one time per year and watered as necessary to reactivate the binding agents in the dust suppressant chemicals.

At the Mine Site, haul road runoff will be captured in mine water ditches and ponds and pumped to the equalization basins for further conveyance to the WWTS via the MPP, as described in Section 2.2 of this volume. Therefore, there is very little potential for excess dust suppressants to be transported off-site via surface water from the Mine Site. In order to mitigate potential environmental transport of the applied suppressants, BMPs will be implemented when calculating usage rates and applying products. The U.S. Environmental Protection Agency (USEPA) (Reference (11)) and Minnesota Pollution Control Agency (MPCA) (Reference (12)) provide guidance on the BMPs associated with the usage of chemical dust suppressants. Adherence to usage BMPs will limit the off-site transport of chemical additives. For example, information from vendors and/or field trials and usage will allow for optimization of application rates, application frequency, and the water dilution to product ratio, so that only the minimum amount of treatment needed to achieve successful dust suppression will be applied to surfaces. Optimizing treatment will result in minimization of pooling, runoff, and costs. Chemical dust suppressants will not be applied immediately adjacent to water bodies or when it is raining or when rain is imminent. Other BMPs for application and usage of chemical dust suppressants will be used when applicable.

Additional information regarding each proposed dust suppressant is included in Large Table 3. Additionally, Safety Data Sheets and product information labels for each proposed dust suppressant are included in Appendix C. Based on Project economics and the availability of specific products, dust suppressants may be acquired from multiple manufacturers provided that the chemical additive is commensurate with the use proposed within this application. Several different dust suppressant products are listed, and the decision on which product to use will be determined and reevaluated throughout the Project.

2.7 Progressive Reclamation, and an Overview of the Reclamation, Closure, and Postclosure Maintenance Phases

While the activities described in this section are beyond the scope of the first NPDES/SDS permit term, an overview of progressive reclamation activities that will occur during the operations phase and activities associated with the reclamation, closure, and postclosure maintenance phases, which are estimated to begin in Mine Years 21, 25, and 55, respectively, are provided here as additional background.

Reclamation activities that affect water management features at the Mine Site will begin during operations. Beginning in Mine Year 11, the contents of the Category 2/3 Waste Rock Stockpile and the Category 4 Waste Rock Stockpile will be relocated to the East and Central Pits, after mining is completed in each pit, and additional waste rock mined from the West and Central Pits will be placed directly in the East Pit (Section 2.3.1 of Reference (8)). Once mining is completed in the Central Pit, the waste rock mined from the West Pit will also be placed in the Central Pit. Once mining ceases in the West Pit, the combined East/Central Pit (now referred to as the East Pit) will be flooded.

Once the waste rock has been removed from the Category 2/3 and the Category 4 Waste Rock Stockpiles, the stockpiles will be reclaimed. The piping, pump systems, liner systems, stockpile foundations, stockpile sumps, and ponds will be removed, and the footprints will be reclaimed into a mixture of upland and wetland areas (Section 7.3.2 of Reference (8)). Water from the East Pit will continue to be pumped to the

WWTS for treatment, then returned to the pit, to reduce the constituent load in the East Pit water (Section 2.1.1 of Reference (3)). The East Pit will not be allowed to overflow to the environment. An outlet structure will be constructed to direct any overflow from the East Pit into the West Pit (Section 6.2.5 of Reference (1)).

The Category 1 Waste Rock Stockpile will also be incrementally reclaimed, with a geomembrane cover system installed progressively starting in Mine Year 14 and completed by the end of Mine Year 21 (Section 3.1 of Reference (3)). As the cover system is constructed, the Category 1 Stockpile Groundwater Containment System will also be covered, as described in Section 7.2 of Reference (8). As the stockpile and groundwater containment system are covered, surface runoff will be directed to the stormwater system and the containment system will continue to collect stockpile drainage via groundwater and route it to the equalization basins for further conveyance to the WWTS via the MPP for treatment until it transitions to non-mechanical treatment (Section 6.2 of Reference (3)).

Reclamation of other Mine Site water management features will take place after mining ceases in approximately Mine Year 20. Pit dewatering infrastructure will be removed from the West Pit, and the pit will be flooded as described in Section 2.1.1 of Reference (3). Stormwater features may be reclaimed or reconfigured for the postclosure maintenance phase. The footprint of the former Ore Surge Pile, sump, and pond will be reclaimed into a mixture of upland and wetland areas after the piping, pump system, and liner systems are removed. The OSLA will also be re-graded, if necessary, and revegetated.

The postclosure maintenance phase will begin at the Mine Site once the West Pit is flooded, which is estimated to occur in Mine Year 55. The ultimate goal for water treatment is to transition from the mechanical treatment provided by the WWTS to non-mechanical treatment systems for the Category 1 Stockpile Groundwater Containment System drainage and the West Pit overflow as soon as possible (Section 2.2.2.3 of Reference (6)).

Monitoring, reporting, and water treatment will continue during the reclamation, closure, and postclosure maintenance phases, until release from these activities is granted via the applicable permit(s).

3.0 Mine Site Monitoring

Monitoring of baseline water quality and quantity has been ongoing in the vicinity of the Mine Site. As the Project commences, monitoring will continue at specific locations for a variety of purposes, including compliance with this permit. Baseline monitoring data from monitoring stations presented in the FEIS (Reference (4)) (which includes stations proposed in the NPDES/SDS monitoring plan) is described in Section 3.1; Section 3.2 provides information on the proposed monitoring plan.

3.1 Existing Baseline Monitoring

This section summarizes the surface water and groundwater monitoring previously conducted at the Mine Site.

3.1.1 Surface Water

The Mine Site is located in the Partridge River watershed, approximately 17 river miles upstream of Colby Lake. Above Colby Lake, the Partridge River watershed covers approximately 103 square miles. The Partridge River flows just east of the site. Partridge River tributaries immediately downstream of the Mine Site include Yelp Creek, located north of the Mine Site, and Unnamed Creek, located south of the Mine Site and downstream of the future West Pit overflow. Other tributaries located between the Mine Site and Colby Lake that could potentially be affected along the Transportation and Utility Corridors (refer to Volume VII) include Wetlegs Creek, Longnose Creek, and Wyman Creek. Other tributaries to the Partridge River upstream of Colby Lake, including Stubble Creek, the south branch of the Partridge River, and Colvin Creek, will not be directly or indirectly impacted by the Project (Section 1.3.1 of Reference (2)). Surface water features in existing conditions are shown on Large Figure 7.

Daily flow data is available for the Partridge River from the U.S. Geological Survey (USGS) gaging station 04015475 (Partridge River above Colby Lake at Hoyt Lakes, Minnesota) from water years 1978 through 1987. During this period, hydrology was affected by the periodic and variable dewatering of Northshore Mining's Peter Mitchell Mine located at the headwaters of the Partridge River. The hydrology data has been validated and adjusted for use on this Project, as described in Section 4.4.1 of Reference (7).

Recent (2011-present) daily flow data near the Mine Site is available from Minnesota Department of Natural Resources (MDNR) gage H03155002, located on the Partridge River at the Dunka Road crossing (existing surface water monitoring station PM-3/SW003). This data is not directly comparable to the USGS gage 04015475 data due to the large difference in tributary watershed size and location. Based on its location, the MDNR gage H03155002 is more heavily influenced by Peter Mitchell Mine dewatering than the USGS gage 04015475.

Several locations within the Partridge River watershed have been monitored for water quality and quantity since 2004, as summarized in Table 3-1; existing surface water monitoring stations are shown on Large Figure 7.

Table 3-1 Summary of Baseline Surface Water Monitoring Stations (2004, 2006 through 2008, 2010 through 2015)

Current Monitoring Station ID	Water Body	Water Quality Monitoring Years	Average Instantaneous Flow (cfs)	Number of Flow Measurements	Flow Measurement Monitoring Years
PM-1/SW001(1)	Partridge River	2004, 2006, 2008	0(2)	2	2004
PM-2/SW002(1)		2004, 2006, 2012-2015	7.7	7	2004-2006
PM-3/SW003		2004, 2006-2008, 2010, 2012-2015	21.1	21	2004-2007
PM-16/SW004		2004, 2006-2008, 2010-2015	16.5	19	2004-2007
SW004a		2010, 2012-2015	N/A	N/A	N/A
SW004b		2010, 2012-2014	N/A	N/A	N/A
PM-4/SW005		2004, 2006-2008, 2010-2015	56.7	21	2004-2007
WP-1	Partridge River Tributary: Unnamed Creek downstream of the future West Pit Overflow	2011-2015	0.9(3)	10	2011

(1) This station represents existing conditions upstream of the potential influence of the Mine Site.
(2) Flow was not observed at this station on the two occasions evaluated.
(3) Flow was observed 2 of 10 occasions evaluated.

Refer to Large Table 4 for a summary of the baseline surface water quality monitoring results and Section 4.4.4 of Reference (7) and Reference (13) for detailed baseline surface water quality results. The frequency and extent (i.e., number of constituents) of monitoring varied by location. Monitoring conducted from 2004 through 2008 generally included a wider list of constituents to characterize the baseline conditions within the watershed. Monitoring from 2008 through 2011 generally focused on a smaller list of constituents and locations to resolve specific issues with the data. More comprehensive baseline monitoring at select locations along the Partridge River and its tributaries was resumed in 2012 with a wider list of constituents (Section 1.3.1 of Reference (2)). Colby Lake and the Whitewater Reservoir were also monitored in 2010 and 2013 through 2015; the related water quality data is available in Section 4.4.4.3 of Reference (7).

Under Minnesota Rules, part 7050.0430, Partridge River and the unnamed creek downstream of the future West Pit overflow are unlisted waters with the default classification of Class 2B, 3C, 4A, 5, and 6. For several parameters, one or more baseline monitoring results recorded a concentration higher than applicable surface water quality standards, as summarized in Table 3-2 for the monitoring stations on the Partridge River and in Table 3-3 for the monitoring station on the unnamed creek downstream of the future West Pit overflow. The baseline water quality of the unnamed creek downstream of the future West Pit overflow represents natural background levels. The baseline water quality of the Partridge River represents a mixture of natural background levels and the possible influence of past and present upstream industrial operations.

Table 3-2 Baseline Exceedances of Applicable Surface Water Standards at Partridge River Monitoring Stations Identified in Table 3-1 (2004, 2006 through 2008, 2010 through 2015)

Parameter	Number of Samples	Water Quality Standard and Number of Exceedances(1)									
		2B(2)		3C		4A		4B		5	
Aluminum (dissolved)	260	125 µg/L	32	N/A	-	N/A	-	N/A	-	N/A	-
Aluminum (total)	319	125 µg/L	73	N/A	-	N/A	-	N/A	-	N/A	-
Cobalt (total)	337	5 µg/L	1	N/A	-	N/A	-	N/A	-	N/A	-
Copper (total)	345	2.04-18.87µg/L(2, 3)	1	N/A	-	N/A	-	N/A	-	N/A	-
Lead (total)	306	0.33-9.08 µg/L	3	N/A	-	N/A	-	N/A	-	N/A	-
Mercury	186	0.0013 µg/L(2)	115	N/A	-	N/A	-	N/A	-	N/A	-
pH (SU)(4)	360	6.5-9.0	15	6.0-9.0	2	6.0-8.5	4	6.0-9.0	2	6.0-9.0	2
Thallium (total)	234	0.56 µg/L	1	N/A	-	N/A	-	N/A	-	N/A	-

Note: This assessment includes all stations located on the Partridge River identified in Table 3-1 (PM-1/SW001, PM-2/SW002, PM-3/SW003, PM-16/SW004, SW004a, SW004b, and PM-4/SW005). Some of the stations monitored for baseline conditions are not proposed to be monitored as part of this permit.

(1) These columns show applicable water quality standards for the stations and the number of exceedances for each standard.

(2) Minnesota Rules, chapter 7052 establishes additional surface water quality standards for Class 2 water bodies within the Lake Superior Basin. The Lake Superior Basin water quality standards in this table include copper (total) and mercury.

(3) Copper (total) is a hardness-dependent water quality standard. The copper (total) standard was calculated on an event-by-event basis for each monitoring event. The range listed here is the minimum and maximum standard calculated for all monitoring stations on the Partridge River identified in Table 3-1.

(4) pH exceedances are due to the samples being either acidic (less than 6.0 or 6.5 SU) or basic (greater than 8.5 or 9.0 SU), as noted.

Table 3-3 Baseline Exceedances of Applicable Surface Water Standards at Monitoring Station WP-1 (2011 through 2015)

Parameter	Number of Samples	Water Quality Standard and Number of Exceedances(1)									
		2B(2)		3C		4A		4B		5	
Aluminum (dissolved)	28	125 µg/L	26	N/A	-	N/A	-	N/A	-	N/A	-
Aluminum (total)	28	125 µg/L	27	N/A	-	N/A	-	N/A	-	N/A	-
Cobalt (dissolved)	19	5 µg/L	1	N/A	-	N/A	-	N/A	-	N/A	-
Cobalt (total)	28	5 µg/L	1	N/A	-	N/A	-	N/A	-	N/A	-
Copper (dissolved)	19	1.44-7.86 µg/L(2, 3)	12	N/A	-	N/A	-	N/A	-	N/A	-
Copper (total)	28	1.50-8.18 µg/L(2, 4)	23	N/A	-	N/A	-	N/A	-	N/A	-
Lead (total)	26	0.21-1.13 µg/L(5)	19	N/A	-	N/A	-	N/A	-	N/A	-
Mercury	11	0.0013 µg/L(2)	11	N/A	-	N/A	-	N/A	-	N/A	-
pH(6)	30	6.5-9.0	23	6.0-9.0	18	6.0-8.5	18	6.0-9.0	18	6.0-9.0	18

Note: This assessment includes station WP-1. This station is not proposed to be monitored as part of this permit.

(1) These columns show applicable water quality standards for the stations and the number of exceedances for each standard.

(2) Minnesota Rules, chapter 7052 establishes additional surface water quality standards for Class 2 water bodies within the Lake Superior Basin. The Lake Superior Basin water quality standards in this table include copper (dissolved), copper (total), and mercury.

(3) Copper (dissolved) is a hardness-dependent water quality standard. The copper (dissolved) standard was calculated on an event-by-event basis for each monitoring event using the conversion factor from copper (total). The range listed here is the minimum and maximum standard calculated for all monitoring events at station WP-1.

(4) Copper (total) is a hardness-dependent water quality standard. The copper (total) standard was calculated on an event-by-event basis for each monitoring event. The range listed here is the minimum and maximum standard calculated for all monitoring events at station WP-1.

(5) Lead (total) is a hardness-dependent water quality standard. The lead (total) standard was calculated on an event-by-event basis for each monitoring event. The range listed here is the minimum and maximum standard calculated for all monitoring events at station WP-1.

(6) pH exceedances are due to the samples being either acidic (less than 6.0 or 6.5 SU) or basic (greater than 8.5 or 9.0 SU), as noted.

3.1.2 Groundwater

Mine Site groundwater includes flows in two hydrogeologic units: the unconsolidated deposits (known as the "surficial aquifer") and bedrock. The Mine Site is covered with 0 to 60 feet of peat and glacigenic sediments, including outwash and bouldery till. Saturated conditions exist within the surficial aquifer at the Mine Site, and the depth to groundwater is typically less than 10 feet with recharge occurring primarily via direct infiltration of precipitation (Section 4.3.3.1 of Reference (7)). Groundwater flow in the surficial aquifer is generally southerly toward the Partridge River and its tributaries (Section 4.3.3.1 of

Reference (7)). The thinness of the surficial aquifer, heterogeneous glacial sediments, including Rainy Lobe till, ultimately controls its ability to transmit water. Groundwater flow paths are likely short because of the thin and discontinuous nature of the surficial aquifer. Shallow groundwater flow can also be interrupted by bedrock outcrops, which force local deviations in the flow field (Section 4.3.3.1 of Reference (7)).

The water table is generally a subdued replica of the land surface, with upland areas generally associated with groundwater divides. Groundwater in the upper portions of the bedrock is hydraulically connected, to some degree, with the overlying surficial aquifer. Groundwater in the upper bedrock also flows generally toward the south (Section 4.3.3.2 of Reference (7)). Recharge to bedrock is by infiltration of precipitation in outcrop areas and seepage from the overlying surficial aquifer (Reference (14)). The bedrock units have low primary hydraulic conductivity, and groundwater flow is primarily through fractures (i.e., secondary porosity features).

Baseline groundwater quality monitoring has been and continues to be assessed via a network of monitoring wells in the unconsolidated surficial aquifer and bedrock. A summary of these existing wells is available in Large Table 5, and their locations are shown on Large Figure 3.

Three monitoring wells were installed in the surficial aquifer at the Mine Site in 2005 (Reference (15)) and have been sampled intermittently since installation. Twenty-one additional wells were installed in the surficial aquifer between October 2011 and February 2012. A monthly groundwater sampling program for these surficial monitoring wells was initiated in November 2011 and continued through August 2012, at which time monitoring switched to quarterly excluding the winter (first) quarter. Nine monitoring wells have been installed in bedrock at the Mine Site. Four of these wells are larger diameter bedrock wells: they were installed in 2006 to depths from 485 to 610 feet below grade and were sampled during aquifer testing in 2006 and 2007. Five bedrock wells are observation wells: they were installed in 2006 in the upper 100 feet of the bedrock and each has been sampled nine or ten times since installation. Two additional bedrock wells were installed for the purpose of aquifer testing, but are not sampled for water quality. In addition, a water supply well used for exploration drilling was installed in bedrock; this well was only sampled in 2005. The surficial and bedrock wells are currently and will continue to be sampled quarterly, with the exception of the winter (first) quarter (Section 4.3 of Reference (7)).

For a complete tabulation of baseline groundwater quality data collected from 2005 through 2015 at the Mine Site, refer to Section 4.3.4 of Reference (7) and Reference (13). Refer also to Large Table 6, which provides a summary of these results. Baseline condition exceedances of groundwater quality standards, specifically USEPA Maximum Concentration Limits (MCLs) and Secondary Maximum Concentration Limits (sMCLs), are summarized in Table 3-4 for wells in the surficial aquifer and Table 3-5 for wells in bedrock. The baseline groundwater quality at the proposed Mine Site represents natural background levels. In accordance with Minnesota Rules, part 7060.0600, subpart 8, “where the background level of natural origin is reasonably definable and higher than the accepted standard for potable water and the hydrology and extent of the aquifer are known, the natural level may be used as the standard”.

Table 3-4 Baseline Exceedances of Groundwater Standards at Surficial Aquifer Wells Identified in Large Table 5 (2005 through 2015)

Parameter	Number of Samples	Water Quality Standard and Number of Exceedances[1]			
		USEPA MCL[2]		USEPA sMCL[3]	
Aluminum (dissolved)	466	N/A	-	50 µg/L	128
Aluminum (total)	27	N/A	-	50 µg/L	26
Arsenic (total)	33	10 µg/L	6	N/A	-
Iron (dissolved)	454	N/A	-	300 µg/L	132
Iron (total)	22	N/A	-	300 µg/L	33
Lead (total)	323	15 µg/L	1	N/A	-
Manganese (dissolved)	457	N/A	-	50 µg/L	268
Manganese (total)	27	N/A	-	50 µg/L	22
pH	464	N/A	-	6.5-8.5 SU	134
TDS	457	N/A	-	500 mg/L	1
Turbidity	443	5 NTU	137	N/A	-

Note: This assessment includes all stations in the surficial aquifer identified in Large Table 5. Some of the stations monitored for baseline conditions are not proposed to be monitored as part of this permit.

(1) The standards in this column (USEPA Maximum Concentration Limits (MCLs) and Secondary Maximum Concentration Limits (sMCLs)) have been incorporated as Minnesota Class I water quality standards in Minnesota Rules, part 7050.0221. However, it remains to be determined whether these standards are applicable to the groundwater at the Mine Site for compliance purposes, and, even if they are, how they should be applied. Under Minnesota Rules, part 7060.0600, subpart 8, where groundwater in its natural state exceeds the standards for potable water, the natural level may be used as the standard. For certain parameters, the natural background level in groundwater at the NorthMet site exceeds potable standards; accordingly, in these situations the background level should be the standard for compliance purposes, not the MCLs. In addition, even if the Class I standards (i.e., the MCLs) do apply for certain parameters, it is not clear whether Class I A, B, or C should apply (see Minnesota Rules, part 7050.0221, subparts 2 to 4). If Class B or C apply, the "applicable standard" will require groundwater being able to meet the standard after varying levels of treatment.

(2) USEPA Maximum Contaminant Levels. These USEPA groundwater quality standards are incorporated by reference into Minnesota Rules, part 7050.0220, subpart 2.A.

(3) USEPA Secondary Maximum Contaminant Levels. These USEPA groundwater quality standards are incorporated by reference into Minnesota Rules, part 7050.0220, subpart 2.A.

Table 3-5 Baseline Exceedances of Groundwater Standards at Bedrock Wells Identified in Large Figure 5 (2005 through 2015)

Parameter	Number of Samples	Water Quality Standard and Number of Exceedances(1)			
		USEPA MCL(2)		USEPA sMCL(3)	
Aluminum (dissolved)	59	N/A	-	50 µg/L	5
Aluminum (total)	51	N/A	-	50 µg/L	30
Arsenic (total)	49	10 µg/L	3	N/A	-
Cadmium (total)	49	5 µg/L	1	N/A	-
Iron (dissolved)	35	N/A	-	300 µg/L	12
Iron (total)	49	N/A	-	300 µg/L	36
Manganese (dissolved)	40	N/A	-	50 µg/L	16
Manganese (total)	49	N/A	-	50 µg/L	26
pH	59	N/A	-	6.5-8.5 SU	20
Turbidity	37	5 NTU	26	N/A	-

Note: This assessment includes all stations in bedrock identified in Large Table 5. Some of the stations monitored for baseline conditions are not proposed to be monitored as part of this permit.

(1) The standards in this column (USEPA Maximum Concentration Limits (MCLs) and Secondary Maximum Concentration Limits (sMCLs)) have been incorporated as Minnesota Class I water quality standards in Minnesota Rules, part 7050.0221. However, it remains to be determined whether these standards are applicable to the groundwater at the Mine Site for compliance purposes, and, even if they are, how they should be applied. Under Minnesota Rules, part 7060.0600, subpart 8, where groundwater in its natural state exceeds the standards for potable water, the natural level may be used as the standard. For certain parameters, the natural background level in groundwater at the NorthMet site exceeds potable standards; accordingly, in these situations the background level should be the standard for compliance purposes, not the MCLs. In addition, even if the Class I standards (i.e., the MCLs) do apply for certain parameters, it is not clear whether Class I A, B, or C should apply (see Minnesota Rules, part 7050.0221, subparts 2 to 4). If Class B or C apply, the "applicable standard" will require groundwater being able to meet the standard after varying levels of treatment.

(2) USEPA Maximum Contaminant Levels. These USEPA groundwater quality standards are incorporated by reference into Minnesota Rules, part 7050.0220, subpart 2.A.

(3) USEPA Secondary Maximum Contaminant Levels. These USEPA groundwater quality standards are incorporated by reference into Minnesota Rules, part 7050.0220, subpart 2.A.

Natural background concentrations are above the standards for aluminum, iron, and manganese in the surficial deposits and iron and manganese in bedrock. These background levels were discussed during the environmental review process (Section 4.3.4.2 of Reference (7)).

3.2 Proposed Monitoring Plan

Monitoring proposed as part of permit requirements for the Mine Site is included in the integrated Mine Site monitoring plan presented in Section 3.0 of Volume I. The proposed Mine Site monitoring plan includes associated groundwater monitoring stations, surface water monitoring stations, and internal waste stream monitoring stations; these proposed monitoring stations are shown on Large Figure 4, Large Figure 5, and Large Figure 6. Additionally, stormwater inspections and monitoring will occur in accordance with the Construction Stormwater General Permit and the Industrial Stormwater General

Permit; the details associated with stormwater inspection and monitoring will be specified in the respective SWPPPs.

4.0 Groundwater Nondegradation

PolyMet evaluated the anticipated effects of Mine Site features on groundwater quality.

- Section 4.1 describes how Minnesota's rules governing protection of underground waters apply to groundwater at the Mine Site.
- Section 4.2 summarizes how PolyMet and the Co-Lead Agencies, as part of the FEIS, analyzed alternative engineering controls for the Mine Site so that the Project design will control waste materials to the maximum practicable extent to protect groundwater.
- Section 4.3 describes the engineering controls that will be constructed to maintain groundwater in its natural quality and to meet maximum practicable extent standards as required by the applicable Minnesota groundwater nondegradation policy.

These engineering controls, in concert with the Mine Site Water Management Plan (Reference (2)), are expected to result in groundwater quality that meets applicable standards at the property boundary (Section 6.3.2 of Reference (7)). Existing groundwater quality at the Mine Site is described in Section 3.1.2 of this volume, and PolyMet's plan for ongoing groundwater monitoring is presented in Section 3.2 of this volume.

4.1 Regulatory Context

The State of Minnesota has policies to protect groundwater, including a groundwater nondegradation policy that states that certain waste "shall be controlled as may be necessary to ensure that to the maximum practicable extent the underground waters of the state are maintained at their natural quality" unless MPCA determines that a change is justifiable on certain specified grounds (Minnesota Rules, part 7060.0500). The MPCA rules contemplate that this maximum practicable extent standard can be satisfied through various control technologies or other measures, including "treatment, safeguards or other control measures" (Minnesota Rules, part 7060.0600, subpart 3).

The available sampling results, as summarized in Section 3.1.2 of this volume, establish that the groundwater at the Mine Site remains in its natural quality. There are no known existing or previous discharges from human activities in the immediate vicinity of the Mine Site, and Mine Site water quality is similar to regional data (Section 4.3.4.1.4 of Reference (7)). Because the Mine Site groundwater remains at its natural quality, PolyMet has designed the Project to comply with the State's groundwater nondegradation policy, including the "maximum practicable extent" requirements of Minnesota Rules, parts 7060.0500 and .0600.

4.2 Alternatives Analysis

The Project, as evaluated in the FEIS, will maintain natural groundwater quality to the maximum practicable extent. During the environmental review process, PolyMet and the Co-Lead Agencies identified and assessed available control-technology alternatives and mitigation measures to protect groundwater. The Project design incorporated the control technology, and the FEIS analysis establishes that the engineering controls included in the design for the Mine Site will meet the maximum practicable extent requirements of Minnesota Rules, chapter 7060 and maintain groundwater in its natural quality in accordance with the State's nondegradation policy.

The following paragraphs briefly summarize the analysis of alternatives that was conducted during environmental review to ensure that groundwater quality is maintained. Full details on the process of developing and evaluating Project alternatives is documented in Section 3.0 of the FEIS (Reference (4)). Section 3.2.3 of Reference (4) details the many alternatives to minimize water quality impacts that were identified and evaluated, and documents the results of the evaluation.

During preparation of the FEIS, along with the preceding environmental review documents, PolyMet and the agencies identified a broad range of reasonable alternatives for protecting groundwater and screened the alternatives against the following factors:

- Project purpose and need
- technical feasibility
- economic feasibility
- availability
- environmental and socioeconomic benefits

Each Project alternative assembled various operating techniques and technologies that, when combined into a single alternative, represented a consistent and unified approach for completing the proposed activity while minimizing impacts to all areas of the environment – air, soil, water, wetlands, etc. The components or technologies of a Project alternative used for protection of a specific media (in this case, groundwater) were selected based on their overall compatibility with the other components of the Project. For example, water treatment technologies that had a negative impact on air quality were avoided. Alternatives that did not meet the screening criteria were not considered reasonable and were eliminated from detailed analysis in accordance with the environmental review requirements of National Environmental Policy Act (NEPA) / Minnesota Environmental Policy Act (MEPA).

The Project design and water management plans were developed based on the NEPA/MEPA alternatives analysis, with additional mitigation measures incorporated during the environmental review process to further minimize groundwater quality impacts. The Mine Site design, as reviewed in the FEIS alternatives analysis, incorporates a combination of design, management, and treatment measures to protect groundwater quality to the maximum practicable extent.

4.3 Description of Engineering Controls to Protect Groundwater

The FEIS identified the following potential sources of groundwater impacts at the Mine Site (Section 5.2.2.3.2 of Reference (4)):

- temporary and permanent waste rock stockpiles

- temporary OSP
- OSLA
- equalization basins
- mine pits

For each of these potential sources of groundwater impacts, the Project incorporates engineering controls designed to maintain natural groundwater quality to the maximum practicable extent, as described in the following subsections.

4.3.1 Permanent Category 1 Waste Rock Stockpile

Potential groundwater impacts due to the Category 1 Waste Rock Stockpile, the only permanent stockpile, will be controlled by a groundwater containment system consisting of a cutoff wall (a low permeability compacted soil hydraulic barrier) combined with a drainage collection system around the perimeter of the stockpile near the stockpile toe, as detailed in Section 2.1.2 of Reference (8). The containment system will surround the stockpile, collecting stockpile drainage and drawing down the water table on the stockpile side of the cutoff wall, thereby maintaining an inward gradient along the cutoff wall and eliminating the potential for stockpile drainage passing through the cutoff wall (hydraulic barrier) (i.e., any leakage through the cutoff wall will be inward into the containment system). Groundwater modeling of the Category 1 Stockpile Groundwater Containment System (Attachment A of Reference (8)) indicates that the containment system and mine pits are expected to capture the total stockpile drainage. Groundwater containment systems, consisting of a cutoff wall and a groundwater collection system, are commonly used at facilities where there is a need to manage groundwater flow, such as landfills, tailings basins, and paper sludge disposal facilities. Academic, governmental, and industry authorities acknowledge that such groundwater containment systems are a successful control technology for potential groundwater impacts (Attachment D of Reference (8)). Therefore, the construction of a groundwater containment system around the Category 1 Waste Rock Stockpile will maintain natural groundwater quality to the maximum practicable extent.

PolyMet will further control potential groundwater impacts from the Category 1 Waste Rock Stockpile by applying a geomembrane cover system incrementally during Project operations (Section 3.0 of Reference (3)). The cover system will reduce pollutant load by reducing infiltration of precipitation through the reclaimed Category 1 Waste Rock Stockpile, thereby reducing the load that reports to the equalization basins. Geomembrane cover systems are widely used throughout the world in mining, landfills, and other industries that have to address long-term containment of wastes that have potential to impact groundwater (Section 3.2.3 of Reference (3)); therefore, progressive reclamation of the Category 1 Waste Rock Stockpile with a geomembrane cover system will maintain natural groundwater quality to the maximum practicable extent.

4.3.2 Temporary Waste Rock and Ore Stockpiles

Potential groundwater impacts from the temporary waste rock stockpiles will be controlled by installation of engineered liner systems and by the fact that the operational life of the stockpiles is limited.

PolyMet will construct an engineered liner system under each temporary waste rock stockpile to control potential groundwater impacts from stockpile drainage. The liner system will consist of, from the top down, an overliner drainage layer, an impermeable composite liner barrier, and a foundation underdrain system, as detailed in Section 2.1.3 of Reference (8). The impermeable composite liner barrier, comprised of a compacted soil liner overlain by a geomembrane layer, will prevent stockpile drainage from infiltrating downward. Stockpile drainage will be collected above the liner in the high permeability overliner drainage layer, then pumped to the equalization basins for further conveyance to the WWTS via the MPP. The overliner drainage layer will minimize the development of hydraulic head on the impermeable liner, thus minimizing the potential for groundwater impacts due to any liner defects. The liners' integrity will also be protected by foundation underdrain systems, which may be installed in areas where high groundwater is encountered to minimize the potential for excess pore pressures adversely affecting the performance of the liner system as the stockpile is loaded. These three liner design components (underdrains, impermeable barrier, and overliner drainage layer) function as a system to enhance liner integrity and stockpile stability. PolyMet will implement a Construction Quality Assurance Plan to assure that the liner system meets design specifications (Section 2.1.3.3 of Reference (8)). Calculations based on typical liner defect size and frequency, expected hydraulic head, and measured hydraulic conductivity of system components indicate that stockpile drainage will be effectively controlled, as shown in Table 4-1 of this volume and discussed in Section 6.1.1 of Reference (7).

Composite liner systems are commonly used and required by regulatory agencies at facilities where there is a need to protect groundwater, such as landfills and waste water treatment ponds. Composite liner systems, consisting of an upper geomembrane hydraulic barrier overlying a low permeability compacted soil layer, when both are properly specified and constructed, are a successful control technology for potential groundwater impacts. Therefore, composite liner use for the temporary stockpiles will protect natural groundwater quality to the maximum practicable extent.

The temporary nature of these stockpiles will also limit their potential impacts to groundwater. The Category 2/3 Waste Rock Stockpile, the Category 4 Waste Rock Stockpile, and the OSP will have operating lives of 11 to 21 years. At the end of their operating lives, PolyMet will remove these temporary waste rock stockpiles and reclaim their footprints. Because these stockpiles are temporary, rather than permanent, there is less potential for degradation of the liners over time, and limited duration of potential groundwater effects from these features.

Overall, these stockpiles are designed to maintain natural groundwater quality at the Mine Site to the maximum practicable extent while the stockpiles are in place, and the temporary nature of these stockpiles minimizes the potential for any long-term or on-going impact to natural groundwater quality.

4.3.3 Overburden Storage and Laydown Area

PolyMet will use the OSLA to screen, sort, and temporarily store peat and unsaturated overburden for future use. Potential groundwater impacts from the OSLA will be controlled by collecting runoff and drainage from the site and pumping it to the FTB. The OSLA will be unlined; it will be graded and compacted to provide a well-drained site. The compacted base will result in most of the precipitation falling on the OSLA to become runoff. However, the compacted base is assumed to allow some water to infiltrate; therefore, the compacted base layer is characterized as a low-permeability base layer. Runoff and drainage will be collected in an unlined mine water pond, then pumped to the Construction Mine Water Basin for further conveyance to the FTB via the MPP (Section 2.1.5.1 of Reference (2)). These proposed management practices are consistent with industry standards, and analyses indicate that they will limit mobilization of constituents, including mercury, to the environment (Section 2.1.5.1 of Reference (2)).

Peat can release mercury when it decomposes. PolyMet has analyzed the potential for groundwater impacts from peat stored in the OSLA, and determined that water leaving the peat stockpile is not expected to result in a measurable change in mercury concentrations in the groundwater. This screening analysis is summarized below.

Most of the peat that will be placed in the OSLA will have already undergone decomposition, and conditions in the stockpile will limit further decomposition. The peat stockpiled in the OSLA will be a mixture of surficial peat (0 to 25 centimeter [cm] depth) and well-decomposed deep peat (25 cm to bottom of the peat profile), placed in a moist to wet condition. Because the largest volume of peat will be obtained from the subsurface of wetlands (deep peat), the stockpiled peat is expected to reflect a well-decomposed material at the time of placement. While surficial peat can decompose quickly, this surficial peat will be a small component of the stockpiled material, and it will be mixed into the pile where low oxygen and moist conditions will limit its decomposition. Overall, because the stockpiled peat is expected to reflect a well decomposed peat and retain most of its original moisture, decomposition is estimated to be slow (Reference (16), Reference (17)), with estimates of potential decomposition ranging from about 3 to 4 millimeter (mm) per year (Reference (18)) up to 20 mm per year, with 10 mm considered to be a reasonable estimate of potential decomposition over the life of the stockpile (Reference (19)). Therefore, potential decomposition of stored peat will occur in only a thin layer at the surface of the stockpile.

Based on available research, almost all of the mercury potentially released due to decomposition of peat at the surface of the stockpile is estimated to volatilize or adsorb to organic material in the peat stockpile (Reference (18), Reference (20)). The peat placed in the OSLA stockpile will contain a large amount of organic matter, which has a high affinity for mercury (Reference (21)). Decomposition of peat at the surface of the stockpile will create additional organic matter. There are two major loss mechanisms for mercury potentially released as the peat decomposes: 1) volatilization, where about 50% to 80% of the mercury input to an ecosystem is estimated to be volatilized into the atmosphere (Reference (20), Reference (21)); and 2) adsorption to organic carbon, and soils in general, with studies indicating a high affinity of mercury to organic carbon and soil organic matter (Reference (22)) and peat (Reference (23)), with about 50% of added mercury being adsorbed by organic matter (Reference (24)). Overall, more than 95% of added mercury was found to be sequestered with organic matter and soil matter (Reference (24)).

If it is assumed that approximately 50% of mercury potentially released from the decomposition of peat is volatilized and that approximately 50% of potentially released mercury is adsorbed to organic matter in the stockpile, then very little mercury would be available to be carried downward through the stockpile with percolating water to the compacted base layer of the OSLA. GoldSim modeling completed for the FEIS estimated that there would be no adsorption of water by the peat, and further estimated that about 22% of precipitation (approximately 6.3 inches per year) would infiltrate and move downward through the peat stockpile (Section 6.1.1.4 of Reference (7)), which results in an overestimate of water moving downward through the stockpile because it does not account for the likely absorbance of water by organic material and it also results in an overestimate of mercury moving downward through the stockpile. This overestimate for water flowing through the peat stockpile was made to provide a conservative estimate of potential impacts to groundwater for the environmental review process. However, a number of studies indicate that very little of the mercury sequestered in soils leaches downward to groundwater (Reference (25), Reference (21), Reference (23), Reference (26)). Based on two known loss mechanisms for mercury (volatilization and adsorbance to organic matter) and assuming that 22% of annual precipitation would move downward through the peat stockpile (with no loss of water or mercury at depth in the stockpile), screening calculations developed for this analysis estimate a potential mercury concentration in the water percolating through the stockpile ranges from less than 2 ng/L to about 10 ng/L and is consistent with the discussion in Section 5.2.2.3.4 of the FEIS (Reference (4)) and Section 2.1.5.1 of Reference (2). The current calculations do not account for the potential loss of mercury as water infiltrates through the compacted base layer of the OSLA and through mineral soil overlying the shallow groundwater aquifer. Therefore, the estimated potential mercury concentration of the water infiltrating from the OSLA to the shallow groundwater is considered a conservative overestimate.

Water reaching the compacted base layer of the OSLA would have the potential to move laterally and become runoff water or to infiltrate through the low-permeability compacted base layer to groundwater. Whether water from the peat stockpile moves laterally as runoff to the OSLA Pond or moves vertically into the low-permeability compacted base and eventually to groundwater, the estimated concentration of mercury in a relatively small volume of water leaving the peat stockpile is not expected to result in any measurable change in existing conditions groundwater or wetland mercury concentrations. Therefore, the design of the OSLA is estimated to maintain groundwater in its natural quality to the maximum practicable extent.

4.3.4 Equalization Basins

Potential groundwater impacts from the equalization basins in the Equalization Basin Area will be controlled by installation of single-liner systems overlying a one-foot thick soil liner (Section 5.2.2.9 of Reference (7)). Calculations based on typical liner characteristics, expected hydraulic head, and measured hydraulic conductivity of system components indicate that leakage from the basins will be controlled to the maximum practicable extent, as shown in Table 4-1 of this volume and discussed in Section 5.2.2.9 of Reference (7).

4.3.5 Mine Pits

PolyMet has designed the East Pit, Central Pit, and the West Pit such that waste rock and *mine water* will be controlled to the maximum practicable extent. During operations, the mine pits will be dewatered and groundwater flow will be inward to the pits; there will be no outward flow from the pits and thus no impact to groundwater quality during operations.

After mining is completed, a sequence of actions is planned for each mine pit that will, in combination, limit the potential impacts of the Project on groundwater quality. The depleted East/Central Pit will be backfilled with waste rock from the temporary waste rock stockpiles and from on-going mining in the West Pit. As the East/Central Pit is backfilled, it will be flooded, to reduce further oxidation in the waste rock and mine pit walls, and thus reduce the potential for surface or groundwater quality impacts. As the East/Central Pit is flooded and for approximately 14 years after flooding is complete, PolyMet will recirculate *mine water* from the pit to the WWTS for treatment to remove the flushing load associated with inundation of the waste rock and the pit walls (Section 2.0 of Reference (3)).

When mining is completed in the West Pit, PolyMet will accelerate the natural flooding of the pit using treated effluent from the WWTS and untreated water from the Plant Site (Section 2.0 of Reference (3)). This accelerated flooding will control water quality in the West Pit by reducing the oxidation time for the pit wall rock; it will bring the initial constituent concentration in the pit water close to the long-term steady state concentration (Section 6.2.3.3.2 of Reference (7)).

Once the pits are flooded (expected during the postclosure maintenance phase, estimated to occur in Mine Year 55) and the water level is above the bedrock rim of each pit, some of the pit water will flow within the surficial aquifer and bedrock to the south towards the Partridge River. The actions described above will control the constituent concentrations in the pit water, thus limiting the potential impacts of mine pit water on groundwater quality. Groundwater flow models for the surficial aquifer and bedrock indicate that these measures will control potential impacts to groundwater from the mine pits to the maximum practicable extent requirements (Section 6.3.2 of Reference (7)).

4.3.6 Mine Water Sumps and Overflow Ponds

Potential groundwater impacts from the mine water sumps will be controlled by the installation of double liners and a Leak Collection and Recovery System, as detailed in Section 2.1.4.1.1 of Reference (2). The Leak Collection and Recovery System will return any leakage through the upper layer of the liner system to the sump. Overflow ponds, which will only receive stockpile runoff during precipitation events larger than the 10-year, 24-hour event and will completely contain runoff up to the 100-year, 24-hour event, will be constructed with a single-liner system overlying a one-foot-thick soil liner. Other mine water ponds will be constructed with liner systems based on the quality of the collected water (Section 2.1.5 of Reference (2)): a double liner (RTH drainage), a single liner (haul road drainage), or no liner (OSLA drainage). Calculations based on typical liner characteristics, expected hydraulic head, and measured hydraulic conductivity of system components indicate that leakage from the sumps and ponds will be controlled to the maximum practicable extent (Sections 5.2.2.4 and 5.2.2.9 of Reference (7)).

4.4 Anticipated Performance of Engineering Controls

Each of the Mine Site features with the potential to affect groundwater will be constructed and managed to maintain natural groundwater quality to the maximum practicable extent. The FEIS (Reference (4)) evaluated the potential impact of each of these sources to groundwater. Table 5.2.2-27 of Reference (4) lists the estimated pit outflow and leakage into groundwater flow paths, based on modeling completed for the Project. This table, shown as Table 4-1, documents the anticipated performance of the planned engineering controls.

PolyMet will monitor the performance of the Mine Site engineering controls and the groundwater quality downgradient of Mine Site features (Section 3.2.1 of Volume I) to meet the maximum practicable extent requirements of Minnesota Rules, chapter 7060, and if the engineering controls are not achieving the desired outcomes, will implement adaptive management actions or contingency mitigation (Sections 6.4 and 6.5 of Reference (2)), as necessary to comply with all permit conditions.

Table 4-1 Estimated Flow from Potential Sources of Groundwater Impacts

Contaminant Source	Flow Rate (gpm)	Duration of Source (Mine Years)	Mine Year when Solute Plume First Arrives at Partridge River
East/Central Pit	3.75(1)	20+	100
West Pit	6.09(1)	55+	105
Category 2/3 Waste Rock Stockpile (Temporary)	0.0193	0-20	35
Ore Surge Pile (Temporary)	0.00116	0-21	90
Equalization Basins	0.0138	0-33	85
Overburden Storage and Laydown Area	14.0	0-20	30(2)

Information from Table 5.2.2-27 of Reference (4), based on GoldSim deterministic run with 50th percentile inputs. See Section 3.0 of Reference (7) for a description of the GoldSim modeling.

(1) Pit water into groundwater flow path

(2) Concentration decrease

5.0 References

1. **Poly Met Mining Inc.** NorthMet Project Mine Plan (v5). July 2016.

2. **Poly Met Mining, Inc.** NorthMet Project Water Management Plan - Mine Site (v6). August 2017.

3. —. NorthMet Project Adaptive Water Management Plan (v11). August 2017.

4. **Minnesota Department of Natural Resources, U.S. Army Corps of Engineers and U.S. Forest Service.** Final Environmental Impact Statement: NorthMet Mining Project and Land Exchange. November 2015.

5. **Poly Met Mining Inc.** NorthMet Project Project Description (v9). February 2015.

6. **Barr Engineering Co.** Memo to Ann Foss (MPCA), Jess Richards (MDNR), Kenton Spading, (USACE) re: Proposed Waste Water Treatment System (WWTS) Relocations v3. April 11, 2017.

7. **Poly Met Mining Inc.** NorthMet Project Water Modeling Data Package Volume 1 - Mine Site (v14). February 2015.

8. —. NorthMet Project Rock and Overburden Management Plan (v9). August 2017.

9. —. NorthMet Project Wetland Data Package (v11). April 2015.

10. —. NorthMet Project Waste Characterization Data Package (v12). February 2015.

11. **U.S. Environmental Protection Agency.** Dust Control. *Water: Best Management Practices.* [Online] July 1, 2014. http://water.epa.gov/polwaste/npdes/swbmp/Dust-Control.cfm.

12. **Minnesota Pollution Control Agency.** Dust Control Treatments for Roads and Surfaces (aq1-15). April 2013.

13. **Barr Engineering Co.** 2014-2015 Surface water and groundwater quality data collected for the NorthMet Project Technical Memorandum to Jennifer Saran, PolyMet Mining Inc. May 27, 2016.

14. **Siegel, D.I. and Ericson, D.W., U.S. Geological Survey.** Hydrology and Water Quality of the Copper-Nickel Study Region, Northeastern Minnesota. Water-Resources Investigations Open-File Report 80-739. 1980.

15. **Barr Engineering Co.** Hydrogeologic Investigation - Phase I, PolyMet NorthMet Mine Site, RS-02 Draft-02. November 2006.

16. *Water Storage Characteristics of Several Peats in situ.* **Boelter, D. H.** 1964. Soil Science Society Proceedings. pp. 433-435.

17. *Important Physical Properties of Peat Materials.* **Boelter, D. H.** Quebec, Canada : s.n., 1968. Proceedings of the Third International Peat Congress. pp. 150-154.

18. **Franzén, L. G.** Increased decomposition of subsurface peat in Swedish raised bogs: are temperate peatlands still net sinks of carbon? *Mires and Peat.* 2006, Vol. 1, Article 3.

19. **Barr Engineering Co.** Greenhouse Gas and Climate Change Evaluation - NorthMet Project. Prepared for PolyMet Mining Inc. June 2012.

20. **Psarska, Sona, Nater, Edward A. and Kolka, Randall K.** Impacts of Invasive Earthworms on Soil Mercury Cycling: Two Mass Balance Approaches to an Earthworm Invasion in a Northern Minnesota Forest. *Water, Air, & Soil Pollution.* 2016, Vol. 227, 6, pp. 1-12.

21. **Grigal, D. F.** Inputs and Outputs of Mercury from Terrestrial Watersheds: A Review. *Environmental Reviews.* 2002, Vol. 10, pp. 1-39.

22. —. Mercury sequestration in forests and peatlands: A review. *Journal of Environmental Quality.* March-April 2003, Vol. 32, 2, pp. 393-405.

23. *The role of organic carbon in facilitating mercury sorption and retention in the soil: Some field evidence from Oak Ridge, Tennessee- 10391.* **Pant, Prabhakar, Allen, Marshall and Tansel, Berrin.** Phoenix, AZ : s.n., 2010. WM2010 Conference. pp. 1-7.

24. **Liu, Jia, et al.** Adsorption/Desorption and Fate of Mercury (II) by Typical Black Soil and Red Soil in China. *Soil and Sediment Contamination: An International Journal.* 2010, Vol. 19, 5, pp. 587-601.

25. **Grigal, D. F., et al.** Mercury budget of an upland-peatland watershed. *Biogeochemistry.* 2000, Vol. 50, pp. 95-109.

26. **Oswald, Claire J., Heyes, Andrew and Branfireun, Brian A.** Fate and Transport of Ambient Mercury and Applied Mercury Isotope in Terrestrial Upland Soils: Insights from the METAALICUS Watershed. *Environmental Science & Technology.* 2014, Vol. 48, 2, pp. 1023-1031.

27. **International Commission on Large Dams.** Manual on Tailings Dams and Dumps (Bulletin 45). 1982.

Large Tables

Large Table 1 Design Criteria for Mine Water Infrastructure

Structure	Objectives	Design Criteria and Assumptions	Design Rationale
Mine Water Ponds: Overburden Storage and Laydown Area (OSLA) Runoff	Provide flood storage and reduce total suspended solids (TSS). Pond is temporary in nature; active during the life of mine.	1. Pond to contain runoff by gravity from 25-year, 24-hour event. 2. Pump capacities based on average annual 30-day spring snowmelt flows (average annual peak runoff volume). 3. Pump location chosen to allow for TSS reduction.	OSLA drainage water quality will be commensurate with unsaturated overburden and peat runoff, where the only constituent of concern is mercury. Low risk of adjacent or downstream infrastructure damages; typical designs are between the 2-year storm (as required by the Minnesota NPDES/SDS Construction Stormwater General Permit for design of temporary construction stormwater ponds) and 25-year storm (as required by 40 CFR 258.26 for runoff from solid waste landfills), depending on the nature of the affected infrastructure.
Mine Water Ponds/Ditches: Haul Road Runoff	Provide conveyance by gravity, flood storage, and TSS reduction. These are temporary in nature; active during the life of mine.	1. Ditches are sized to convey and ponds are sized to contain runoff by gravity from the 100-year, 24-hour event. 2. Pump capacities based on average annual 30-day spring snowmelt flows (average annual peak runoff volume). 3. Pump location chosen to allow for TSS reduction.	Haul road drainage water quality could be commensurate with drainage from overburden runoff, or Category 1 to Category 4 waste rock with limited flow path. The 100-year storm event is standard for small impoundments with an acknowledged hazard potential, but considered low hazard (no downstream residents or development) (ICOLD 1982). Runoff in excess of the 100-year storm event, which will be significantly diluted, will be managed through overflow contingencies (see last row of table).
Mine Water Ponds: Rail Transfer Hopper (RTH) Runoff	Provide flood storage and reduce TSS. Pond is temporary in nature; active during the life of mine.	1. Pond to contain runoff from 100-year, 24-hour event with pumped outflow. 2. Pump capacity set to contain 100-year, 24-hour storm event within pond without overflow. 3. Sediment trap designed prior to pond inlet and pump location chosen to allow for reduction in TSS reduction.	RTH drainage water quality will be commensurate with drainage from Category 4 waste rock runoff, which is how ore is categorized, with a limited flow path. The 100-year storm event is standard for small impoundments with an acknowledged hazard potential, but considered low hazard (no downstream residents or development) (ICOLD 1982). Runoff in excess of the 100-year storm event, which will be significantly diluted, will be managed through overflow contingencies (see last row of table).
Sumps (Manholes): Category 1 Stockpile Groundwater Containment System	Provide collection and conveyance of Category 1 Waste Rock Stockpile drainage. Sumps are permanent in nature; long-term use.	1. Manhole to provide collection for pump and piping system. 2. Conveyance along the groundwater containment system and overflow pipes to the East and West Pit are based on gravity flow of the 100-year, 24-hour event plus groundwater. 3. Pump capacity and pipe capacity from sump to equalization basins based on 1.5-inch, 24-hour storm event. 4. Overflow pipes to East and West Pit for flows in excess of pump capacity up to the 100-year, 24-hour event.	Drainage water quality from the stockpile will be commensurate with drainage from Category 1 waste rock runoff. The 100-year storm event was chosen for pipes as standard for an acknowledged but small hazard potential. An analysis of 30 years of local rainfall determined that the 1.5-inch event is exceeded, on average, one time per year. Therefore, this storm event was chosen based on optimization of operations and economics associated with pit pumping, treatment, and storage capacity. Overflow from this system will be routed to the pits and captured.
Sump/Overflow Pond: Category 2/3 and 4 Waste Rock Stockpiles and Ore Surge Pile (OSP)	Provide storage for collection and conveyance of stockpile drainage. Sumps and ponds are temporary in nature; active during the life of mine.	1. Sumps to contain yield from 10-year, 24-hour event by gravity. 2. Overflow ponds to provide excess capacity up to the 100-year, 24-hour event by gravity. 3. Sumps and ponds to have 3-foot of freeboard between maximum water level (water level based on associated design storm) and top of dike. 4. Pump capacities based on average annual 30-day spring snowmelt flows (average annual peak runoff volume).	Drainage from the stockpile will be commensurate with drainage from the associated waste rock runoff. The 10-year storm event was chosen to handle the direct runoff based on an industrial stormwater pond design requirement. Overflow up to the 100-year storm event was chosen as standard for small impoundments with an acknowledged hazard potential, but considered low hazard (no downstream residents or development) (ICOLD 1982).
Sumps: Mine Pit	Provide storage of runoff and groundwater inflows for collection and conveyance. Sumps are temporary in nature; active during the life of mine.	1. Pit pump capacities are based on groundwater inflows plus peak flows from the annual snowmelt event, assuming a rapid spring snowmelt (40% of the snowmelt occurring within one day). This design results in removing the groundwater inflows and 40% of the annual snowmelt runoff (1.28 inches) within 3 days; the volume from this snowmelt event is approximately equivalent to the runoff volume expected from a 5-year, 24-hour storm event. The sumps are designed with capacity to hold the remaining volume from this snowmelt runoff event assuming pumps are operating. 2. Lowest pit level to act as sump overflow 3. Temporary in nature and continually moved with mine progression	Mine pit drainage water quality could be commensurate with drainage from Category 1 to Category 4 waste rock. Drainage within the pits will be fully contained within the sump or the lowest level of the pit. Pit sump and pump sizing was based on optimization of operations and economics associated with pit pumping, treatment, and storage.
Mine Water Pipes	Convey *mine water* to the Equalization Basin Area.	Pipes are designed to maintain velocities less than 5 feet per second.	

Structure	Objectives	Design Criteria and Assumptions	Design Rationale
Overflow Contingencies for Storm Events in Excess of the Design Storm	1. Minimize uncontrolled overflows of *mine water* from sumps and ponds. 2. Direct *mine water* away from stormwater features during events greater than design storm, if possible.	1. With the exception of the RTH pond, the sumps and ponds include three feet of freeboard as a factor of safety. The RTH pond includes one foot of freeboard and a larger pump to accommodate larger flows. 2. An emergency operational contingency plan includes use of temporary diesel pumps to operate during events greater than the design volume or under circumstances of extended power outages associated with heavy rainfall. This plan will maintain water levels below the total capacity of the sumps and ponds, pumping to the pits until mine water volumes are down to manageable levels. 3. If necessary, pumping priorities will be given based on the reactivity of the material drained, following these priorities in descending order: OSP sump SOSP and overflow pond MW-SOSP; Category 4 Waste Rock Stockpile sump S4 and overflow pond MW-S4; Category 2/3 Waste Rock Stockpile sumps and overflow ponds; RTH runoff pond MW-RTH; haul road runoff ponds MW-HRC, MW-HRE, MW-HRW, and MW-HRN; and OSLA runoff pond MW-OSLA. During this time, pit dewatering may cease, with water contained in the lower portions of the pits.	Additional contingency measures to mitigate hazards associated with flows in excess of the 100-year, 24-hour storm

ICOLD. 1982. Manual on Tailings Dams and Dumps. Bulletin 45. Published by the International Commission on Large Dams, Paris. (Reference (27))

Large Table 2 Design Criteria for Mine Site Stormwater Infrastructure

Structure	Objectives	Design Criteria	Rationale
Ditches	Convey runoff from reclaimed and natural areas within Mine Site to stormwater ponds	Contain and convey peak flows associated with 10-year, 24-hour storm event	Manage *stormwater* runoff
	Intercept *stormwater* prior to reaching mine water areas (pits, unreclaimed stockpiles, haul roads, etc.)	Size ditches and dikes to manage *stormwater* up to the 100-year, 24-hour storm event	Avoid *stormwater* mixing with *mine water* or contacting surfaces disturbed by mining activities
	Limit erosion	Install riprap, drop structures, or other best management practices (BMPs) in ditch sections where flow velocities are greater than 4 feet per second during the 100-year, 24-hour storm	Protect infrastructure and reduce total suspended solids (TSS) in runoff
Ponds	Control the conveyance of *stormwater* to the Partridge River to avoid significant localized increases in peak flows to the Partridge River or its tributaries	Provide storage and conveyance of peak flows and volumes associated with 10-year, 24-hour storm event through the primary pond outlet	Manage *stormwater* runoff
	Reduce TSS concentration in *stormwater* discharged from the Mine Site to the Partridge River	Size ponds to provide residence time needed to meet 100 mg/L TSS storm event benchmark limit for up to the 100-year, 24-hour storm event	Comply with expected individual permit requirements; 100 mg/L TSS benchmark limit as defined by the Minnesota NPDES/SDS Industrial Stormwater General Permit
	Manage *stormwater* runoff to avoid overflows into mine water areas	Size ponds to manage, control, and convey *stormwater* runoff up to the 100-year, 24-hour storm event, with an overflow weir in the northern ponds (Ponds A and B) to pass flows in excess of this design storm	Avoid *stormwater* mixing with *mine water* or contacting surfaces disturbed by mining activities
	In the event of a flood on the Partridge River, divert Partridge River floodwaters from flowing onto the Mine Site	Size exterior dikes and pond components (i.e., culverts and weirs) to convey the 100-year, 24-hour storm flows from Mine Site to the Partridge River when the Partridge River is at its 100-year flood level. Include check valves on the outlet culverts from the northern ponds (Ponds A and B) to block inflows from Partridge River flooding.	Mitigate potential hazards associated with Partridge River water flowing onto the Mine Site and mixing with *mine water* or contacting surfaces disturbed by mining activities
	Manage *stormwater* from the Mine Site in an event in excess of the design storm	During events in excess of the 100-year flood in the Partridge River, excess *stormwater* from the northern ponds (Ponds A and B) could be pumped to the stormwater ditch that flows south to Pond C or off-site using temporary portable pumps. If necessary, pumping priorities will be given to the stormwater pond with potential to overflow into the mine water systems.	Additional contingency measure to mitigate hazards associated with flows in excess of the 100-year, 24-hour storm

Large Table 3 Mine Site Chemical Additives

Chemical	Purpose	Location of chemical addition in process	Amount/ duration/ frequency of addition	Average rate of use	Maximum rate of use	Storage Location	Storage Capacity	Tank Description	Secondary Containment	Fate and Transport
Magnesium Chloride Aqueous Solution (Dustgard) (Primary)	Dust suppressant (one type to be applied; others are alternatives)	Haul roads and stockpiles, if needed	For average use: main roads will be sprayed twice per year and minor roads once per year For maximum use: roads will be sprayed 3 times per year	104,428 gallons/day (208,856 gallons/year)	104,428 gallons/day (313,284 gallons/year)	None - to be brought on-site and applied by a vendor.				This product binds to soils and because it is composed of, soluble salts may also become entrained in *stormwater*. Adherence to best management practices will limit the off-site transport of chemical additives. Optimization of application rates, application frequency, and the water dilution to product ratio will allow for the minimum amount of treatment needed to achieve successful dust suppression. Haul road runoff is captured as part of the mine water system.
Aqueous Amorphous Polymer Solution (BT-468) (Potential Substitute)	Dust suppressant (one type to be applied; others are alternatives)	Haul roads	For average use: main roads will be sprayed twice per year and minor roads once per year For maximum use: roads will be sprayed 3 times per year	104,428 gallons/day (208,856 gallons/year)	104,428 gallons/day (313,284 gallons/year)	None - to be brought on-site and applied by a vendor.				This product is comprised of organic components, and thus will biodegrade over time, while bound to soils or if it becomes entrained in *stormwater*. Adherence to best management practices will limit the off-site transport of chemical additives. Optimization of application rates, application frequency, and the water dilution to product ratio will allow for the minimum amount of treatment needed to achieve successful dust suppression. Haul road runoff is captured as part of the mine water system.
Roadsaver®-C (Potential Substitute)	Dust suppressant (one type to be applied; others are alternatives)	Haul roads	For average use: main roads will be sprayed twice per year and minor roads once per year For maximum use: roads will be sprayed 3 times per year	94,934 gallons/day (189,869 gallons/year)	94,934 gallons/day (284,803 gallons/year)	None - to be brought on-site and applied by a vendor.				This product binds to soils and because it is composed of, soluble salts may also become entrained in *stormwater*. Adherence to best management practices will limit the off-site transport of chemical additives. Optimization of application rates, application frequency, and the water dilution to product ratio will allow for the minimum amount of treatment needed to achieve successful dust suppression. Haul road runoff is captured as part of the mine water system.
Roadsaver® (Potential Substitute)	Dust suppressant (one type to be applied; others are alternatives)	Haul roads	For average use: main roads will be sprayed twice per year and minor roads once per year For maximum use: roads will be sprayed 3 times per year	104,428 gallons per day (208,856 gallons per year)	104,428 gallons per day (313,284 gallons per year)	None - to be brought on-site and applied by a vendor.				This product binds to soils and because it is composed of, soluble salts may also become entrained in *stormwater*. Adherence to best management practices will limit the off-site transport of chemical additives. Optimization of application rates, application frequency, and the water dilution to product ratio will allow for the minimum amount of treatment needed to achieve successful dust suppression. Haul road runoff is captured as part of the mine water system.
Durasoil (Potential Substitute)	Dust suppressant (one type to be applied; others are alternatives)	Haul roads	For average use: main roads will be sprayed twice per year and minor roads once per year For maximum use: roads will be sprayed 3 times per year	104,428 gallons/day (208,856 gallons/year)	104,428 gallons/day (313,284 gallon/year)	None - to be brought on-site and applied by a vendor.				This product binds to soils and because it is composed of, soluble salts may also become entrained in *stormwater*. Adherence to best management practices will limit the off-site transport of chemical additives. Optimization of application rates, application frequency, and the water dilution to product ratio will allow for the minimum amount of treatment needed to achieve successful dust suppression. Haul road runoff is captured as part of the mine water system.
Gorilla-Snot (Potential Substitute)	Dust suppressant (one type to be applied; others are alternatives)	Haul roads	For average use: main roads will be sprayed twice per year and minor roads once per year For maximum use: roads will be sprayed 3 times per year	104,428 gallons/day (208,856 gallons/year)	104,428 gallons/day (313,284 gallons/year)	None - to be brought on-site and applied by a vendor.				This product is comprised of organic components, and thus will biodegrade over time, while bound to soils or if it becomes entrained in *stormwater*. Adherence to best management practices will limit the off-site transport of chemical additives. Optimization of application rates, application frequency, and the water dilution to product ratio will allow for the minimum amount of treatment needed to achieve successful dust suppression. Haul road runoff is captured as part of the mine water system.

Chemical	Purpose	Location of chemical addition in process	Amount/ duration/ frequency of addition	Average rate of use	Maximum rate of use	Storage Location	Storage Capacity	Tank Description	Secondary Containment	Fate and Transport
Soiltac (Potential Substitute)	Dust suppressant (one type to be applied; others are alternatives)	Haul roads	For average use: main roads will be sprayed twice per year and minor roads once per year For maximum use: roads will be sprayed 3 times per year	52,214 gallons/day (104,428 gallons/year)	52,214 gallons/day (156,642 gallons/year)	None - to be brought on-site and applied by a vendor.				This product is comprised of organic components, and thus will biodegrade over time, while bound to soils or if it becomes entrained in *stormwater*. Adherence to best management practices will limit the off-site transport of chemical additives. Optimization of application rates, application frequency, and the water dilution to product ratio will allow for the minimum amount of treatment needed to achieve successful dust suppression. Haul road runoff is captured as part of the mine water system.
Coherex (Potential Substitute)	Dust suppressant (one type to be applied; others are alternatives)	Haul roads	For average use: main roads will be sprayed twice per year and minor roads once per year For maximum use: roads will be sprayed 3 times per year	104,428 gallons/day (208,856 gallons/year)	104,428 gallons/day (313,284 gallons/year)	None - to be brought on-site and applied by a vendor.				This product is comprised of organic components, and thus will biodegrade over time, while bound to soils or if it becomes entrained in *stormwater*. Adherence to best management practices will limit the off-site transport of chemical additives. Optimization of application rates, application frequency, and the water dilution to product ratio will allow for the minimum amount of treatment needed to achieve successful dust suppression. Haul road runoff is captured as part of the mine water system.
Calcium Chloride (Primary)	De-icer	Walkways, haul roads	No average use planned For maximum use: used, as needed, based on recommended application rates (if needed, this will be a winter application)	NA	TBD based on recommended application rates	None planned - to be brought on-site as needed.				This product is a soluble substance and melts ice. It will be used in winter application, when *stormwater* is not moving. Adherence to best management practices will limit the off-site transport of chemical additives. Optimization of application rates and application frequency will allow for the minimum amount of treatment needed to achieve successful de-icing of the roads. Application areas (haul roads, Fueling and Maintenance Facility, etc.) runoff is captured as part of the mine water system.

Large Table 4 Mine Site Baseline Surface Water Quality Monitoring Summary

Water Quality Data for PM-1 / SW001 / SD009 1999-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, bicarbonate, as HCO3	NA	mg/l	21	83.4	126	97.7	92.2
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	10	84.3	106	94.6	93.2
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	NA	NA	NA	NA	NA
Carbon, total organic	NA	mg/l	8	1.80	2.40	2.13	2.15
Chemical Oxygen Demand	NA	mg/l	7	< 1	24	8.39	9.00
Chloride	NA	mg/l	31	0.9	21.05	6.73	6.41
Cyanide	NA	mg/l	4	< 0.02	< 0.02	NA	< 0.02
Dissolved oxygen	NA	mg/l	3	9.3	15.2	11.4	9.6
Fluoride	NA	mg/l	9	0.11	0.17	0.14	0.14
Hardness, as CaCO3	NA	mg/l	31	77.5	164.5	120	124
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	7	< 0.1	0.2	0.12	0.14
Nitrogen, ammonia, as N	NA	mg/l	80	0.025	0.28	0.05	< 0.1
Nitrogen, unionized ammonia, as N	NA	mg/l	76	0.0001	0.022	0.003	0.004
pH	NA	pH units	132	7.2	8.73	8	8
Phosphorus, total, as P	Dissolved	mg/l	1	< 0.02	NA	NA	< 0.02
Phosphorus, total, as P	NA	mg/l	8	< 0.004	0.14	0.063	< 0.1
Redox (oxidation potential)	NA	mV	NA	NA	NA	NA	NA
Solids, total dissolved	NA	mg/l	31	93	236	159	154
Solids, total suspended	NA	mg/l	44	< 1	3	1.07	< 1
Specific Conductance @ 25 °C	NA	µmhos/cm	31	209	393	282	296
Sulfate, as SO4	NA	mg/l	70	9.1	41.35	25.0	25.4
Temperature	NA	deg C	100	0.3	23.9	12.6	14.9
Turbidity	NA	NTU	130	0	3.1	0.92	0.90
Metals							
Aluminum	Dissolved	µg/l	NA	NA	NA	NA	NA
Aluminum	Total	µg/l	10	< 10	33.9	18.1	< 25
Antimony	Total	µg/l	4	< 3	< 3	NA	< 3
Arsenic	Dissolved	µg/l	NA	NA	NA	NA	NA
Arsenic	Total	µg/l	4	< 2	11.7	6.53	6.70
Barium	Total	µg/l	4	< 10	< 10	NA	< 10
Beryllium	Total	µg/l	4	< 0.2	< 0.2	NA	< 0.2
Boron	Total	µg/l	9	80.9	116	96.0	93.5
Cadmium	Total	µg/l	5	< 0.2	< 0.2	NA	< 0.2
Calcium	Total	mg/l	10	23.1	25.9	24.6	24.7
Chromium	Total	µg/l	5	< 0.5	< 1	NA	< 1
Cobalt	Dissolved	µg/l	NA	NA	NA	NA	NA
Cobalt	Total	µg/l	8	0.1	< 1	0.45	< 1
Copper	Dissolved	µg/l	NA	NA	NA	NA	NA
Copper	Total	µg/l	10	< 0.66	< 5	1.72	1.65
Iron	Dissolved	µg/l	70	< 30	76	30.9	< 50
Iron	Total	µg/l	7	0.06	50	27	< 30
Lead	Total	µg/l	10	0.054	< 1	0.32	0.45
Magnesium	Total	mg/l	10	9.58	11	10.4	10.5
Manganese	Dissolved	µg/l	NA	NA	NA	NA	NA
Manganese	Total	µg/l	8	3.4	10	7.93	10.0
Mercury	Total	ng/l	33	< 0.5	< 10	1.11	0.70
Methyl Mercury	Total	ng/l	1	< 0.1	NA	NA	< 0.1
Molybdenum	Dissolved	µg/l	NA	NA	NA	NA	NA
Molybdenum	Total	µg/l	5	2	< 5	2.80	< 5
Nickel	Dissolved	µg/l	NA	NA	NA	NA	NA
Nickel	Total	µg/l	10	< 0.6	< 5	1.59	1.20
Palladium	Total	µg/l	5	< 0.3	< 25	NA	< 25
Platinum	Total	µg/l	5	< 0.25	< 25	NA	< 25
Potassium	Total	mg/l	7	2.38	3	2.65	2.70
Selenium	Total	µg/l	9	< 1	< 10	NA	< 3.6
Silver	Total	µg/l	9	< 0.2	< 1	NA	< 0.24
Sodium	Total	mg/l	9	4.1	5.7	4.78	4.8
Strontium	Total	µg/l	4	148	161	157	159
Thallium	Total	µg/l	9	< 0.4	< 2	0.60	0.63
Tin	Total	µg/l	NA	NA	NA	NA	NA
Titanium	Total	µg/l	1	< 10	NA	NA	< 10
Vanadium	Total	µg/l	NA	NA	NA	NA	NA
Zinc	Dissolved	µg/l	NA	NA	NA	NA	NA
Zinc	Total	µg/l	10	0.94	29	8.85	< 10

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for PM-2 / SW002 2004-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	28	43.2	192	122	119
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	25	35.7	192	108	111
Biochemical Oxygen Demand (5-day)	NA	mg/l	1	< 3	NA	NA	< 3
Carbon, dissolved organic	NA	mg/l	1	NA	NA	6.9	6.9
Carbon, total organic	NA	mg/l	51	4	25.9	9.83	8.70
Chemical Oxygen Demand	NA	mg/l	15	< 10	65.5	31.0	25.7
Chloride	NA	mg/l	53	0.7	55.2	27.3	33.8
Cyanide	NA	mg/l	4	< 0.02	< 0.02	NA	< 0.02
Dissolved oxygen	NA	mg/l	58	< 0.1	13.37	7.39	7.22
Fluoride	NA	mg/l	9	< 0.1	0.17	0.11	0.12
Hardness, as CaCO3	NA	mg/l	53	38.5	228	145	163
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	15	< 0.1	2	0.22	< 0.1
Nitrogen, ammonia, as N	NA	mg/l	12	< 0.1	2.5	0.44	< 0.1
pH	NA	pH units	66	6.12	8.09	7.16	7.20
Phosphorus, total, as P	Dissolved	mg/l	1	< 0.02	NA	NA	< 0.02
Phosphorus, total, as P	NA	mg/l	15	< 0.004	0.2	0.049	0.083
Redox (oxidation potential)	NA	mV	13	381	809	513	496
Solids, total dissolved	NA	mg/l	53	78	422	250	288
Solids, total suspended	NA	mg/l	9	< 1	15	3.35	< 1
Specific Conductance @ 25 °C	NA	µmhos/cm	66	0	555.1	362	411
Sulfate, as SO4	NA	mg/l	65	0.13	108	38.3	38.6
Temperature	NA	deg C	65	0.19	22.67	9.53	7.17
Turbidity	NA	NTU	52	0	31.1	3.24	0.60
Metals							
Aluminum	Dissolved	µg/l	43	< 10	53.1	19.5	21.3
Aluminum	Total	µg/l	52	< 10	188	31.0	26.3
Antimony	Total	µg/l	26	< 0.5	< 3	NA	< 0.5
Arsenic	Dissolved	µg/l	18	< 0.22	1.4	0.51	< 0.5
Arsenic	Total	µg/l	48	0.41	2	0.57	< 0.5
Barium	Total	µg/l	18	< 10	36	17.3	16.6
Beryllium	Total	µg/l	18	< 0.2	< 0.2	NA	< 0.2
Boron	Total	µg/l	23	< 35	438	178	158
Cadmium	Total	µg/l	18	< 0.2	< 0.2	NA	< 0.2
Calcium	Total	mg/l	53	11.9	45.9	29.4	31.4
Chromium	Total	µg/l	18	< 1	1.5	0.56	< 1
Cobalt	Dissolved	µg/l	29	< 0.2	0.78	0.25	0.22
Cobalt	Total	µg/l	50	< 0.2	< 1	0.26	0.21
Copper	Dissolved	µg/l	29	< 0.5	1.3	0.52	0.52
Copper	Total	µg/l	52	< 0.5	5.9	0.79	0.63
Iron	Dissolved	µg/l	30	128	26900	3165	587
Iron	Total	µg/l	51	1.27	30700	2718	789
Lead	Total	µg/l	52	< 0.3	< 1	0.28	< 0.5
Magnesium	Total	mg/l	53	4.7	29.1	17.7	20.3
Manganese	Dissolved	µg/l	29	13.4	1130	320	103
Manganese	Total	µg/l	50	5.7	1100	275	98
Mercury	Total	ng/l	24	0.522	< 10	2.46	2.30
Methyl Mercury	Total	ng/l	NA	NA	NA	NA	NA
Molybdenum	Dissolved	µg/l	NA	NA	NA	NA	NA
Molybdenum	Total	µg/l	11	< 0.3	< 5	2.42	3.95
Nickel	Dissolved	µg/l	29	< 0.5	1.5	0.31	< 0.5
Nickel	Total	µg/l	52	< 0.5	< 5	0.55	< 0.5
Palladium	Total	µg/l	5	< 0.3	< 25	NA	< 25
Platinum	Total	µg/l	5	< 0.25	< 25	NA	< 25
Potassium	Total	mg/l	22	1.72	5.2	3.39	3.80
Selenium	Total	µg/l	38	< 1	< 10	NA	< 1
Silver	Total	µg/l	16	< 0.2	< 1	NA	< 0.2
Sodium	Total	mg/l	24	2.2	40.5	18.3	13.1
Strontium	Total	µg/l	4	67.2	156	111	111
Thallium	Total	µg/l	38	< 0.0004	< 2	0.14	0.01
Tin	Total	µg/l	NA	NA	NA	NA	NA
Titanium	Total	µg/l	1	< 10	NA	NA	< 10
Vanadium	Total	µg/l	7	< 3	< 3	NA	< 3
Zinc	Dissolved	µg/l	29	< 6	7.2	3.34	< 6
Zinc	Total	µg/l	52	< 6	26.5	4.28	< 6

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for PM-3 / SW003 2004-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	27	29.4	125	89.7	97.2
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	40	36.6	151	84.3	88.8
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	NA	NA	NA	NA	NA
Carbon, total organic	NA	mg/l	66	3.1	40.8	12.3	10.1
Chemical Oxygen Demand	NA	mg/l	14	< 10	82.4	38.2	35.8
Chloride	NA	mg/l	68	2.4	28.3	9.74	9.20
Cyanide	NA	mg/l	4	< 0.02	< 0.02	NA	< 0.02
Dissolved oxygen	NA	mg/l	64	< 0.1	13.86	9.59	10.2
Fluoride	NA	mg/l	21	< 0.1	0.17	0.09	0.10
Hardness, as CaCO3	NA	mg/l	68	35.7	140	100	109
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	14	< 0.1	0.88	0.20	< 0.1
Nitrogen, ammonia, as N	NA	mg/l	11	< 0.1	0.45	0.13	< 0.1
pH	NA	pH units	72	5.98	8.15	7.40	7.48
Phosphorus, total, as P	Dissolved	mg/l	1	< 0.02	NA	NA	< 0.02
Phosphorus, total, as P	NA	mg/l	30	< 0.004	0.18	0.041	< 0.1
Redox (oxidation potential)	NA	mV	NA	NA	NA	NA	NA
Solids, total dissolved	NA	mg/l	68	75	267	168	175
Solids, total suspended	NA	mg/l	10	< 1	6	2.80	2.80
Specific Conductance @ 25 ºC	NA	μmhos/cm	72	80.6	368	226	233
Sulfate, as SO4	NA	mg/l	68	0.41	49.3	16.3	15.9
Temperature	NA	deg C	71	0.2	24.2	10.1	9.2
Turbidity	NA	NTU	53	0	50.8	3.63	1.60
Metals							
Aluminum	Dissolved	μg/l	48	10.1	150	39.4	25.8
Aluminum	Total	μg/l	60	< 20	188	56.2	< 40
Antimony	Total	μg/l	26	< 0.5	< 3	NA	< 0.5
Arsenic	Dissolved	μg/l	17	< 0.5	2.2	0.83	0.86
Arsenic	Total	μg/l	47	< 0.5	2.4	0.95	0.94
Barium	Total	μg/l	18	< 10	17.2	11.4	12.5
Beryllium	Total	μg/l	18	< 0.2	< 0.2	NA	< 0.2
Boron	Total	μg/l	23	< 35	239	103	< 100
Cadmium	Total	μg/l	21	0.054	< 0.2	0.10	< 0.2
Calcium	Total	mg/l	68	9.4	33.1	23.1	25.2
Chromium	Total	μg/l	21	0.24	1.4	0.57	< 1
Cobalt	Dissolved	μg/l	29	< 0.2	0.41	0.13	< 0.2
Cobalt	Total	μg/l	68	0.14	< 1	0.26	< 0.2
Copper	Dissolved	μg/l	29	< 0.5	1.5	0.70	0.63
Copper	Total	μg/l	70	0.45	< 5	0.98	< 0.8
Iron	Dissolved	μg/l	29	215	3080	972	796
Iron	Total	μg/l	50	1.45	3840	1458	1265
Lead	Total	μg/l	55	0.14	< 1	0.27	< 0.5
Magnesium	Total	mg/l	68	4.3	15.1	10.5	11.5
Manganese	Dissolved	μg/l	29	24.8	413	136	74
Manganese	Total	μg/l	53	30	430	144	95
Mercury	Total	ng/l	39	< 0.5	< 10	2.69	2.46
Methyl Mercury	Total	ng/l	9	0.061	0.492	0.26	0.28
Molybdenum	Dissolved	μg/l	NA	NA	NA	NA	NA
Molybdenum	Total	μg/l	14	0.8	< 5	1.98	1.75
Nickel	Dissolved	μg/l	29	< 0.5	1.4	0.49	< 0.5
Nickel	Total	μg/l	70	0.24	< 5	0.93	0.68
Palladium	Total	μg/l	5	< 0.3	< 25	NA	< 25
Platinum	Total	μg/l	5	< 0.25	< 25	NA	< 25
Potassium	Total	mg/l	21	1.7	3.7	2.61	2.70
Selenium	Total	μg/l	38	< 1	< 10	NA	< 1
Silver	Total	μg/l	16	< 0.2	< 1	NA	< 0.2
Sodium	Total	mg/l	23	2.3	25.2	8.04	7.02
Strontium	Total	μg/l	4	59.6	137	94.5	90.8
Thallium	Total	μg/l	38	< 0.0004	< 2	0.14	< 0.005
Tin	Total	μg/l	NA	NA	NA	NA	NA
Titanium	Total	μg/l	1	< 10	NA	NA	< 10
Vanadium	Total	μg/l	7	< 3	< 3	NA	< 3
Zinc	Dissolved	μg/l	29	< 6	16.3	4.01	< 6
Zinc	Total	μg/l	70	2.1	52.7	7.11	< 6

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for PM-16 / SW004 2004-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	30	20.8	123	80.5	87.9
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	41	27.3	853	95.3	81.5
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	NA	NA	NA	NA	NA
Carbon, total organic	NA	mg/l	68	3.6	36.2	14.9	13.0
Chemical Oxygen Demand	NA	mg/l	16	< 10	93.7	41.9	35.5
Chloride	NA	mg/l	71	1.8	27.6	8.67	7.09
Cyanide	NA	mg/l	4	< 0.02	< 0.02	NA	< 0.02
Dissolved oxygen	NA	mg/l	63	< 0.1	14.81	8.94	9.49
Fluoride	NA	mg/l	24	< 0.1	0.17	0.10	< 0.1
Hardness, as CaCO3	NA	mg/l	74	30.2	149	93.4	105
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	16	< 0.1	0.82	0.17	0.11
Nitrogen, ammonia, as N	NA	mg/l	13	< 0.05	0.38	0.12	< 0.1
pH	NA	pH units	71	5.6	8.31	7.38	7.45
Phosphorus, total, as P	Dissolved	mg/l	1	< 0.02	NA	NA	< 0.02
Phosphorus, total, as P	NA	mg/l	32	< 0.004	0.1	0.041	< 0.1
Redox (oxidation potential)	NA	mV	3	211	446	324	315
Solids, total dissolved	NA	mg/l	70	66	314	162	164
Solids, total suspended	NA	mg/l	12	< 1	11	3.82	3.60
Specific Conductance @ 25 °C	NA	µmhos/cm	70	71.8	354	213	231
Sulfate, as SO4	NA	mg/l	74	< 1	34	14.5	13.2
Temperature	NA	deg C	70	0.04	26.27	10.8	9.70
Turbidity	NA	NTU	52	0	131	6.06	2.35
Metals							
Aluminum	Dissolved	µg/l	48	15.8	159	49.0	36.5
Aluminum	Total	µg/l	61	17.7	4600	150	60.4
Antimony	Total	µg/l	26	< 0.5	< 3	NA	< 0.5
Arsenic	Dissolved	µg/l	18	< 0.5	1.8	0.78	0.69
Arsenic	Total	µg/l	52	0.46	6.4	1.03	0.94
Barium	Total	µg/l	20	< 10	16.3	9.93	10.9
Beryllium	Total	µg/l	20	< 0.2	< 0.2	NA	< 0.2
Boron	Total	µg/l	25	< 35	223	100	< 100
Cadmium	Total	µg/l	23	< 0.02	< 0.2	0.09	< 0.2
Calcium	Total	mg/l	74	7	35.8	21.2	23.7
Chromium	Total	µg/l	23	0.19	2.5	0.73	< 1
Cobalt	Dissolved	µg/l	31	< 0.2	0.91	0.21	< 0.2
Cobalt	Total	µg/l	70	0.13	8.5	0.43	0.24
Copper	Dissolved	µg/l	31	< 0.5	2	0.97	0.79
Copper	Total	µg/l	72	0.43	7.8	1.42	1.10
Iron	Dissolved	µg/l	30	521	3310	1186	1003
Iron	Total	µg/l	52	1.41	29100	2083	1350
Lead	Total	µg/l	57	< 0.03	2.4	0.29	< 0.5
Magnesium	Total	mg/l	74	3.5	15.6	9.92	11.05
Manganese	Dissolved	µg/l	30	33.8	2150	190	120
Manganese	Total	µg/l	55	11.3	6480	244	125
Mercury	Total	ng/l	41	< 0.5	< 10	3.15	3.00
Methyl Mercury	Total	ng/l	11	< 0.056	0.89	0.39	0.36
Molybdenum	Dissolved	µg/l	NA	NA	NA	NA	NA
Molybdenum	Total	µg/l	16	0.64	< 5	1.72	1.60
Nickel	Dissolved	µg/l	31	< 0.5	2	0.66	< 0.5
Nickel	Total	µg/l	72	0.3	7.3	1.26	1.05
Palladium	Total	µg/l	5	< 0.3	< 25	NA	< 25
Platinum	Total	µg/l	5	< 0.25	< 25	NA	< 25
Potassium	Total	mg/l	23	1.4	4.02	2.37	2.42
Selenium	Total	µg/l	41	0.29	< 3.6	0.67	< 1
Silver	Total	µg/l	18	< 0.2	< 1	NA	< 0.2
Sodium	Total	mg/l	25	1.9	20.2	7.75	6.90
Strontium	Total	µg/l	6	45.2	224	110	109
Thallium	Total	µg/l	44	< 0.0004	< 2	0.13	< 0.005
Tin	Total	µg/l	2	< 0.5	< 0.5	NA	< 0.5
Titanium	Total	µg/l	1	< 10	NA	NA	< 10
Vanadium	Total	µg/l	7	< 3	< 3	NA	< 3
Zinc	Dissolved	µg/l	31	< 6	8.7	3.61	< 6
Zinc	Total	µg/l	72	1.9	78.7	8.09	< 6

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for SW004a 2010-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	31	15.9	118	70.4	76.1
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	20	24.3	114	72.2	77.1
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	NA	NA	NA	NA	NA
Carbon, total organic	NA	mg/l	48	4.3	48.3	17.5	14.9
Chemical Oxygen Demand	NA	mg/l	12	< 10	131	55.9	46.9
Chloride	NA	mg/l	48	1.6	24.2	7.72	6.45
Cyanide	NA	mg/l	NA	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	47	4.49	13.86	9.52	9.84
Fluoride	NA	mg/l	5	< 0.1	0.17	0.11	0.12
Hardness, as CaCO3	NA	mg/l	48	27.5	130	90.0	100
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	12	< 0.1	0.83	0.24	0.15
Nitrogen, ammonia, as N	NA	mg/l	12	< 0.05	0.41	0.14	0.11
pH	NA	pH units	47	6.41	8.18	7.30	7.30
Phosphorus, total, as P	NA	mg/l	12	< 0.004	0.098	0.029	0.024
Redox (oxidation potential)	NA	mV	3	170	405	292	300
Solids, total dissolved	NA	mg/l	48	75	222	168	174
Solids, total suspended	NA	mg/l	5	1.6	3.2	2.24	2.0
Specific Conductance @ 25 °C	NA	µmhos/cm	47	46.8	371	198	213
Sulfate, as SO4	NA	mg/l	48	4.8	30.8	14.1	12.3
Temperature	NA	deg C	47	0.13	27.24	11.1	9.7
Turbidity	NA	NTU	47	0	131.2	7.51	3.20
Metals							
Aluminum	Dissolved	µg/l	47	< 20	208	70.7	51.8
Aluminum	Total	µg/l	48	< 20	570	117	90.2
Antimony	Total	µg/l	22	< 0.5	< 0.5	NA	< 0.5
Arsenic	Dissolved	µg/l	18	< 0.5	2.3	0.85	0.78
Arsenic	Total	µg/l	48	< 0.5	2.9	0.95	0.85
Barium	Total	µg/l	19	< 10	18.7	10.8	11.1
Beryllium	Total	µg/l	19	< 0.2	< 0.2	NA	< 0.2
Boron	Total	µg/l	19	58.2	206	102	103
Cadmium	Total	µg/l	19	< 0.02	< 0.2	0.09	< 0.2
Calcium	Total	mg/l	48	5.4	29.6	19.9	22.1
Chromium	Total	µg/l	19	< 1	< 1	NA	< 1
Cobalt	Dissolved	µg/l	34	< 0.2	1.8	0.34	0.25
Cobalt	Total	µg/l	48	< 0.2	2.2	0.38	0.27
Copper	Dissolved	µg/l	34	< 0.5	4.3	1.15	1.03
Copper	Total	µg/l	48	< 0.5	9.1	1.53	1.20
Iron	Dissolved	µg/l	30	526	5180	1416	1065
Iron	Total	µg/l	48	479	6820	1919	1595
Lead	Total	µg/l	48	< 0.03	< 0.5	0.24	< 0.5
Magnesium	Total	mg/l	48	3.4	14.3	9.79	10.70
Manganese	Dissolved	µg/l	30	< 0.5	525	149	124
Manganese	Total	µg/l	48	13.2	687	152	112
Mercury	Total	ng/l	19	0.79	12.5	3.82	2.90
Methyl Mercury	Total	ng/l	5	0.26	0.78	0.58	0.62
Molybdenum	Dissolved	µg/l	NA	NA	NA	NA	NA
Molybdenum	Total	µg/l	12	0.5	1.74	1.11	1.15
Nickel	Dissolved	µg/l	34	< 0.5	3.4	1.00	0.79
Nickel	Total	µg/l	48	< 0.5	3.8	1.18	1.20
Palladium	Total	µg/l	NA	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA	NA
Potassium	Total	mg/l	19	1.48	3.95	2.40	2.30
Selenium	Total	µg/l	35	< 0.2	< 1	0.46	< 1
Silver	Total	µg/l	12	< 0.2	< 0.2	NA	< 0.2
Sodium	Total	mg/l	19	2.2	19.8	9.12	8.70
Strontium	Total	µg/l	5	83.5	218	143	155
Thallium	Total	µg/l	35	< 0.0004	< 0.2	0.02	0.01
Tin	Total	µg/l	5	< 0.5	< 0.5	NA	< 0.5
Titanium	Total	µg/l	NA	NA	NA	NA	NA
Vanadium	Total	µg/l	7	< 3	< 3	NA	< 3
Zinc	Dissolved	µg/l	34	< 6	16.3	4.34	< 6
Zinc	Total	µg/l	48	< 6	19.7	4.41	< 6

NA No data available.

(1) Field duplicates not included in count of samples.

(2) Minimum and maximum determined with non-detect samples at the detection limit.

(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.

(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for SW004b 2010, 2012-2014							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	12	27.7	104	61.9	65.9
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	12	27.7	104	61.9	65.9
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	NA	NA	NA	NA	NA
Carbon, total organic	NA	mg/l	27	6.4	66.2	21.3	17.4
Chemical Oxygen Demand	NA	mg/l	12	20.7	172	76.4	72.5
Chloride	NA	mg/l	27	1.6	17.4	5.38	4.10
Cyanide	NA	mg/l	NA	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	26	5.04	13.67	9.52	9.66
Fluoride	NA	mg/l	5	< 0.1	0.15	0.10	0.11
Hardness, as CaCO3	NA	mg/l	27	24.0	139	82.2	88.2
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	12	< 0.1	0.48	0.13	< 0.1
Nitrogen, ammonia, as N	NA	mg/l	12	< 0.05	0.32	0.13	< 0.1
pH	NA	pH units	26	6.20	7.93	7.20	7.26
Phosphorus, total, as P	NA	mg/l	12	< 0.004	0.047	0.024	0.024
Redox (oxidation potential)	NA	mV	1	NA	NA	441	441
Solids, total dissolved	NA	mg/l	27	74	217	154	155
Solids, total suspended	NA	mg/l	5	1.2	3.6	2.44	3.0
Specific Conductance @ 25 °C	NA	µmhos/cm	26	39.9	326.5	157	159
Sulfate, as SO4	NA	mg/l	27	4.2	25.1	11.2	10.6
Temperature	NA	deg C	26	0.92	25.01	10.9	7.1
Turbidity	NA	NTU	26	0	45.1	6.15	2.80
Metals							
Aluminum	Dissolved	µg/l	26	22.0	328	84.6	55.2
Aluminum	Total	µg/l	27	39.4	442	121	83
Antimony	Total	µg/l	15	< 0.5	< 0.5	NA	< 0.5
Arsenic	Dissolved	µg/l	10	< 0.5	2.0	0.75	0.67
Arsenic	Total	µg/l	27	< 0.5	3.2	0.91	0.83
Barium	Total	µg/l	12	7.37	14.6	8.53	< 10
Beryllium	Total	µg/l	12	< 0.2	< 0.2	NA	< 0.2
Boron	Total	µg/l	12	< 50	160	74.5	88.1
Cadmium	Total	µg/l	12	< 0.02	< 0.2	0.07	< 0.2
Calcium	Total	mg/l	27	4.6	30.6	17.7	18.7
Chromium	Total	µg/l	12	< 1	1.2	0.56	< 1
Cobalt	Dissolved	µg/l	26	< 0.2	1.9	0.35	0.26
Cobalt	Total	µg/l	27	< 0.2	2.1	0.42	0.29
Copper	Dissolved	µg/l	26	0.54	7.0	1.59	1.40
Copper	Total	µg/l	27	0.55	2.8	1.39	1.22
Iron	Dissolved	µg/l	22	603	4190	1652	1225
Iron	Total	µg/l	27	1040	6580	2442	1990
Lead	Total	µg/l	27	0.13	0.51	0.26	< 0.5
Magnesium	Total	mg/l	27	3	15.2	9.24	9.90
Manganese	Dissolved	µg/l	22	18.6	512	135	109
Manganese	Total	µg/l	27	44.3	544	145	117
Mercury	Total	ng/l	12	0.82	18.5	5.10	3.90
Methyl Mercury	Total	ng/l	5	0.28	0.67	0.51	0.51
Molybdenum	Dissolved	µg/l	NA	NA	NA	NA	NA
Molybdenum	Total	µg/l	12	0.30	1.5	0.72	0.65
Nickel	Dissolved	µg/l	26	< 0.5	4.2	1.37	1.05
Nickel	Total	µg/l	27	< 0.5	4.4	1.49	1.20
Palladium	Total	µg/l	NA	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA	NA
Potassium	Total	mg/l	12	0.69	3.12	1.73	1.83
Selenium	Total	µg/l	27	< 0.2	5.0	0.62	< 1
Silver	Total	µg/l	12	< 0.2	< 0.2	NA	< 0.2
Sodium	Total	mg/l	12	2.7	14.9	6.55	5.35
Strontium	Total	µg/l	5	40.8	156	94.5	113.0
Thallium	Total	µg/l	28	< 0.0004	0.030	0.01	0.01
Tin	Total	µg/l	5	< 0.5	< 0.5	NA	< 0.5
Titanium	Total	µg/l	NA	NA	NA	NA	NA
Vanadium	Total	µg/l	7	< 3	< 3	NA	< 3
Zinc	Dissolved	µg/l	26	< 6	22.3	5.06	< 6
Zinc	Total	µg/l	27	< 6	23.6	4.59	< 6

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for PM-4 / SW005 2004-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	30	5.8	137	57.0	58.2
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	42	< 0	137	56.0	48.65
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	NA	NA	NA	NA	NA
Carbon, total organic	NA	mg/l	68	6.3	72.7	21.9	20.7
Chemical Oxygen Demand	NA	mg/l	16	20.9	185	68.7	54.2
Chloride	NA	mg/l	71	0.83	20.3	5.07	4.1
Cyanide	NA	mg/l	4	< 0.02	< 0.02	NA	< 0.02
Dissolved oxygen	NA	mg/l	64	< 0.1	13.32	8.37	9.12
Fluoride	NA	mg/l	24	< 0.1	< 5	0.32	0.11
Hardness, as CaCO3	NA	mg/l	74	16.9	118	69.4	72.5
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	16	< 0.1	0.44	0.14	0.11
Nitrogen, ammonia, as N	NA	mg/l	13	< 0.05	0.35	0.11	0.11
pH	NA	pH units	72	6	8.45	7.49	7.59
Phosphorus, total, as P	Dissolved	mg/l	1	< 0.02	NA	NA	< 0.02
Phosphorus, total, as P	NA	mg/l	32	< 0	< 10	0.28	< 0.1
Redox (oxidation potential)	NA	mV	2	453	457	455	455
Solids, total dissolved	NA	mg/l	70	49	340	147	149
Solids, total suspended	NA	mg/l	12	< 1	10	4.01	2.0
Specific Conductance @ 25 ºC	NA	µmhos/cm	72	15.6	258	143	140
Sulfate, as SO4	NA	mg/l	74	0.78	20	9.66	9.7
Temperature	NA	deg C	71	0.14	26.6	11.1	10.3
Turbidity	NA	NTU	53	0	58.3	6.51	4.5
Metals							
Aluminum	Dissolved	µg/l	48	20.4	355	94.1	68.3
Aluminum	Total	µg/l	61	29	1550	164	120
Antimony	Total	µg/l	26	< 0.5	< 3	NA	< 0.5
Arsenic	Dissolved	µg/l	17	0.49	2.2	0.83	0.63
Arsenic	Total	µg/l	52	< 0.5	3	1.02	1
Barium	Total	µg/l	20	8.01	20.1	7.49	< 10
Beryllium	Total	µg/l	20	< 0.2	< 0.2	NA	< 0.2
Boron	Total	µg/l	25	< 35	157	53.6	67.7
Cadmium	Total	µg/l	23	< 0.02	< 0.2	0.09	< 0.2
Calcium	Total	mg/l	74	3.9	25.5	14.8	15.0
Chromium	Total	µg/l	23	0.37	2.6	0.64	< 1
Cobalt	Dissolved	µg/l	30	< 0.2	2.4	0.35	0.22
Cobalt	Total	µg/l	70	< 0.2	< 25	0.87	0.38
Copper	Dissolved	µg/l	30	0.61	2.9	1.33	1.3
Copper	Total	µg/l	72	0.63	< 5	1.62	1.5
Iron	Dissolved	µg/l	29	548	5380	1808	1425
Iron	Total	µg/l	52	2.03	6200	2125	1880
Lead	Total	µg/l	57	0.14	12.3	0.68	< 0.5
Magnesium	Total	mg/l	74	2.7	13.4	7.96	8.34
Manganese	Dissolved	µg/l	29	24.5	577	107	75.2
Manganese	Total	µg/l	55	17.9	780	121	81.6
Mercury	Total	ng/l	41	< 0.5	18.4	4.31	< 4
Methyl Mercury	Total	ng/l	11	< 0.056	0.676	0.416	0.44
Molybdenum	Dissolved	µg/l	NA	NA	NA	NA	NA
Molybdenum	Total	µg/l	16	0.17	< 5	1.22	0.71
Nickel	Dissolved	µg/l	30	< 0.5	4.5	1.38	1
Nickel	Total	µg/l	72	0.46	< 5	1.68	1.5
Palladium	Total	µg/l	5	< 0.3	< 25	NA	< 25
Platinum	Total	µg/l	5	< 0.25	< 25	NA	< 25
Potassium	Total	mg/l	23	0.6	3.07	1.43	1.15
Selenium	Total	µg/l	40	0.36	< 3.6	0.70	< 1
Silver	Total	µg/l	18	< 0.2	< 1	NA	< 0.2
Sodium	Total	mg/l	25	1.2	14.3	4.66	3.90
Strontium	Total	µg/l	6	17.3	149	58.5	47.2
Thallium	Total	µg/l	44	< 0.0004	< 2	0.125	0.0065
Tin	Total	µg/l	2	< 0.5	< 0.5	NA	< 0.5
Titanium	Total	µg/l	1	< 10	NA	NA	< 10
Vanadium	Total	µg/l	7	< 3	< 3	NA	< 3
Zinc	Dissolved	µg/l	30	< 6	24.2	5.67	< 6
Zinc	Total	µg/l	72	< 0	82.9	8.51	< 6

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for WP-1 2011-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	23	< 5	87.5	8.55	8.40
Alkalinity, carbonate, as CaCO3	NA	mg/l	1	< 10	NA	NA	< 10
Alkalinity, total, as CaCO3	NA	mg/l	13	< 5	87.5	12.2	< 10
Biochemical Oxygen Demand (5-day)	NA	mg/l	1	< 4	NA	NA	< 4
Carbon, dissolved organic	NA	mg/l	1	NA	NA	28.4	28.4
Carbon, total organic	NA	mg/l	32	16.3	125	44.0	41.2
Chemical Oxygen Demand	NA	mg/l	7	80.9	355	179	147
Chloride	NA	mg/l	32	< 0.5	1.39	0.56	< 1
Cyanide	NA	mg/l	NA	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	32	< 0.1	12.85	5.95	6.07
Fluoride	NA	mg/l	1	< 0.1	NA	NA	< 0.1
Hardness, as CaCO3	NA	mg/l	31	11.8	85.8	22.6	20.3
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	7	< 0.1	0.25	0.12	0.11
Nitrogen, ammonia, as N	NA	mg/l	6	< 0.1	2.11	0.50	0.22
pH	NA	pH units	33	4.95	7.82	6.07	5.78
Phosphorus, total, as P	NA	mg/l	6	0.034	< 0.1	0.051	0.054
Redox (oxidation potential)	NA	mV	1	NA	NA	472	472
Solids, total dissolved	NA	mg/l	32	79	312	139	125
Solids, total suspended	NA	mg/l	1	NA	NA	6	6
Specific Conductance @ 25 °C	NA	µmhos/cm	33	0	72.3	30.7	29.0
Sulfate, as SO4	NA	mg/l	32	< 1	12.6	2.08	< 2
Temperature	NA	deg C	33	0.02	22.64	9.71	7.65
Turbidity	NA	NTU	33	0	22.3	3.35	0.90
Metals							
Aluminum	Dissolved	µg/l	31	78.4	1170	371	325
Aluminum	Total	µg/l	31	94.4	1200	390	354
Antimony	Total	µg/l	16	< 0.5	< 0.5	NA	< 0.5
Arsenic	Dissolved	µg/l	13	0.53	5.8	1.61	1.30
Arsenic	Total	µg/l	32	0.46	6	1.54	1.20
Barium	Total	µg/l	10	< 10	20.4	7.18	< 10
Beryllium	Total	µg/l	10	< 0.2	< 0.2	NA	< 0.2
Boron	Total	µg/l	10	< 50	< 100	NA	< 100
Cadmium	Total	µg/l	10	0.03	< 0.2	0.09	< 0.2
Calcium	Total	mg/l	32	2.1	18.2	4.42	3.80
Chromium	Total	µg/l	10	< 1	2	0.81	< 1
Cobalt	Dissolved	µg/l	20	0.51	6.92	1.51	0.91
Cobalt	Total	µg/l	31	0.31	6.6	1.27	0.80
Copper	Dissolved	µg/l	20	0.9	5.4	3.36	3.4
Copper	Total	µg/l	31	0.86	5.9	3.55	3.6
Iron	Dissolved	µg/l	21	1240	33900	5335	2900
Iron	Total	µg/l	32	908	35000	4901	2440
Lead	Total	µg/l	29	< 0.5	3.1	0.84	0.68
Magnesium	Total	mg/l	32	1.5	9.8	2.75	2.50
Manganese	Dissolved	µg/l	18	81.5	427	169	127
Manganese	Total	µg/l	32	40.6	2590	235	115
Mercury	Total	ng/l	12	5.1	28.1	12.4	10.5
Methyl Mercury	Total	ng/l	1	NA	NA	0.82	0.82
Molybdenum	Dissolved	µg/l	1	< 0.2	NA	NA	< 0.2
Molybdenum	Total	µg/l	7	< 0.2	0.34	0.17	< 0.2
Nickel	Dissolved	µg/l	20	2.4	22.1	6.72	5.07
Nickel	Total	µg/l	31	1.8	22.4	6.34	5.23
Palladium	Total	µg/l	NA	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA	NA
Potassium	Total	mg/l	13	0.116	1.8	0.52	0.46
Selenium	Total	µg/l	18	0.22	< 1	0.49	< 1
Silver	Total	µg/l	4	< 0.2	< 0.2	NA	< 0.2
Sodium	Total	mg/l	13	0.9	2.74	1.20	1.25
Strontium	Total	µg/l	1	NA	NA	20.3	20.3
Thallium	Total	µg/l	20	0.0022	< 0.2	0.026	0.006
Tin	Total	µg/l	NA	NA	NA	NA	NA
Titanium	Total	µg/l	1	< 10	NA	NA	< 10
Vanadium	Total	µg/l	4	< 3	< 10	4.33	9.3
Zinc	Dissolved	µg/l	20	< 6	16.1	8.50	9.0
Zinc	Total	µg/l	31	< 6	14.3	5.26	< 6

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for SW001b 2014-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	21	6	118	33.1	25.6
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	7	13.8	53	25.9	22.6
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	NA	NA	NA	NA	NA
Carbon, total organic	NA	mg/l	21	2.9	52.4	21.8	19.3
Chemical Oxygen Demand	NA	mg/l	NA	NA	NA	NA	NA
Chloride	NA	mg/l	21	< 1	1.9	0.70	< 1
Cyanide	NA	mg/l	NA	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	21	4.67	12.31	8.86	9.29
Fluoride	NA	mg/l	NA	NA	NA	NA	NA
Hardness, as CaCO3	NA	mg/l	21	15.4	123	38.5	27.8
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	NA	NA	NA	NA	NA
Nitrogen, ammonia, as N	NA	mg/l	NA	NA	NA	NA	NA
pH	NA	pH units	21	6.29	8.48	7.27	7.24
Phosphorus, total, as P	Dissolved	mg/l	NA	NA	NA	NA	NA
Phosphorus, total, as P	NA	mg/l	NA	NA	NA	NA	NA
Redox (oxidation potential)	NA	mV	NA	NA	NA	NA	NA
Solids, total dissolved	NA	mg/l	21	66	194	124	111
Solids, total suspended	NA	mg/l	NA	NA	NA	NA	NA
Specific Conductance @ 25 °C	NA	µmhos/cm	21	28	243.2	78.4	58.5
Sulfate, as SO4	NA	mg/l	21	< 2	17	1.89	< 2
Temperature	NA	deg C	21	1.74	22.91	10.2	7.3
Turbidity	NA	NTU	21	0	38.3	6.52	2.60
Metals							
Aluminum	Dissolved	µg/l	21	14.3	190	62.3	< 50
Aluminum	Total	µg/l	21	13.3	274	81.4	68.2
Antimony	Total	µg/l	7	< 0.5	< 0.5	NA	< 0.5
Arsenic	Dissolved	µg/l	7	< 0.5	2	0.97	0.78
Arsenic	Total	µg/l	21	0.44	4	1.44	0.92
Barium	Total	µg/l	7	< 10	14.9	8.04	< 10
Beryllium	Total	µg/l	7	< 0.2	< 0.2	NA	< 0.2
Boron	Total	µg/l	7	< 100	< 100	NA	< 100
Cadmium	Total	µg/l	7	< 0.2	< 0.2	NA	< 0.2
Calcium	Total	mg/l	21	3.4	30.7	9.04	6.30
Chromium	Total	µg/l	7	< 1	1.3	0.61	< 1
Cobalt	Dissolved	µg/l	7	< 0.2	0.54	0.27	< 0.2
Cobalt	Total	µg/l	21	< 0.2	0.74	0.29	< 0.2
Copper	Dissolved	µg/l	7	< 0.5	< 0.5	NA	< 0.5
Copper	Total	µg/l	21	< 0.5	4	0.50	< 0.5
Iron	Dissolved	µg/l	7	627	4500	1875	1380
Iron	Total	µg/l	21	339	11400	2601	1600
Lead	Total	µg/l	21	< 0.5	1.4	0.44	< 0.5
Magnesium	Total	mg/l	21	1.6	11.4	3.87	2.90
Manganese	Dissolved	µg/l	7	7.3	536	202	108
Manganese	Total	µg/l	21	5.2	667	196	102
Mercury	Total	ng/l	7	1.3	4.67	2.99	3.33
Methyl Mercury	Total	ng/l	NA	NA	NA	NA	NA
Molybdenum	Dissolved	µg/l	NA	NA	NA	NA	NA
Molybdenum	Total	µg/l	NA	NA	NA	NA	NA
Nickel	Dissolved	µg/l	7	< 0.5	0.79	0.38	< 0.5
Nickel	Total	µg/l	21	< 0.5	1	0.40	< 0.5
Palladium	Total	µg/l	NA	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA	NA
Potassium	Total	mg/l	7	0.258	1.9	0.90	0.85
Selenium	Total	µg/l	7	< 1	< 1	NA	< 1
Silver	Total	µg/l	NA	NA	NA	NA	NA
Sodium	Total	mg/l	7	0.89	1.9	1.26	1.2
Strontium	Total	µg/l	NA	NA	NA	NA	NA
Thallium	Total	µg/l	8	< 0.005	< 0.2	0.04	0.01
Tin	Total	µg/l	NA	NA	NA	NA	NA
Titanium	Total	µg/l	NA	NA	NA	NA	NA
Vanadium	Total	µg/l	NA	NA	NA	NA	NA
Zinc	Dissolved	µg/l	7	< 6	9	5.41	6.0
Zinc	Total	µg/l	21	< 6	11.4	3.93	< 6

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Large Table 5 Mine Site Groundwater Monitoring Stations

Current Monitoring Station ID (Local Name)	Proposed NPDES/SDS Station ID	Unique Well Number	Bedrock or Surficial Aquifer	Water Quality Monitoring Years	Well Location						Upgradient/Downgradient?	Average depth to water table (feet)	Installation Date
					UTM Easting	UTM Northing	Township	Range	Section	Forty	Current[1]		
MW-1	--	00786714	Surficial Aquifer	2011-2015	578783.97	5274724.09	59	13	2	NESE	Not applicable	4.20	October 2011
MW-2	GW402	00786713	Surficial Aquifer	2011-2015	576322.91	5272799.38	59	13	10	SWSW	Not applicable	7.79	October 2011
MW-3	GW403	00786717	Surficial Aquifer	2011-2015	579699.06	5273721.07	59	13	12	NENW	Not applicable	6.67	October 2011
MW-4	--	00786718	Surficial Aquifer	2011-2015	580179.60	5273586.12	59	13	12	SWNE	Not applicable	4.22	October 2011
MW-5	GW405	00786708	Surficial Aquifer	2011-2015	577505.09	5273223.38	59	13	10	NESE	Not applicable	11.21	October 2011
MW-6S	--	00786709	Surficial Aquifer	2011-2015	577496.82	5272901.76	59	13	10	SESE	Not applicable	8.20	October 2011
MW-6D	--	00786711	Surficial Aquifer	2011-2015	577496.94	5272903.04	59	13	10	NESE	Not applicable	7.71	October 2011
MW-7	GW407	00786726	Surficial Aquifer	2011-2015	578651.31	5273142.60	59	13	11	NWSE	Not applicable	4.72	October 2011
MW-8S	GW408	00786712	Surficial Aquifer	2011-2015	574655.20	5272483.25	59	13	9	SWSW	Not applicable	5.80	October 2011
MW-8D	--	00786728	Surficial Aquifer	2011-2015	574656.76	5272484.69	59	13	9	SWSW	Not applicable	6.02	December 2011
MW-9	--	00786715	Surficial Aquifer	2011-2015	579294.32	5275210.58	59	13	1	SWNW	Not applicable	5.21	December 2011
MW-10S	GW409	00786724	Surficial Aquifer	2011-2015	577735.75	5272548.82	59	13	11	SWSW	Not applicable	12.05	December 2011
MW-10D	--	00786725	Surficial Aquifer	2011-2015	577735.37	5272547.19	59	13	11	SWSW	Not applicable	15.36	December 2011
MW-11	GW411	00786710	Surficial Aquifer	2011-2015	577186.45	5272902.66	59	13	10	NESE	Not applicable	4.40	December 2011
MW-12	GW412	00786732	Surficial Aquifer	2012-2015	577352.77	5275230.72	59	13	3	SENE	Not applicable	3.72	February 2012
MW-13	--	00786720	Surficial Aquifer	2012-2015	580109.24	5275611.70	59	13	1	NWNE	Not applicable	5.22	February 2012
MW-14	GW414	00786730	Surficial Aquifer	2012-2015	574492.18	5273769.82	59	13	9	NWNW	Not applicable	2.08	February 2012
MW-15	GW415	00786731	Surficial Aquifer	2012-2015	575826.33	5274678.08	59	13	4	NESE	Not applicable	2.53	February 2012
MW-16	GW416	00786727	Surficial Aquifer	2012-2015	576583.73	5272121.62	59	13	15	NENW	Not applicable	3.78	February 2012
MW-17	GW417	00786719	Surficial Aquifer	2012-2015	580327.09	5274506.46	59	13	1	SESE	Not applicable	2.74	February 2012
MW-18	GW418	00786729	Surficial Aquifer	2012-2015	574994.18	5272958.45	59	13	9	NESW	Not applicable	5.03	February 2012
MW-05-02	--	0	Surficial Aquifer	2005, 2006, 2009-2015	578260.12	5273824.20	59	13	11	NENW	Not applicable	5.15	--
MW-05-08	--	0	Surficial Aquifer	2005, 2006, 2009-2015	575722.00	5272923.00	59	13	9	NESE	Not applicable	4.39	--
MW-05-09	--	0	Surficial Aquifer	2005, 2006, 2009-2015	575849.40	5274234.70	59	13	4	SESE	Not applicable	10.16	--
OB-1	GW507	00736121	Bedrock	2006, 2009-2015	576938.25	5274551.25	59	13	3	NWSE	Not applicable	12.09	December 2005
OB-2	--	00736120	Bedrock	2006, 2009-2015	578216.05	5275039.93	59	13	2	SENW	Not applicable	8.45	December 2005
OB-3	--	00736123	Bedrock	2006, 2007, 2009-2015	578710.35	5275261.27	59	13	2	SWNE	Not applicable	9.28	December 2005
OB-3A[2]	--	00736122	Bedrock	--	578711.30	5275263.51	59	13	2	SWNE	Not applicable	--	December 2005
OB-4	GW504	00736118	Bedrock	2006, 2009-2015	578892.80	5275408.75	59	13	2	NENE	Not applicable	14.47	December 2005
OB-5	GW505	00736119	Bedrock	2006, 2009-2015	579291.92	5275529.52	59	13	1	NWNW	Not applicable	10.86	December 2005

Current Monitoring Station ID (Local Name)	Proposed NPDES/SDS Station ID	Unique Well Number	Bedrock or Surficial Aquifer	Water Quality Monitoring Years	Well Location						Upgradient/Downgradient?	Average depth to water table (feet)	Installation Date
					UTM Easting	UTM Northing	Township	Range	Section	Forty	Current(1)		
P-1	--	00736114	Bedrock	2006	577016.34	5274604.39	59	13	3	NWSE	Not applicable	--	December 2005
P-2	--	00736115	Bedrock	2005, 2006	578294.14	5275068.52	59	13	2	SENW	Not applicable	--	December 2005
P-3	--	00736116	Bedrock	2006	578731.29	5275289.68	59	13	2	SWNE	Not applicable	--	December 2005
P-4	--	00736117	Bedrock	2005	579247.19	5275469.67	59	13	1	NWNW	Not applicable	--	December 2005

(1) Prior to permit issuance, mine features are not present, thus whether wells are upgradient or downgradient of Project features is not applicable. For information regarding well locations following Mine Year 1, refer to Volume I.
(2) Although this well exists, it is not included in the baseline groundwater monitoring network. This well is redundant with an adjacent groundwater monitoring well.

Large Table 6 Mine Site Baseline Groundwater Quality Monitoring Summary

Water Quality Data for MW-1 2011-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	20	80.5	118	90.0	87.9
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	14	1.9	4.15	2.95	2.80
Carbon, total organic	NA	mg/l	20	2	3.52	2.59	2.60
Chemical Oxygen Demand	NA	mg/l	14	< 10	24.6	9.20	< 10
Chloride	NA	mg/l	20	1.41	3	2.17	2.10
Cyanide	NA	mg/l	NA	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	20	0.02	8.45	1.46	1.66
Fluoride	NA	mg/l	20	0.14	0.25	0.19	0.19
Hardness, as CaCO3	NA	mg/l	20	76.9	107	85.1	84.4
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	20	< 0.1	< 0.1	NA	< 0.1
Nitrogen, ammonia, as N	NA	mg/l	20	< 0.1	0.19	0.12	0.12
pH	NA	pH units	26	8.2	10.02	8.88	8.86
Phosphorus, total, as P	NA	mg/l	NA	NA	NA	NA	NA
Redox (oxidation potential)	NA	mV	19	49	507	270	273
Solids, total dissolved	NA	mg/l	20	102	175	148	151
Specific Conductance @ 25 °C	NA	µmhos/cm	20	140	227.6	179	180
Sulfate, as SO4	NA	mg/l	20	5	6.81	6.07	6.30
Temperature	NA	deg C	20	1.25	12.63	7.96	9.04
Turbidity	NA	NTU	20	0	6.1	0.76	0
Metals							
Aluminum	Dissolved	µg/l	20	< 10	47.3	13.1	< 20
Aluminum	Total	µg/l	NA	NA	NA	NA	NA
Antimony	Dissolved	µg/l	20	< 0.5	< 0.5	NA	< 0.5
Antimony	Total	µg/l	NA	NA	NA	NA	NA
Arsenic	Dissolved	µg/l	20	< 0.5	1.25	0.84	0.92
Arsenic	Total	µg/l	NA	NA	NA	NA	NA
Barium	Dissolved	µg/l	6	4.5	6.3	5.33	5.1
Barium	Total	µg/l	14	7.7	25.3	11.9	10.9
Beryllium	Dissolved	µg/l	6	< 0.2	< 0.2	NA	< 0.2
Beryllium	Total	µg/l	14	< 0.2	< 0.2	NA	< 0.2
Boron	Dissolved	µg/l	6	< 100	< 100	NA	< 100
Boron	Total	µg/l	14	58.7	99.4	71.2	67.7
Cadmium	Dissolved	µg/l	20	< 0.2	< 0.2	NA	< 0.2
Cadmium	Total	µg/l	NA	NA	NA	NA	NA
Calcium	Total	mg/l	20	21	32.9	23.8	23.1
Chromium	Dissolved	µg/l	20	< 1	2	0.61	< 1
Chromium	Total	µg/l	NA	NA	NA	NA	NA
Cobalt	Dissolved	µg/l	20	< 0.2	< 0.5	NA	< 0.2
Cobalt	Total	µg/l	NA	NA	NA	NA	NA
Copper	Dissolved	µg/l	20	< 0.5	3.85	0.89	0.76
Copper	Total	µg/l	NA	NA	NA	NA	NA
Iron	Dissolved	µg/l	20	< 50	90.3	31.4	< 50
Iron	Total	µg/l	NA	NA	NA	NA	NA
Lead	Dissolved	µg/l	6	< 0.5	< 0.5	NA	< 0.5
Lead	Total	µg/l	14	< 0.5	< 0.5	NA	< 0.5
Magnesium	Total	mg/l	20	5.6	7.1	6.3	6.3
Manganese	Dissolved	µg/l	20	25.6	79.4	50.4	52.4
Manganese	Total	µg/l	NA	NA	NA	NA	NA
Mercury	Total	ng/l	20	< 0.5	0.95	0.29	< 0.5
Methyl Mercury	Total	ng/l	NA	NA	NA	NA	NA
Molybdenum	Dissolved	µg/l	20	0.74	4.57	1.33	1.10
Molybdenum	Total	µg/l	NA	NA	NA	NA	NA
Nickel	Dissolved	µg/l	20	< 0.5	2.53	0.61	0.53
Nickel	Total	µg/l	NA	NA	NA	NA	NA
Palladium	Total	µg/l	NA	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA	NA
Potassium	Total	mg/l	20	1.28	3.61	1.89	1.80
Selenium	Dissolved	µg/l	20	< 1	< 1	NA	< 1
Selenium	Total	µg/l	NA	NA	NA	NA	NA
Silver	Dissolved	µg/l	14	< 0.2	< 0.5	NA	< 0.2
Silver	Total	µg/l	NA	NA	NA	NA	NA
Sodium	Total	mg/l	20	5.9	10.7	7.38	7.30
Strontium	Total	µg/l	NA	NA	NA	NA	NA
Thallium	Dissolved	µg/l	6	< 0.02	< 0.2	NA	< 0.11
Thallium	Total	µg/l	14	< 0.017	< 0.2	NA	< 0.2
Titanium	Total	µg/l	NA	NA	NA	NA	NA
Vanadium	Dissolved	µg/l	14	< 5	< 10	NA	< 5
Zinc	Dissolved	µg/l	20	< 6	11.5	3.83	< 6
Zinc	Total	µg/l	NA	NA	NA	NA	NA

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for MW-2 2011-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	19	50.7	148	105	113
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	13	3.8	53.9	12.4	6.0
Carbon, total organic	NA	mg/l	19	2.1	57.6	8.84	4.85
Chemical Oxygen Demand	NA	mg/l	13	20.4	242	58.4	29.0
Chloride	NA	mg/l	19	< 0.5	1.29	0.62	< 1
Cyanide	NA	mg/l	NA	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	19	5.56	11.59	8.35	8.05
Fluoride	NA	mg/l	19	< 0.1	0.18	0.08	< 0.1
Hardness, as CaCO3	NA	mg/l	19	34.6	154	98.4	96.5
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	19	< 0.1	0.14	0.07	< 0.1
Nitrogen, ammonia, as N	NA	mg/l	19	< 0.05	0.59	0.09	< 0.1
pH	NA	pH units	25	6.51	8.13	7.18	7.1
Phosphorus, total, as P	NA	mg/l	NA	NA	NA	NA	NA
Redox (oxidation potential)	NA	mV	19	157	567	396	387
Solids, total dissolved	NA	mg/l	19	96	209	158	156
Specific Conductance @ 25 °C	NA	µmhos/cm	19	115.2	306.9	211	220.3
Sulfate, as SO4	NA	mg/l	19	2.1	17.5	6.69	6.65
Temperature	NA	deg C	19	3.14	23.45	11.7	11.1
Turbidity	NA	NTU	19	11.4	461	140	88.0
Metals							
Aluminum	Dissolved	µg/l	19	< 10	6510	367	23.0
Aluminum	Total	µg/l	NA	NA	NA	NA	NA
Antimony	Dissolved	µg/l	19	< 0.5	< 0.5	NA	< 0.5
Antimony	Total	µg/l	NA	NA	NA	NA	NA
Arsenic	Dissolved	µg/l	19	< 0.5	3.17	0.62	< 0.5
Arsenic	Total	µg/l	NA	NA	NA	NA	NA
Barium	Dissolved	µg/l	6	18.5	38.3	27.8	26.3
Barium	Total	µg/l	13	27.3	154	81.1	82.3
Beryllium	Dissolved	µg/l	6	< 0.2	< 0.2	NA	< 0.2
Beryllium	Total	µg/l	13	< 0.2	0.35	0.14	< 0.2
Boron	Dissolved	µg/l	6	< 100	< 100	NA	< 100
Boron	Total	µg/l	13	< 50	< 50	NA	< 50
Cadmium	Dissolved	µg/l	19	< 0.2	< 0.2	NA	< 0.2
Cadmium	Total	µg/l	NA	NA	NA	NA	NA
Calcium	Total	mg/l	19	8.6	37.4	25.0	25.3
Chromium	Dissolved	µg/l	19	< 1	19.3	1.83	< 1
Chromium	Total	µg/l	NA	NA	NA	NA	NA
Cobalt	Dissolved	µg/l	19	< 0.2	5.95	0.93	0.55
Cobalt	Total	µg/l	NA	NA	NA	NA	NA
Copper	Dissolved	µg/l	19	0.72	21	3.45	2.10
Copper	Total	µg/l	NA	NA	NA	NA	NA
Iron	Dissolved	µg/l	19	< 50	11600	695	< 50
Iron	Total	µg/l	NA	NA	NA	NA	NA
Lead	Dissolved	µg/l	6	< 0.5	< 0.5	NA	< 0.5
Lead	Total	µg/l	13	0.57	4.75	1.86	1.33
Magnesium	Total	mg/l	19	2.4	14.8	8.73	8.75
Manganese	Dissolved	µg/l	19	9.2	3280	834	770
Manganese	Total	µg/l	NA	NA	NA	NA	NA
Mercury	Total	ng/l	19	1.7	13	5.19	3.96
Methyl Mercury	Total	ng/l	NA	NA	NA	NA	NA
Molybdenum	Dissolved	µg/l	19	0.27	2.6	1.62	1.72
Molybdenum	Total	µg/l	NA	NA	NA	NA	NA
Nickel	Dissolved	µg/l	19	< 0.5	18.5	2.37	1.30
Nickel	Total	µg/l	NA	NA	NA	NA	NA
Palladium	Total	µg/l	NA	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA	NA
Potassium	Total	mg/l	19	2.39	8.2	4.02	3.50
Selenium	Dissolved	µg/l	19	< 1	< 1	NA	< 1
Selenium	Total	µg/l	NA	NA	NA	NA	NA
Silver	Dissolved	µg/l	13	< 0.2	< 0.2	NA	< 0.2
Silver	Total	µg/l	NA	NA	NA	NA	NA
Sodium	Total	mg/l	19	5.08	29.8	12.5	12.9
Strontium	Total	µg/l	NA	NA	NA	NA	NA
Thallium	Dissolved	µg/l	6	< 0.02	< 0.2	NA	< 0.11
Thallium	Total	µg/l	13	< 0.017	< 0.2	NA	< 0.2
Titanium	Total	µg/l	NA	NA	NA	NA	NA
Vanadium	Dissolved	µg/l	13	< 5	17.3	4.58	< 5
Zinc	Dissolved	µg/l	19	< 6	24.4	4.76	< 6
Zinc	Total	µg/l	NA	NA	NA	NA	NA

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for MW-3 2011-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	20	27.4	48.1	33.1	34.2
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	14	1.2	2.45	1.80	1.75
Carbon, total organic	NA	mg/l	20	< 1	2.3	1.37	1.3
Chemical Oxygen Demand	NA	mg/l	14	< 10	22	7.54	< 10
Chloride	NA	mg/l	20	< 0.5	< 1	NA	< 0.5
Cyanide	NA	mg/l	NA	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	20	4.64	7.61	6.16	6.13
Fluoride	NA	mg/l	20	< 0.1	0.1	0.05	< 0.1
Hardness, as CaCO3	NA	mg/l	20	31.2	45.5	37.4	38.5
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	20	0.29	0.75	0.46	0.43
Nitrogen, ammonia, as N	NA	mg/l	20	< 0.05	0.1	0.05	< 0.1
pH	NA	pH units	26	5.96	7.7	6.51	6.36
Phosphorus, total, as P	NA	mg/l	NA	NA	NA	NA	NA
Redox (oxidation potential)	NA	mV	20	285	591	422	401
Solids, total dissolved	NA	mg/l	20	68	139	101	100
Specific Conductance @ 25 °C	NA	µmhos/cm	20	49.7	113.3	82.8	82.5
Sulfate, as SO4	NA	mg/l	20	7.7	12.9	10.2	10.5
Temperature	NA	deg C	20	3.29	18.16	10.0	9.8
Turbidity	NA	NTU	20	0	19.6	2.49	1.10
Metals							
Aluminum	Dissolved	µg/l	20	< 10	< 200	13.1	< 20
Aluminum	Total	µg/l	NA	NA	NA	NA	NA
Antimony	Dissolved	µg/l	20	< 0.5	< 5	NA	< 0.5
Antimony	Total	µg/l	NA	NA	NA	NA	NA
Arsenic	Dissolved	µg/l	20	< 0.5	< 5	NA	< 0.5
Arsenic	Total	µg/l	NA	NA	NA	NA	NA
Barium	Dissolved	µg/l	6	12.2	14.2	13.3	13.5
Barium	Total	µg/l	14	14.7	28.3	17.8	16.8
Beryllium	Dissolved	µg/l	6	< 0.2	< 0.2	NA	< 0.2
Beryllium	Total	µg/l	14	< 0.2	< 0.2	NA	< 0.2
Boron	Dissolved	µg/l	6	< 100	< 100	NA	< 100
Boron	Total	µg/l	14	< 50	< 50	NA	< 50
Cadmium	Dissolved	µg/l	20	< 0.2	< 2	NA	< 0.2
Cadmium	Total	µg/l	NA	NA	NA	NA	NA
Calcium	Total	mg/l	20	6.9	10.8	8.69	9.10
Chromium	Dissolved	µg/l	20	< 1	< 10	0.97	< 1
Chromium	Total	µg/l	NA	NA	NA	NA	NA
Cobalt	Dissolved	µg/l	20	< 0.2	< 2	0.26	0.24
Cobalt	Total	µg/l	NA	NA	NA	NA	NA
Copper	Dissolved	µg/l	20	0.8	< 5	1.36	1.10
Copper	Total	µg/l	NA	NA	NA	NA	NA
Iron	Dissolved	µg/l	20	< 50	< 500	37.6	< 50
Iron	Total	µg/l	NA	NA	NA	NA	NA
Lead	Dissolved	µg/l	6	< 0.5	< 0.5	NA	< 0.5
Lead	Total	µg/l	14	< 0.5	0.54	0.28	< 0.5
Magnesium	Total	mg/l	20	3.3	4.51	3.82	3.90
Manganese	Dissolved	µg/l	20	1.7	166	52.5	51.3
Manganese	Total	µg/l	NA	NA	NA	NA	NA
Mercury	Total	ng/l	20	< 0.5	5.3	0.52	< 0.5
Methyl Mercury	Total	ng/l	NA	NA	NA	NA	NA
Molybdenum	Dissolved	µg/l	20	0.35	< 2	0.64	0.61
Molybdenum	Total	µg/l	NA	NA	NA	NA	NA
Nickel	Dissolved	µg/l	20	2.9	6.8	4.16	4.0
Nickel	Total	µg/l	NA	NA	NA	NA	NA
Palladium	Total	µg/l	NA	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA	NA
Potassium	Total	mg/l	20	0.96	1.8	1.38	1.39
Selenium	Dissolved	µg/l	20	< 1	< 10	NA	< 1
Selenium	Total	µg/l	NA	NA	NA	NA	NA
Silver	Dissolved	µg/l	14	< 0.2	< 2	NA	< 0.2
Silver	Total	µg/l	NA	NA	NA	NA	NA
Sodium	Total	mg/l	20	2.38	10.3	3.02	2.90
Strontium	Total	µg/l	NA	NA	NA	NA	NA
Thallium	Dissolved	µg/l	6	< 0.02	< 0.2	NA	< 0.2
Thallium	Total	µg/l	14	< 0.2	0.21	0.11	< 0.2
Titanium	Total	µg/l	NA	NA	NA	NA	NA
Vanadium	Dissolved	µg/l	14	< 5	< 50	NA	< 5
Zinc	Dissolved	µg/l	20	< 6	< 60	4.07	< 6
Zinc	Total	µg/l	NA	NA	NA	NA	NA

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for MW-4 2011-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	20	56.4	90.8	68.4	66.6
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	14	2.9	9.3	5.17	5.35
Carbon, total organic	NA	mg/l	20	1.8	10.2	5.94	5.5
Chemical Oxygen Demand	NA	mg/l	14	< 10	32.3	15.0	13.5
Chloride	NA	mg/l	20	< 0.5	< 1	0.46	0.62
Cyanide	NA	mg/l	NA	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	20	0.06	7.81	2.07	1.97
Fluoride	NA	mg/l	20	< 0.1	0.13	0.06	< 0.1
Hardness, as CaCO3	NA	mg/l	20	46.4	98.1	66.7	65.3
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	20	< 0.1	0.52	0.27	0.27
Nitrogen, ammonia, as N	NA	mg/l	20	0.06	0.28	0.12	< 0.1
pH	NA	pH units	26	6.1	7.9	6.65	6.61
Phosphorus, total, as P	NA	mg/l	NA	NA	NA	NA	NA
Redox (oxidation potential)	NA	mV	20	108	517	324	339
Solids, total dissolved	NA	mg/l	20	96	175	138	138
Specific Conductance @ 25 °C	NA	µmhos/cm	20	106.9	200.9	146	148.5
Sulfate, as SO4	NA	mg/l	20	6.2	11.3	8.26	7.9
Temperature	NA	deg C	20	2.46	19.11	10.1	9.11
Turbidity	NA	NTU	20	0	15.7	5.09	4.35
Metals							
Aluminum	Dissolved	µg/l	20	24.9	316	101	51.2
Aluminum	Total	µg/l	NA	NA	NA	NA	NA
Antimony	Dissolved	µg/l	20	< 0.5	< 0.5	NA	< 0.5
Antimony	Total	µg/l	NA	NA	NA	NA	NA
Arsenic	Dissolved	µg/l	20	< 0.5	< 0.65	0.28	< 0.5
Arsenic	Total	µg/l	NA	NA	NA	NA	NA
Barium	Dissolved	µg/l	6	11	20.1	14.4	12.5
Barium	Total	µg/l	14	18.2	34.2	27.0	27.7
Beryllium	Dissolved	µg/l	6	< 0.2	< 0.2	NA	< 0.2
Beryllium	Total	µg/l	14	< 0.2	< 0.2	NA	< 0.2
Boron	Dissolved	µg/l	6	< 100	< 100	NA	< 100
Boron	Total	µg/l	14	< 50	< 50	NA	< 50
Cadmium	Dissolved	µg/l	20	< 0.2	< 0.2	NA	< 0.2
Cadmium	Total	µg/l	NA	NA	NA	NA	NA
Calcium	Total	mg/l	20	10.4	29.7	14.5	13.0
Chromium	Dissolved	µg/l	20	< 1	< 4.5	0.79	< 1
Chromium	Total	µg/l	NA	NA	NA	NA	NA
Cobalt	Dissolved	µg/l	20	0.26	3.2	1.40	1.4
Cobalt	Total	µg/l	NA	NA	NA	NA	NA
Copper	Dissolved	µg/l	20	1.95	17.9	8.25	6.75
Copper	Total	µg/l	NA	NA	NA	NA	NA
Iron	Dissolved	µg/l	20	55.1	1150	519	447
Iron	Total	µg/l	NA	NA	NA	NA	NA
Lead	Dissolved	µg/l	6	< 0.5	< 0.5	NA	< 0.5
Lead	Total	µg/l	14	< 0.5	0.53	0.27	< 0.5
Magnesium	Total	mg/l	20	5	8.75	7.43	7.85
Manganese	Dissolved	µg/l	20	80.2	626	338	350
Manganese	Total	µg/l	NA	NA	NA	NA	NA
Mercury	Total	ng/l	20	< 0.5	3.8	1.87	1.85
Methyl Mercury	Total	ng/l	NA	NA	NA	NA	NA
Molybdenum	Dissolved	µg/l	20	0.86	2.8	1.75	1.75
Molybdenum	Total	µg/l	NA	NA	NA	NA	NA
Nickel	Dissolved	µg/l	20	1.74	7.6	4.85	4.75
Nickel	Total	µg/l	NA	NA	NA	NA	NA
Palladium	Total	µg/l	NA	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA	NA
Potassium	Total	mg/l	20	1.2	4.9	2.52	2.14
Selenium	Dissolved	µg/l	20	< 1	< 1	NA	< 1
Selenium	Total	µg/l	NA	NA	NA	NA	NA
Silver	Dissolved	µg/l	14	< 0.2	< 0.5	NA	< 0.2
Silver	Total	µg/l	NA	NA	NA	NA	NA
Sodium	Total	mg/l	20	3.1	10.3	5.71	4.22
Strontium	Total	µg/l	NA	NA	NA	NA	NA
Thallium	Dissolved	µg/l	6	< 0.02	< 0.2	NA	< 0.11
Thallium	Total	µg/l	14	< 0.017	< 0.2	NA	< 0.2
Titanium	Total	µg/l	NA	NA	NA	NA	NA
Vanadium	Dissolved	µg/l	14	< 5	< 10	NA	< 5
Zinc	Dissolved	µg/l	20	< 6	18.6	3.78	< 6
Zinc	Total	µg/l	NA	NA	NA	NA	NA

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for MW-5 2011-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	20	14.3	51.4	26.8	28.3
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	14	1.5	3.9	2.58	2.4
Carbon, total organic	NA	mg/l	20	1.2	5.1	2.36	2.2
Chemical Oxygen Demand	NA	mg/l	14	< 10	104	26.3	19.1
Chloride	NA	mg/l	20	< 0.5	1.1	0.46	0.55
Cyanide	NA	mg/l	NA	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	20	7.56	10.97	9.40	9.16
Fluoride	NA	mg/l	20	< 0.1	< 0.1	NA	< 0.1
Hardness, as CaCO3	NA	mg/l	20	10.9	164	56.3	49.3
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	20	< 0.1	0.16	0.08	< 0.1
Nitrogen, ammonia, as N	NA	mg/l	20	< 0.05	0.17	0.06	< 0.1
pH	NA	pH units	26	5.93	7.89	6.83	6.79
Phosphorus, total, as P	NA	mg/l	NA	NA	NA	NA	NA
Redox (oxidation potential)	NA	mV	20	184	515	367	392
Solids, total dissolved	NA	mg/l	20	41	136	84.5	83.0
Specific Conductance @ 25 °C	NA	µmhos/cm	20	0	122.6	57.7	53.4
Sulfate, as SO4	NA	mg/l	20	< 2	17.4	6.04	5.60
Temperature	NA	deg C	20	4.26	23.64	11.5	11.0
Turbidity	NA	NTU	20	47.7	2530	373	226
Metals							
Aluminum	Dissolved	µg/l	20	< 20	293	47.3	33.5
Aluminum	Total	µg/l	NA	NA	NA	NA	NA
Antimony	Dissolved	µg/l	20	< 0.5	< 0.5	NA	< 0.5
Antimony	Total	µg/l	NA	NA	NA	NA	NA
Arsenic	Dissolved	µg/l	20	< 0.5	1.5	0.33	< 0.5
Arsenic	Total	µg/l	NA	NA	NA	NA	NA
Barium	Dissolved	µg/l	6	5.2	10.3	8.00	8.6
Barium	Total	µg/l	14	7.5	615	140	58
Beryllium	Dissolved	µg/l	6	< 0.2	< 0.2	NA	< 0.2
Beryllium	Total	µg/l	14	< 0.2	1.6	0.36	< 0.2
Boron	Dissolved	µg/l	6	< 100	< 100	NA	< 100
Boron	Total	µg/l	14	< 50	< 50	NA	< 50
Cadmium	Dissolved	µg/l	20	< 0.2	< 0.2	NA	< 0.2
Cadmium	Total	µg/l	NA	NA	NA	NA	NA
Calcium	Total	mg/l	20	2.7	35.8	12.9	11.1
Chromium	Dissolved	µg/l	20	< 1	1.6	0.69	< 1
Chromium	Total	µg/l	NA	NA	NA	NA	NA
Cobalt	Dissolved	µg/l	20	< 0.2	1.9	0.24	< 0.2
Cobalt	Total	µg/l	NA	NA	NA	NA	NA
Copper	Dissolved	µg/l	20	0.6	2.8	1.60	1.4
Copper	Total	µg/l	NA	NA	NA	NA	NA
Iron	Dissolved	µg/l	20	< 50	775	97.3	51.2
Iron	Total	µg/l	NA	NA	NA	NA	NA
Lead	Dissolved	µg/l	6	< 0.5	< 0.5	NA	< 0.5
Lead	Total	µg/l	14	< 0.5	16.7	3.95	1.70
Magnesium	Total	mg/l	20	1	18.1	5.82	4.50
Manganese	Dissolved	µg/l	20	2.4	2400	153	25
Manganese	Total	µg/l	NA	NA	NA	NA	NA
Mercury	Total	ng/l	20	1.5	54.5	9.99	6.80
Methyl Mercury	Total	ng/l	NA	NA	NA	NA	NA
Molybdenum	Dissolved	µg/l	20	< 0.3	3.41	0.84	0.43
Molybdenum	Total	µg/l	NA	NA	NA	NA	NA
Nickel	Dissolved	µg/l	20	< 0.5	2.3	0.82	0.74
Nickel	Total	µg/l	NA	NA	NA	NA	NA
Palladium	Total	µg/l	NA	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA	NA
Potassium	Total	mg/l	20	1	8.6	2.99	2.5
Selenium	Dissolved	µg/l	20	< 1	< 1	NA	< 1
Selenium	Total	µg/l	NA	NA	NA	NA	NA
Silver	Dissolved	µg/l	14	< 0.2	< 0.5	NA	< 0.2
Silver	Total	µg/l	NA	NA	NA	NA	NA
Sodium	Total	mg/l	20	2.8	8.6	4.38	4.0
Strontium	Total	µg/l	NA	NA	NA	NA	NA
Thallium	Dissolved	µg/l	6	< 0.02	< 0.2	NA	0.11
Thallium	Total	µg/l	14	< 0.2	0.49	0.17	< 0.2
Titanium	Total	µg/l	NA	NA	NA	NA	NA
Vanadium	Dissolved	µg/l	14	< 5	< 10	NA	< 5
Zinc	Dissolved	µg/l	20	< 6	44.4	5.51	< 6
Zinc	Total	µg/l	NA	NA	NA	NA	NA

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for MW-6S 2011-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	20	64	91.6	79.0	80.7
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	14	1.5	3.4	2.28	2.0
Carbon, total organic	NA	mg/l	20	1.2	2.5	1.76	1.7
Chemical Oxygen Demand	NA	mg/l	14	< 10	17.6	7.14	< 10
Chloride	NA	mg/l	20	< 0.5	< 1	0.47	0.62
Cyanide	NA	mg/l	NA	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	20	0.01	6.33	2.40	1.88
Fluoride	NA	mg/l	20	< 0.1	0.12	0.06	< 0.1
Hardness, as CaCO3	NA	mg/l	20	67.9	98.5	84.7	85.8
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	20	< 0.1	< 0.1	NA	< 0.1
Nitrogen, ammonia, as N	NA	mg/l	20	< 0.05	< 0.1	NA	< 0.1
pH	NA	pH units	26	6.81	7.9	7.40	7.43
Phosphorus, total, as P	NA	mg/l	NA	NA	NA	NA	NA
Redox (oxidation potential)	NA	mV	20	142	526	352	342
Solids, total dissolved	NA	mg/l	20	99	179	137	134
Specific Conductance @ 25 °C	NA	µmhos/cm	20	0.1	195	160	171
Sulfate, as SO4	NA	mg/l	20	9.1	11.5	10.4	10.4
Temperature	NA	deg C	20	2.19	14.18	8.03	8.47
Turbidity	NA	NTU	20	0	12.5	1.87	0.35
Metals							
Aluminum	Dissolved	µg/l	20	< 10	30.9	12.6	< 20
Aluminum	Total	µg/l	NA	NA	NA	NA	NA
Antimony	Dissolved	µg/l	20	< 0.5	< 0.5	NA	< 0.5
Antimony	Total	µg/l	NA	NA	NA	NA	NA
Arsenic	Dissolved	µg/l	20	< 0.5	0.92	0.52	0.53
Arsenic	Total	µg/l	NA	NA	NA	NA	NA
Barium	Dissolved	µg/l	6	12.9	15.5	14.0	13.9
Barium	Total	µg/l	14	15.4	21.4	18.3	18.7
Beryllium	Dissolved	µg/l	6	< 0.2	< 0.2	NA	< 0.2
Beryllium	Total	µg/l	14	< 0.2	< 0.2	NA	< 0.2
Boron	Dissolved	µg/l	6	< 100	< 100	NA	< 100
Boron	Total	µg/l	14	< 50	< 50	NA	< 50
Cadmium	Dissolved	µg/l	20	< 0.2	< 0.2	NA	< 0.2
Cadmium	Total	µg/l	NA	NA	NA	NA	NA
Calcium	Total	mg/l	20	14.4	20.9	17.6	18.4
Chromium	Dissolved	µg/l	20	< 1	1.7	0.70	< 1
Chromium	Total	µg/l	NA	NA	NA	NA	NA
Cobalt	Dissolved	µg/l	20	< 0.2	0.5	0.19	0.20
Cobalt	Total	µg/l	NA	NA	NA	NA	NA
Copper	Dissolved	µg/l	20	0.66	3	1.07	0.90
Copper	Total	µg/l	NA	NA	NA	NA	NA
Iron	Dissolved	µg/l	20	< 50	79.4	30.5	< 50
Iron	Total	µg/l	NA	NA	NA	NA	NA
Lead	Dissolved	µg/l	6	< 0.5	< 0.5	NA	< 0.5
Lead	Total	µg/l	14	< 0.5	0.65	0.29	< 0.5
Magnesium	Total	mg/l	20	7.7	11.4	9.87	9.8
Manganese	Dissolved	µg/l	20	3.5	238	81.9	64.5
Manganese	Total	µg/l	NA	NA	NA	NA	NA
Mercury	Total	µg/l	20	< 0.5	0.924	0.44	< 0.5
Methyl Mercury	Total	µg/l	NA	NA	NA	NA	NA
Molybdenum	Dissolved	µg/l	20	0.95	4.1	2.33	2.3
Molybdenum	Total	µg/l	NA	NA	NA	NA	NA
Nickel	Dissolved	µg/l	20	< 0.5	1.92	0.62	0.51
Nickel	Total	µg/l	NA	NA	NA	NA	NA
Palladium	Total	µg/l	NA	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA	NA
Potassium	Total	mg/l	20	1.5	2.2	1.87	1.86
Selenium	Dissolved	µg/l	20	< 1	< 1	NA	< 1
Selenium	Total	µg/l	NA	NA	NA	NA	NA
Silver	Dissolved	µg/l	14	< 0.2	< 0.5	NA	< 0.2
Silver	Total	µg/l	NA	NA	NA	NA	NA
Sodium	Total	mg/l	20	3.8	11.2	4.57	4.12
Strontium	Total	µg/l	NA	NA	NA	NA	NA
Thallium	Dissolved	µg/l	6	< 0.02	< 0.2	NA	0.11
Thallium	Total	µg/l	14	< 0.2	0.24	0.11	< 0.2
Titanium	Total	µg/l	NA	NA	NA	NA	NA
Vanadium	Dissolved	µg/l	14	< 5	< 10	NA	< 5
Zinc	Dissolved	µg/l	20	< 6	7.2	3.37	< 6
Zinc	Total	µg/l	NA	NA	NA	NA	NA

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for MW-6D 2011-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	20	77.5	121	90.5	87.8
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	14	1.7	3.2	2.32	2.39
Carbon, total organic	NA	mg/l	20	1.4	3.2	1.97	1.9
Chemical Oxygen Demand	NA	mg/l	14	< 10	46.8	9.50	< 10
Chloride	NA	mg/l	20	< 0.5	< 1	0.44	0.58
Cyanide	NA	mg/l	NA	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	19	0.01	10.54	1.67	1.30
Fluoride	NA	mg/l	20	< 0.1	0.13	0.07	< 0.1
Hardness, as CaCO3	NA	mg/l	20	88.4	102	94.5	94.0
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	20	< 0.1	0.29	0.06	< 0.1
Nitrogen, ammonia, as N	NA	mg/l	20	< 0.05	0.1	0.05	< 0.1
pH	NA	pH units	25	7.25	8.1	7.79	7.88
Phosphorus, total, as P	NA	mg/l	NA	NA	NA	NA	NA
Redox (oxidation potential)	NA	mV	19	76	517	281	279
Solids, total dissolved	NA	mg/l	20	129	212	149	143
Specific Conductance @ 25 °C	NA	μmhos/cm	19	150.6	199.2	185	189
Sulfate, as SO4	NA	mg/l	20	9.6	11.4	10.2	10.2
Temperature	NA	deg C	19	2.85	10.38	7.24	6.91
Turbidity	NA	NTU	19	0	13.4	1.33	0
Metals							
Aluminum	Dissolved	μg/l	20	< 10	91.7	12.7	< 20
Aluminum	Total	μg/l	NA	NA	NA	NA	NA
Antimony	Dissolved	μg/l	20	< 0.5	< 0.5	NA	< 0.5
Antimony	Total	μg/l	NA	NA	NA	NA	NA
Arsenic	Dissolved	μg/l	20	< 0.5	1	0.72	0.73
Arsenic	Total	μg/l	NA	NA	NA	NA	NA
Barium	Dissolved	μg/l	6	14.9	16.1	15.3	15.2
Barium	Total	μg/l	14	16.4	36.7	22.8	22.1
Beryllium	Dissolved	μg/l	6	< 0.2	< 0.2	NA	< 0.2
Beryllium	Total	μg/l	14	< 0.2	< 0.2	NA	< 0.2
Boron	Dissolved	μg/l	6	< 100	< 100	NA	< 100
Boron	Total	μg/l	14	< 50	< 50	NA	< 50
Cadmium	Dissolved	μg/l	20	< 0.2	< 0.2	NA	< 0.2
Cadmium	Total	μg/l	NA	NA	NA	NA	NA
Calcium	Total	mg/l	20	18.1	22.3	20.0	20.1
Chromium	Dissolved	μg/l	20	< 1	< 4.5	0.62	< 1
Chromium	Total	μg/l	NA	NA	NA	NA	NA
Cobalt	Dissolved	μg/l	20	< 0.2	< 0.5	0.15	< 0.2
Cobalt	Total	μg/l	NA	NA	NA	NA	NA
Copper	Dissolved	μg/l	20	< 0.5	5.03	0.51	< 0.5
Copper	Total	μg/l	NA	NA	NA	NA	NA
Iron	Dissolved	μg/l	20	< 50	127	37.3	< 50
Iron	Total	μg/l	NA	NA	NA	NA	NA
Lead	Dissolved	μg/l	6	< 0.5	< 0.5	NA	< 0.5
Lead	Total	μg/l	14	< 0.5	1.43	0.33	< 0.5
Magnesium	Total	mg/l	20	9.26	12.3	10.8	10.6
Manganese	Dissolved	μg/l	20	95.6	180	136	152
Manganese	Total	μg/l	NA	NA	NA	NA	NA
Mercury	Total	ng/l	20	< 0.5	1.1	0.30	< 0.5
Methyl Mercury	Total	ng/l	NA	NA	NA	NA	NA
Molybdenum	Dissolved	μg/l	20	0.63	3.66	1.37	1.40
Molybdenum	Total	μg/l	NA	NA	NA	NA	NA
Nickel	Dissolved	μg/l	20	< 0.5	1.48	0.30	< 0.5
Nickel	Total	μg/l	NA	NA	NA	NA	NA
Palladium	Total	μg/l	NA	NA	NA	NA	NA
Platinum	Total	μg/l	NA	NA	NA	NA	NA
Potassium	Total	mg/l	20	1.8	2.33	1.96	1.90
Selenium	Dissolved	μg/l	20	< 1	< 1	NA	< 1
Selenium	Total	μg/l	NA	NA	NA	NA	NA
Silver	Dissolved	μg/l	14	< 0.2	< 0.5	NA	< 0.2
Silver	Total	μg/l	NA	NA	NA	NA	NA
Sodium	Total	mg/l	20	3.5	4.56	3.88	3.88
Strontium	Total	μg/l	NA	NA	NA	NA	NA
Thallium	Dissolved	μg/l	6	< 0.02	< 0.2	NA	< 0.2
Thallium	Total	μg/l	14	< 0.2	< 0.2	NA	< 0.2
Titanium	Total	μg/l	NA	NA	NA	NA	NA
Vanadium	Dissolved	μg/l	14	< 5	< 10	NA	< 5
Zinc	Dissolved	μg/l	20	< 6	6.3	3.08	< 6
Zinc	Total	μg/l	NA	NA	NA	NA	NA

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for MW-7 2011-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	20	31.6	59.6	37.6	35.7
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	14	1.1	3.4	2.05	2.1
Carbon, total organic	NA	mg/l	20	< 1	2.6	1.57	1.6
Chemical Oxygen Demand	NA	mg/l	14	< 10	16.4	8.16	< 10
Chloride	NA	mg/l	20	< 0.5	1.1	0.68	0.86
Cyanide	NA	mg/l	NA	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	20	0.03	9.64	1.90	1.61
Fluoride	NA	mg/l	20	< 0.1	0.1	0.05	< 0.1
Hardness, as CaCO3	NA	mg/l	20	37.8	65.3	43.3	41.0
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	20	< 0.1	0.17	0.06	< 0.1
Nitrogen, ammonia, as N	NA	mg/l	20	0.08	0.2	0.07	< 0.1
pH	NA	pH units	26	6.99	7.88	7.44	7.48
Phosphorus, total, as P	NA	mg/l	NA	NA	NA	NA	NA
Redox (oxidation potential)	NA	mV	20	148	624	332	325
Solids, total dissolved	NA	mg/l	20	< 10	114	81.8	81.5
Specific Conductance @ 25 °C	NA	µmhos/cm	20	48.1	102.2	85.9	85.7
Sulfate, as SO4	NA	mg/l	20	7.7	10.4	9.38	9.70
Temperature	NA	deg C	20	4.03	12.31	8.48	8.22
Turbidity	NA	NTU	20	0	16.5	2.43	0.3
Metals							
Aluminum	Dissolved	µg/l	20	< 10	68.1	19.0	< 20
Aluminum	Total	µg/l	NA	NA	NA	NA	NA
Antimony	Dissolved	µg/l	20	< 0.5	< 0.5	NA	< 0.5
Antimony	Total	µg/l	NA	NA	NA	NA	NA
Arsenic	Dissolved	µg/l	20	< 0.31	1.23	0.69	0.67
Arsenic	Total	µg/l	NA	NA	NA	NA	NA
Barium	Dissolved	µg/l	6	5.2	6.7	5.88	5.5
Barium	Total	µg/l	14	5.2	24.8	10.4	7.9
Beryllium	Dissolved	µg/l	6	< 0.2	< 0.2	NA	< 0.2
Beryllium	Total	µg/l	14	< 0.2	< 0.2	NA	< 0.2
Boron	Dissolved	µg/l	6	< 100	< 100	NA	< 100
Boron	Total	µg/l	14	< 50	< 50	NA	< 50
Cadmium	Dissolved	µg/l	20	< 0.2	< 0.2	NA	< 0.2
Cadmium	Total	µg/l	NA	NA	NA	NA	NA
Calcium	Total	mg/l	20	7.4	13.5	8.62	8.05
Chromium	Dissolved	µg/l	20	< 1	1.83	0.73	< 1
Chromium	Total	µg/l	NA	NA	NA	NA	NA
Cobalt	Dissolved	µg/l	20	< 0.2	1.02	0.22	0.20
Cobalt	Total	µg/l	NA	NA	NA	NA	NA
Copper	Dissolved	µg/l	20	< 0.5	29.8	3.37	1.66
Copper	Total	µg/l	NA	NA	NA	NA	NA
Iron	Dissolved	µg/l	20	< 50	662	87.0	50.8
Iron	Total	µg/l	NA	NA	NA	NA	NA
Lead	Dissolved	µg/l	6	< 0.5	< 0.5	NA	< 0.5
Lead	Total	µg/l	14	< 0.5	6.21	0.76	< 0.5
Magnesium	Total	mg/l	20	4.7	7.7	5.28	5.05
Manganese	Dissolved	µg/l	20	< 0.5	253	77.1	65.8
Manganese	Total	µg/l	NA	NA	NA	NA	NA
Mercury	Total	ng/l	20	< 0.5	7.4	0.93	< 0.5
Methyl Mercury	Total	ng/l	NA	NA	NA	NA	NA
Molybdenum	Dissolved	µg/l	20	0.56	1.83	1.12	1.10
Molybdenum	Total	µg/l	NA	NA	NA	NA	NA
Nickel	Dissolved	µg/l	20	< 0.5	1.43	0.48	< 0.5
Nickel	Total	µg/l	NA	NA	NA	NA	NA
Palladium	Total	µg/l	NA	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA	NA
Potassium	Total	mg/l	20	0.84	1.6	1.13	1.1
Selenium	Dissolved	µg/l	20	< 1	< 1	NA	< 1
Selenium	Total	µg/l	NA	NA	NA	NA	NA
Silver	Dissolved	µg/l	14	< 0.2	< 0.5	NA	< 0.2
Silver	Total	µg/l	NA	NA	NA	NA	NA
Sodium	Total	mg/l	20	1.8	3.3	2.23	2.0
Strontium	Total	µg/l	NA	NA	NA	NA	NA
Thallium	Dissolved	µg/l	6	< 0.02	< 0.2	NA	< 0.2
Thallium	Total	µg/l	14	< 0.017	< 0.2	NA	< 0.2
Titanium	Total	µg/l	NA	NA	NA	NA	NA
Vanadium	Dissolved	µg/l	14	< 5	< 10	NA	< 5
Zinc	Dissolved	µg/l	20	< 6	< 6	NA	< 6
Zinc	Total	µg/l	NA	NA	NA	NA	NA

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for MW-8S 2011-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	20	58.8	263	93.9	77.6
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	14	1.6	3.9	2.45	2.5
Carbon, total organic	NA	mg/l	20	1.1	3	1.82	1.72
Chemical Oxygen Demand	NA	mg/l	14	< 10	16.6	8.42	10.3
Chloride	NA	mg/l	20	< 0.5	< 1	0.56	0.78
Cyanide	NA	mg/l	NA	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	20	0.58	6.48	2.45	2.59
Fluoride	NA	mg/l	20	< 0.1	0.25	0.11	0.11
Hardness, as CaCO3	NA	mg/l	20	38.3	94.8	75.9	79.1
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	20	< 0.1	0.35	0.19	0.22
Nitrogen, ammonia, as N	NA	mg/l	20	0.06	0.25	0.06	< 0.1
pH	NA	pH units	26	6.1	10.41	8.10	7.57
Phosphorus, total, as P	NA	mg/l	NA	NA	NA	NA	NA
Redox (oxidation potential)	NA	mV	20	82	712	293	272
Solids, total dissolved	NA	mg/l	20	99	179	142	142
Specific Conductance @ 25 °C	NA	µmhos/cm	20	147.9	212.2	179.1	179.4
Sulfate, as SO4	NA	mg/l	20	5.7	19.6	8.52	7.90
Temperature	NA	deg C	20	3.48	13.59	8.62	8.79
Turbidity	NA	NTU	20	0	21.1	3.17	0.4
Metals							
Aluminum	Dissolved	µg/l	20	< 10	128	42.4	< 25
Aluminum	Total	µg/l	NA	NA	NA	NA	NA
Antimony	Dissolved	µg/l	20	< 0.5	< 0.5	NA	< 0.5
Antimony	Total	µg/l	NA	NA	NA	NA	NA
Arsenic	Dissolved	µg/l	20	< 0.5	4.1	1.71	1.1
Arsenic	Total	µg/l	NA	NA	NA	NA	NA
Barium	Dissolved	µg/l	6	5.1	9.2	8.03	8.65
Barium	Total	µg/l	14	7	23.6	15.2	15.9
Beryllium	Dissolved	µg/l	6	< 0.2	< 0.2	NA	< 0.2
Beryllium	Total	µg/l	14	< 0.2	< 0.2	NA	< 0.2
Boron	Dissolved	µg/l	6	< 100	< 100	NA	< 100
Boron	Total	µg/l	14	< 50	< 50	NA	< 50
Cadmium	Dissolved	µg/l	20	< 0.2	< 0.2	NA	< 0.2
Cadmium	Total	µg/l	NA	NA	NA	NA	NA
Calcium	Total	mg/l	20	12.4	36	22.0	19.5
Chromium	Dissolved	µg/l	20	< 1	4.1	1.12	< 1
Chromium	Total	µg/l	NA	NA	NA	NA	NA
Cobalt	Dissolved	µg/l	20	< 0.2	1.18	0.26	< 0.2
Cobalt	Total	µg/l	NA	NA	NA	NA	NA
Copper	Dissolved	µg/l	20	0.55	23.5	2.60	1.10
Copper	Total	µg/l	NA	NA	NA	NA	NA
Iron	Dissolved	µg/l	20	< 50	137	39.4	< 50
Iron	Total	µg/l	NA	NA	NA	NA	NA
Lead	Dissolved	µg/l	6	< 0.5	< 0.5	NA	< 0.5
Lead	Total	µg/l	14	< 0.5	0.56	0.27	< 0.5
Magnesium	Total	mg/l	20	0.66	9.23	5.12	6.20
Manganese	Dissolved	µg/l	20	0.55	1270	237	27
Manganese	Total	µg/l	NA	NA	NA	NA	NA
Mercury	Total	ng/l	20	< 0.5	4.5	1.84	1.31
Methyl Mercury	Total	ng/l	NA	NA	NA	NA	NA
Molybdenum	Dissolved	µg/l	20	0.71	11.1	3.06	1.79
Molybdenum	Total	µg/l	NA	NA	NA	NA	NA
Nickel	Dissolved	µg/l	20	< 0.5	2.58	0.93	0.75
Nickel	Total	µg/l	NA	NA	NA	NA	NA
Palladium	Total	µg/l	NA	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA	NA
Potassium	Total	mg/l	20	0.86	3.1	1.75	1.6
Selenium	Dissolved	µg/l	20	< 1	< 1	NA	< 1
Selenium	Total	µg/l	NA	NA	NA	NA	NA
Silver	Dissolved	µg/l	14	< 0.2	< 0.5	NA	< 0.2
Silver	Total	µg/l	NA	NA	NA	NA	NA
Sodium	Total	mg/l	20	3.7	23.1	11.1	7.7
Strontium	Total	µg/l	NA	NA	NA	NA	NA
Thallium	Dissolved	µg/l	6	< 0.02	< 0.2	NA	0.11
Thallium	Total	µg/l	14	< 0.017	< 0.2	NA	< 0.2
Titanium	Total	µg/l	NA	NA	NA	NA	NA
Vanadium	Dissolved	µg/l	14	< 5	15.5	7.06	8.90
Zinc	Dissolved	µg/l	20	< 6	19.4	3.50	< 6
Zinc	Total	µg/l	NA	NA	NA	NA	NA

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for MW-8D 2011-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	19	108	128	122	122
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	13	3	5.8	4.30	4.4
Carbon, total organic	NA	mg/l	19	3.1	4.6	3.72	3.65
Chemical Oxygen Demand	NA	mg/l	13	< 10	24	12.9	13.8
Chloride	NA	mg/l	19	< 0.5	< 1	0.49	0.58
Cyanide	NA	mg/l	NA	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	19	0.01	3.21	0.82	< 0.1
Fluoride	NA	mg/l	19	< 0.1	0.17	0.13	0.15
Hardness, as CaCO3	NA	mg/l	19	118	137	127	127
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	19	< 0.1	0.16	0.05	< 0.1
Nitrogen, ammonia, as N	NA	mg/l	19	< 0.05	0.28	0.07	< 0.1
pH	NA	pH units	25	7.1	8.2	7.50	7.5
Phosphorus, total, as P	NA	mg/l	NA	NA	NA	NA	NA
Redox (oxidation potential)	NA	mV	19	-105	335	98.4	123
Solids, total dissolved	NA	mg/l	19	150	201	181	183
Specific Conductance @ 25 °C	NA	µmhos/cm	19	212.6	258.4	243	247
Sulfate, as SO4	NA	mg/l	19	4.7	7.26	6.58	6.65
Temperature	NA	deg C	19	4.37	13.55	7.98	7.51
Turbidity	NA	NTU	19	0	4.5	0.75	0
Metals							
Aluminum	Dissolved	µg/l	19	< 10	83.6	12.2	< 20
Aluminum	Total	µg/l	NA	NA	NA	NA	NA
Antimony	Dissolved	µg/l	19	< 0.5	< 0.5	NA	< 0.5
Antimony	Total	µg/l	NA	NA	NA	NA	NA
Arsenic	Dissolved	µg/l	19	1.76	2.7	2.27	2.25
Arsenic	Total	µg/l	NA	NA	NA	NA	NA
Barium	Dissolved	µg/l	6	7.9	10.4	9.20	9.25
Barium	Total	µg/l	13	10.1	25.4	16.0	15.4
Beryllium	Dissolved	µg/l	6	< 0.2	< 0.2	NA	< 0.2
Beryllium	Total	µg/l	13	< 0.2	< 0.2	NA	< 0.2
Boron	Dissolved	µg/l	6	< 100	< 100	NA	< 100
Boron	Total	µg/l	13	< 50	< 50	NA	< 50
Cadmium	Dissolved	µg/l	19	< 0.2	0.21	0.10	< 0.2
Cadmium	Total	µg/l	NA	NA	NA	NA	NA
Calcium	Total	mg/l	19	28.8	33.1	30.9	31.0
Chromium	Dissolved	µg/l	19	< 1	< 1	NA	< 1
Chromium	Total	µg/l	NA	NA	NA	NA	NA
Cobalt	Dissolved	µg/l	19	< 0.2	0.52	0.18	< 0.2
Cobalt	Total	µg/l	NA	NA	NA	NA	NA
Copper	Dissolved	µg/l	19	< 0.5	0.84	0.34	< 0.5
Copper	Total	µg/l	NA	NA	NA	NA	NA
Iron	Dissolved	µg/l	19	1050	1760	1350	1295
Iron	Total	µg/l	NA	NA	NA	NA	NA
Lead	Dissolved	µg/l	6	< 0.5	< 0.5	NA	< 0.5
Lead	Total	µg/l	13	< 0.5	< 0.5	NA	< 0.5
Magnesium	Total	mg/l	19	11.2	13.1	12.2	12.2
Manganese	Dissolved	µg/l	19	529	767	687	700
Manganese	Total	µg/l	NA	NA	NA	NA	NA
Mercury	Total	ng/l	19	< 0.5	< 0.5	NA	< 0.5
Methyl Mercury	Total	ng/l	NA	NA	NA	NA	NA
Molybdenum	Dissolved	µg/l	19	0.71	1.6	1.00	0.94
Molybdenum	Total	µg/l	NA	NA	NA	NA	NA
Nickel	Dissolved	µg/l	19	< 0.5	1.09	0.33	< 0.5
Nickel	Total	µg/l	NA	NA	NA	NA	NA
Palladium	Total	µg/l	NA	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA	NA
Potassium	Total	mg/l	19	1.12	1.41	1.24	1.21
Selenium	Dissolved	µg/l	19	< 1	< 1	NA	< 1
Selenium	Total	µg/l	NA	NA	NA	NA	NA
Silver	Dissolved	µg/l	13	< 0.2	< 0.2	NA	< 0.2
Silver	Total	µg/l	NA	NA	NA	NA	NA
Sodium	Total	mg/l	19	3.95	4.71	4.48	4.50
Strontium	Total	µg/l	NA	NA	NA	NA	NA
Thallium	Dissolved	µg/l	6	< 0.02	< 0.2	NA	0.11
Thallium	Total	µg/l	13	< 0.017	< 0.2	NA	< 0.2
Titanium	Total	µg/l	NA	NA	NA	NA	NA
Vanadium	Dissolved	µg/l	13	< 5	< 10	NA	< 5
Zinc	Dissolved	µg/l	19	< 6	9.5	3.17	< 6
Zinc	Total	µg/l	NA	NA	NA	NA	NA

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for MW-9 2011-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	19	24.7	56.7	41.8	43.0
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	13	4	26.6	15.6	12.8
Carbon, total organic	NA	mg/l	19	3.4	26	15.6	12.8
Chemical Oxygen Demand	NA	mg/l	13	< 10	84.2	48.5	44.6
Chloride	NA	mg/l	19	< 0.5	< 1	0.50	0.64
Cyanide	NA	mg/l	NA	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	18	0.07	2.58	0.87	0.59
Fluoride	NA	mg/l	19	< 0.1	0.1	0.05	< 0.1
Hardness, as CaCO3	NA	mg/l	19	25.1	58.4	42.7	41.8
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	19	< 0.1	0.44	0.07	< 0.1
Nitrogen, ammonia, as N	NA	mg/l	19	< 0.1	0.31	0.15	0.16
pH	NA	pH units	24	6.24	7.1	6.62	6.63
Phosphorus, total, as P	NA	mg/l	NA	NA	NA	NA	NA
Redox (oxidation potential)	NA	mV	18	-7	303	148	152
Solids, total dissolved	NA	mg/l	19	60	185	129	121
Specific Conductance @ 25 °C	NA	µmhos/cm	18	67	152	109	109
Sulfate, as SO4	NA	mg/l	19	1.28	7.4	4.88	5.10
Temperature	NA	deg C	18	2.56	11.75	7.39	7.66
Turbidity	NA	NTU	18	0	31.1	3.38	0.25
Metals							
Aluminum	Dissolved	µg/l	19	42.9	617	135	115
Aluminum	Total	µg/l	NA	NA	NA	NA	NA
Antimony	Dissolved	µg/l	19	< 0.5	< 0.5	NA	< 0.5
Antimony	Total	µg/l	NA	NA	NA	NA	NA
Arsenic	Dissolved	µg/l	19	2.4	6.7	4.35	4.7
Arsenic	Total	µg/l	NA	NA	NA	NA	NA
Barium	Dissolved	µg/l	6	7.5	15.1	11.7	12.2
Barium	Total	µg/l	13	10.1	70.3	23.8	19.6
Beryllium	Dissolved	µg/l	6	< 0.2	< 0.2	NA	< 0.2
Beryllium	Total	µg/l	13	< 0.2	0.23	0.11	< 0.2
Boron	Dissolved	µg/l	6	< 100	< 100	NA	< 100
Boron	Total	µg/l	13	< 50	< 50	NA	< 50
Cadmium	Dissolved	µg/l	19	< 0.2	< 0.2	NA	< 0.2
Cadmium	Total	µg/l	NA	NA	NA	NA	NA
Calcium	Total	mg/l	19	4.7	13.7	8.68	8.4
Chromium	Dissolved	µg/l	19	< 1	2	0.72	< 1
Chromium	Total	µg/l	NA	NA	NA	NA	NA
Cobalt	Dissolved	µg/l	19	1.2	4.5	2.53	2.1
Cobalt	Total	µg/l	NA	NA	NA	NA	NA
Copper	Dissolved	µg/l	19	1.7	16	4.46	3.4
Copper	Total	µg/l	NA	NA	NA	NA	NA
Iron	Dissolved	µg/l	19	4870	17900	11003	10700
Iron	Total	µg/l	NA	NA	NA	NA	NA
Lead	Dissolved	µg/l	6	< 0.5	< 0.5	NA	< 0.5
Lead	Total	µg/l	13	< 0.5	3.07	0.50	< 0.5
Magnesium	Total	mg/l	19	3.2	6.66	5.10	5.10
Manganese	Dissolved	µg/l	19	498	1400	903	945
Manganese	Total	µg/l	NA	NA	NA	NA	NA
Mercury	Total	ng/l	19	0.91	13.7	2.58	1.70
Methyl Mercury	Total	ng/l	NA	NA	NA	NA	NA
Molybdenum	Dissolved	µg/l	19	0.69	2.3	1.52	1.5
Molybdenum	Total	µg/l	NA	NA	NA	NA	NA
Nickel	Dissolved	µg/l	19	0.89	4.6	1.72	1.3
Nickel	Total	µg/l	NA	NA	NA	NA	NA
Palladium	Total	µg/l	NA	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA	NA
Potassium	Total	mg/l	19	0.96	1.96	1.42	1.40
Selenium	Dissolved	µg/l	19	< 1	< 1	NA	< 1
Selenium	Total	µg/l	NA	NA	NA	NA	NA
Silver	Dissolved	µg/l	13	< 0.2	< 0.2	NA	< 0.2
Silver	Total	µg/l	NA	NA	NA	NA	NA
Sodium	Total	mg/l	19	1.3	9.3	2.08	1.7
Strontium	Total	µg/l	NA	NA	NA	NA	NA
Thallium	Dissolved	µg/l	6	< 0.02	< 0.2	NA	< 0.02
Thallium	Total	µg/l	13	< 0.017	0.64	0.13	< 0.2
Titanium	Total	µg/l	NA	NA	NA	NA	NA
Vanadium	Dissolved	µg/l	13	< 5	< 10	4.34	5.35
Zinc	Dissolved	µg/l	19	< 6	11.8	3.72	< 6
Zinc	Total	µg/l	NA	NA	NA	NA	NA

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for MW-10S 2011-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	15	6.1	69.5	16.3	11.0
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	9	2.1	44.6	8.83	4.10
Carbon, total organic	NA	mg/l	15	2	40.2	6.08	3.0
Chemical Oxygen Demand	NA	mg/l	9	< 10	133	29.0	16.5
Chloride	NA	mg/l	15	< 0.5	9.33	1.20	< 1
Cyanide	NA	mg/l	NA	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	15	5.66	11.3	9.14	9.65
Fluoride	NA	mg/l	15	< 0.1	0.25	0.07	< 0.1
Hardness, as CaCO3	NA	mg/l	15	15.2	136	29.9	18.1
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	15	0.33	2.7	1.19	1.0
Nitrogen, ammonia, as N	NA	mg/l	15	< 0.1	0.1	0.05	0.1
pH	NA	pH units	21	4.95	8.14	6.30	6.00
Phosphorus, total, as P	NA	mg/l	NA	NA	NA	NA	NA
Redox (oxidation potential)	NA	mV	15	159	544	399	412
Solids, total dissolved	NA	mg/l	15	48	228	85.5	72
Specific Conductance @ 25 °C	NA	µmhos/cm	15	34.3	308.1	72.8	46.6
Sulfate, as SO4	NA	mg/l	15	5	42.9	10.6	7.7
Temperature	NA	deg C	15	7.56	20.19	13.1	11.2
Turbidity	NA	NTU	15	12.1	306.3	68.7	52.6
Metals							
Aluminum	Dissolved	µg/l	15	35.6	96.3	59.9	56.4
Aluminum	Total	µg/l	NA	NA	NA	NA	NA
Antimony	Dissolved	µg/l	15	< 0.5	< 0.5	NA	< 0.5
Antimony	Total	µg/l	NA	NA	NA	NA	NA
Arsenic	Dissolved	µg/l	15	< 0.31	1.05	0.34	< 0.5
Arsenic	Total	µg/l	NA	NA	NA	NA	NA
Barium	Dissolved	µg/l	6	6.1	11.8	9.60	10.25
Barium	Total	µg/l	9	16	85.9	41.7	33.5
Beryllium	Dissolved	µg/l	6	< 0.2	< 0.2	NA	< 0.2
Beryllium	Total	µg/l	9	< 0.2	0.25	0.12	< 0.2
Boron	Dissolved	µg/l	6	< 100	< 100	NA	< 100
Boron	Total	µg/l	9	< 50	< 50	NA	< 50
Cadmium	Dissolved	µg/l	15	< 0.2	0.3	0.11	< 0.2
Cadmium	Total	µg/l	NA	NA	NA	NA	NA
Calcium	Total	mg/l	15	3.7	38.8	7.79	4.45
Chromium	Dissolved	µg/l	15	< 1	3.29	0.99	< 1
Chromium	Total	µg/l	NA	NA	NA	NA	NA
Cobalt	Dissolved	µg/l	15	< 0.2	0.59	0.28	0.24
Cobalt	Total	µg/l	NA	NA	NA	NA	NA
Copper	Dissolved	µg/l	15	1.3	20.3	4.40	2.0
Copper	Total	µg/l	NA	NA	NA	NA	NA
Iron	Dissolved	µg/l	15	< 50	84.8	47.8	53.0
Iron	Total	µg/l	NA	NA	NA	NA	NA
Lead	Dissolved	µg/l	6	< 0.5	< 0.5	NA	< 0.5
Lead	Total	µg/l	9	< 0.5	2.9	1.06	0.69
Magnesium	Total	mg/l	15	1.4	9.48	2.54	1.7
Manganese	Dissolved	µg/l	15	10.9	87.8	37.2	28.3
Manganese	Total	µg/l	NA	NA	NA	NA	NA
Mercury	Total	ng/l	15	1.31	14.1	3.41	2.30
Methyl Mercury	Total	ng/l	NA	NA	NA	NA	NA
Molybdenum	Dissolved	µg/l	15	< 0.2	35.9	2.96	< 0.3
Molybdenum	Total	µg/l	NA	NA	NA	NA	NA
Nickel	Dissolved	µg/l	15	< 0.5	2.76	1.13	1.10
Nickel	Total	µg/l	NA	NA	NA	NA	NA
Palladium	Total	µg/l	NA	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA	NA
Potassium	Total	mg/l	15	< 0.25	3.68	0.91	0.62
Selenium	Dissolved	µg/l	15	< 1	4.73	0.85	< 1
Selenium	Total	µg/l	NA	NA	NA	NA	NA
Silver	Dissolved	µg/l	9	< 0.2	< 0.2	NA	< 0.2
Silver	Total	µg/l	NA	NA	NA	NA	NA
Sodium	Total	mg/l	15	2.6	9.82	4.26	3.3
Strontium	Total	µg/l	NA	NA	NA	NA	NA
Thallium	Dissolved	µg/l	6	< 0.02	< 0.2	NA	0.11
Thallium	Total	µg/l	9	< 0.2	0.3	0.13	< 0.2
Titanium	Total	µg/l	NA	NA	NA	NA	NA
Vanadium	Dissolved	µg/l	9	< 5	< 10	NA	< 5
Zinc	Dissolved	µg/l	15	< 6	19	5.02	< 6
Zinc	Total	µg/l	NA	NA	NA	NA	NA

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for MW-10D 2011-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	19	30.8	49.5	41.2	41.6
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	13	1.2	4.1	2.28	2.05
Carbon, total organic	NA	mg/l	19	< 1	3.9	1.56	1.4
Chemical Oxygen Demand	NA	mg/l	13	< 10	23.2	9.11	< 10
Chloride	NA	mg/l	19	< 0.5	< 1	0.44	0.62
Cyanide	NA	mg/l	NA	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	19	0.94	6.97	2.09	1.74
Fluoride	NA	mg/l	19	< 0.1	0.11	0.06	0.1
Hardness, as CaCO3	NA	mg/l	19	34.4	60.8	48.5	49.6
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	19	0.91	2.4	1.66	1.6
Nitrogen, ammonia, as N	NA	mg/l	19	< 0.05	0.19	0.05	< 0.1
pH	NA	pH units	25	6.14	7.22	6.72	6.71
Phosphorus, total, as P	NA	mg/l	NA	NA	NA	NA	NA
Redox (oxidation potential)	NA	mV	19	-67	521	282	258
Solids, total dissolved	NA	mg/l	19	30	131	106	111
Specific Conductance @ 25 °C	NA	µmhos/cm	19	83.8	145.1	113	107
Sulfate, as SO4	NA	mg/l	19	9.2	13.4	11.1	11.2
Temperature	NA	deg C	19	6.6	12.89	9.01	8.51
Turbidity	NA	NTU	19	0	7.1	1.01	0
Metals							
Aluminum	Dissolved	µg/l	19	< 10	< 25	NA	< 20
Aluminum	Total	µg/l	NA	NA	NA	NA	NA
Antimony	Dissolved	µg/l	19	< 0.5	< 0.5	NA	< 0.5
Antimony	Total	µg/l	NA	NA	NA	NA	NA
Arsenic	Dissolved	µg/l	19	< 0.31	0.82	0.38	< 0.5
Arsenic	Total	µg/l	NA	NA	NA	NA	NA
Barium	Dissolved	µg/l	6	9.3	11.1	10.1	10.3
Barium	Total	µg/l	13	12.5	22.7	17.8	18.5
Beryllium	Dissolved	µg/l	6	< 0.2	< 0.2	NA	< 0.2
Beryllium	Total	µg/l	13	< 0.2	< 0.2	NA	< 0.2
Boron	Dissolved	µg/l	6	< 100	< 100	NA	< 100
Boron	Total	µg/l	13	< 50	< 100	NA	< 50
Cadmium	Dissolved	µg/l	19	< 0.2	< 0.2	NA	< 0.2
Cadmium	Total	µg/l	NA	NA	NA	NA	NA
Calcium	Total	mg/l	19	8.4	15.5	11.6	11.9
Chromium	Dissolved	µg/l	19	< 1	3.2	0.78	< 1
Chromium	Total	µg/l	NA	NA	NA	NA	NA
Cobalt	Dissolved	µg/l	19	0.47	1.5	0.84	0.76
Cobalt	Total	µg/l	NA	NA	NA	NA	NA
Copper	Dissolved	µg/l	19	< 0.5	2.2	1.01	0.99
Copper	Total	µg/l	NA	NA	NA	NA	NA
Iron	Dissolved	µg/l	19	< 50	874	359	303
Iron	Total	µg/l	NA	NA	NA	NA	NA
Lead	Dissolved	µg/l	6	< 0.5	< 0.5	NA	< 0.5
Lead	Total	µg/l	13	< 0.5	< 0.5	NA	< 0.5
Magnesium	Total	mg/l	19	3.3	5.9	4.76	4.8
Manganese	Dissolved	µg/l	19	60.9	362	199	235
Manganese	Total	µg/l	NA	NA	NA	NA	NA
Mercury	Total	ng/l	19	< 0.5	1.1	0.35	< 0.5
Methyl Mercury	Total	ng/l	NA	NA	NA	NA	NA
Molybdenum	Dissolved	µg/l	19	1.6	4.99	3.23	3.7
Molybdenum	Total	µg/l	NA	NA	NA	NA	NA
Nickel	Dissolved	µg/l	19	0.84	4.3	2.16	1.62
Nickel	Total	µg/l	NA	NA	NA	NA	NA
Palladium	Total	µg/l	NA	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA	NA
Potassium	Total	mg/l	19	1.1	3.17	1.59	1.5
Selenium	Dissolved	µg/l	19	< 1	< 1	NA	< 1
Selenium	Total	µg/l	NA	NA	NA	NA	NA
Silver	Dissolved	µg/l	13	< 0.2	< 0.2	NA	< 0.2
Silver	Total	µg/l	NA	NA	NA	NA	NA
Sodium	Total	mg/l	19	3.9	5.4	4.34	4.3
Strontium	Total	µg/l	NA	NA	NA	NA	NA
Thallium	Dissolved	µg/l	6	< 0.02	< 0.2	NA	< 0.02
Thallium	Total	µg/l	13	< 0.017	< 0.2	NA	< 0.2
Titanium	Total	µg/l	NA	NA	NA	NA	NA
Vanadium	Dissolved	µg/l	13	< 5	< 10	NA	< 5
Zinc	Dissolved	µg/l	19	< 6	< 6	NA	< 6
Zinc	Total	µg/l	NA	NA	NA	NA	NA

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for MW-11 2011-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	19	32.7	62.9	57.8	59.9
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	13	< 1	3.4	1.68	1.6
Carbon, total organic	NA	mg/l	19	< 1	2	1.10	1.2
Chemical Oxygen Demand	NA	mg/l	13	< 10	16.5	7.25	< 10
Chloride	NA	mg/l	19	< 0.5	1.1	0.70	0.88
Cyanide	NA	mg/l	NA	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	19	2.68	4.84	3.98	4.06
Fluoride	NA	mg/l	19	< 0.1	< 0.1	NA	< 0.1
Hardness, as CaCO3	NA	mg/l	19	41.1	68.9	63.7	66.2
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	19	< 0.1	0.21	0.15	0.15
Nitrogen, ammonia, as N	NA	mg/l	19	< 0.05	< 0.1	0.05	< 0.1
pH	NA	pH units	25	7.79	8.42	8.17	8.20
Phosphorus, total, as P	NA	mg/l	NA	NA	NA	NA	NA
Redox (oxidation potential)	NA	mV	19	145	481	321	306
Solids, total dissolved	NA	mg/l	19	76	133	111	113
Specific Conductance @ 25 °C	NA	µmhos/cm	19	99.7	143.1	133	136
Sulfate, as SO4	NA	mg/l	19	7.8	10.1	9.32	9.35
Temperature	NA	deg C	19	4	9.92	6.86	6.83
Turbidity	NA	NTU	19	0	19.6	1.87	0
Metals							
Aluminum	Dissolved	µg/l	19	< 10	< 25	NA	< 20
Aluminum	Total	µg/l	NA	NA	NA	NA	NA
Antimony	Dissolved	µg/l	19	< 0.5	< 0.5	NA	< 0.5
Antimony	Total	µg/l	NA	NA	NA	NA	NA
Arsenic	Dissolved	µg/l	19	< 0.5	1.3	0.47	0.52
Arsenic	Total	µg/l	NA	NA	NA	NA	NA
Barium	Dissolved	µg/l	6	3.4	4	3.73	3.7
Barium	Total	µg/l	13	4.3	12.4	7.77	7.5
Beryllium	Dissolved	µg/l	6	< 0.2	< 0.2	NA	< 0.2
Beryllium	Total	µg/l	13	< 0.2	< 0.2	NA	< 0.2
Boron	Dissolved	µg/l	6	< 100	< 100	NA	< 100
Boron	Total	µg/l	13	< 50	< 50	NA	< 50
Cadmium	Dissolved	µg/l	19	< 0.2	< 0.2	NA	< 0.2
Cadmium	Total	µg/l	NA	NA	NA	NA	NA
Calcium	Total	mg/l	19	8.1	14.5	13.3	13.8
Chromium	Dissolved	µg/l	19	< 1	3.4	1.11	1.05
Chromium	Total	µg/l	NA	NA	NA	NA	NA
Cobalt	Dissolved	µg/l	19	< 0.2	< 0.2	NA	< 0.2
Cobalt	Total	µg/l	NA	NA	NA	NA	NA
Copper	Dissolved	µg/l	19	< 0.5	2.1	0.60	0.67
Copper	Total	µg/l	NA	NA	NA	NA	NA
Iron	Dissolved	µg/l	19	< 50	< 50	NA	< 50
Iron	Total	µg/l	NA	NA	NA	NA	NA
Lead	Dissolved	µg/l	6	< 0.5	< 0.5	NA	< 0.5
Lead	Total	µg/l	13	< 0.5	< 0.5	NA	< 0.5
Magnesium	Total	mg/l	19	5.1	8	7.41	7.6
Manganese	Dissolved	µg/l	19	< 0.5	36.8	8.29	3.95
Manganese	Total	µg/l	NA	NA	NA	NA	NA
Mercury	Total	ng/l	19	< 0.5	0.97	0.32	< 0.5
Methyl Mercury	Total	ng/l	NA	NA	NA	NA	NA
Molybdenum	Dissolved	µg/l	19	0.42	4.95	1.23	0.97
Molybdenum	Total	µg/l	NA	NA	NA	NA	NA
Nickel	Dissolved	µg/l	19	< 0.5	1.4	0.40	< 0.5
Nickel	Total	µg/l	NA	NA	NA	NA	NA
Palladium	Total	µg/l	NA	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA	NA
Potassium	Total	mg/l	19	1.1	1.7	1.50	1.52
Selenium	Dissolved	µg/l	19	< 1	< 1	NA	< 1
Selenium	Total	µg/l	NA	NA	NA	NA	NA
Silver	Dissolved	µg/l	13	< 0.2	< 0.2	NA	< 0.2
Silver	Total	µg/l	NA	NA	NA	NA	NA
Sodium	Total	mg/l	19	2	10.3	3.60	3.30
Strontium	Total	µg/l	NA	NA	NA	NA	NA
Thallium	Dissolved	µg/l	6	< 0.02	< 0.2	NA	< 0.02
Thallium	Total	µg/l	13	< 0.017	< 0.2	NA	< 0.2
Titanium	Total	µg/l	NA	NA	NA	NA	NA
Vanadium	Dissolved	µg/l	13	< 5	< 10	NA	< 5
Zinc	Dissolved	µg/l	19	< 6	< 6	NA	< 6
Zinc	Total	µg/l	NA	NA	NA	NA	NA

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for MW-12 2012-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	17	22.4	27.3	25.1	25.8
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	11	< 1	4.2	1.65	1.45
Carbon, total organic	NA	mg/l	17	< 1	2.2	0.92	1.0
Chemical Oxygen Demand	NA	mg/l	11	< 10	19.9	7.50	< 10
Chloride	NA	mg/l	17	< 0.5	< 1	0.54	0.67
Cyanide	NA	mg/l	NA	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	17	1.76	4.34	3.57	3.64
Fluoride	NA	mg/l	17	< 0.1	0.11	0.06	< 0.1
Hardness, as CaCO3	NA	mg/l	17	23	31.1	25.9	25.5
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	17	< 0.1	0.13	0.06	< 0.1
Nitrogen, ammonia, as N	NA	mg/l	17	< 0.05	0.2	0.06	< 0.1
pH	NA	pH units	23	6.15	7.1	6.63	6.68
Phosphorus, total, as P	NA	mg/l	NA	NA	NA	NA	NA
Redox (oxidation potential)	NA	mV	17	122	506	308	305
Solids, total dissolved	NA	mg/l	17	18	108	68.6	71
Specific Conductance @ 25 °C	NA	µmhos/cm	17	19.9	71.8	56.7	57
Sulfate, as SO4	NA	mg/l	17	5.4	8.79	6.10	5.8
Temperature	NA	deg C	17	2.9	11.31	7.15	7.36
Turbidity	NA	NTU	17	0	20.1	2.35	0
Metals							
Aluminum	Dissolved	µg/l	17	< 10	< 25	NA	< 20
Aluminum	Total	µg/l	NA	NA	NA	NA	NA
Antimony	Dissolved	µg/l	17	< 0.5	< 0.5	NA	< 0.5
Antimony	Total	µg/l	NA	NA	NA	NA	NA
Arsenic	Dissolved	µg/l	17	< 0.5	< 0.63	0.28	< 0.5
Arsenic	Total	µg/l	NA	NA	NA	NA	NA
Barium	Dissolved	µg/l	6	< 0.5	9.5	6.68	7.45
Barium	Total	µg/l	11	8.3	16.6	9.85	9.05
Beryllium	Dissolved	µg/l	6	< 0.2	< 0.2	NA	< 0.2
Beryllium	Total	µg/l	11	< 0.2	< 0.2	NA	< 0.2
Boron	Dissolved	µg/l	6	< 100	< 100	NA	< 100
Boron	Total	µg/l	11	< 50	< 50	NA	< 50
Cadmium	Dissolved	µg/l	17	< 0.2	< 0.2	NA	< 0.2
Cadmium	Total	µg/l	NA	NA	NA	NA	NA
Calcium	Total	mg/l	17	5.4	7.24	6.22	6.2
Chromium	Dissolved	µg/l	17	< 1	1.9	0.58	< 1
Chromium	Total	µg/l	NA	NA	NA	NA	NA
Cobalt	Dissolved	µg/l	17	< 0.2	1.7	1.33	1.4
Cobalt	Total	µg/l	NA	NA	NA	NA	NA
Copper	Dissolved	µg/l	17	< 0.5	16.2	1.46	0.645
Copper	Total	µg/l	NA	NA	NA	NA	NA
Iron	Dissolved	µg/l	17	< 50	166	75.8	63.0
Iron	Total	µg/l	NA	NA	NA	NA	NA
Lead	Dissolved	µg/l	6	< 0.5	< 0.5	NA	< 0.5
Lead	Total	µg/l	11	< 0.5	< 0.5	NA	< 0.5
Magnesium	Total	mg/l	17	2.3	3.17	2.54	2.5
Manganese	Dissolved	µg/l	17	< 0.5	208	129	149
Manganese	Total	µg/l	NA	NA	NA	NA	NA
Mercury	Total	ng/l	17	< 0.5	2	0.39	< 0.5
Methyl Mercury	Total	ng/l	NA	NA	NA	NA	NA
Molybdenum	Dissolved	µg/l	17	< 0.3	3.38	2.18	2.10
Molybdenum	Total	µg/l	NA	NA	NA	NA	NA
Nickel	Dissolved	µg/l	17	< 0.5	1.04	0.74	0.75
Nickel	Total	µg/l	NA	NA	NA	NA	NA
Palladium	Total	µg/l	NA	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA	NA
Potassium	Total	mg/l	17	1.1	1.5	1.29	1.28
Selenium	Dissolved	µg/l	17	< 1	< 1	NA	< 1
Selenium	Total	µg/l	NA	NA	NA	NA	NA
Silver	Dissolved	µg/l	11	< 0.2	< 0.2	NA	< 0.2
Silver	Total	µg/l	NA	NA	NA	NA	NA
Sodium	Total	mg/l	17	1.9	2.5	2.20	2.15
Strontium	Total	µg/l	NA	NA	NA	NA	NA
Thallium	Dissolved	µg/l	6	< 0.02	< 0.2	NA	0.11
Thallium	Total	µg/l	11	< 0.017	< 0.2	NA	< 0.2
Titanium	Total	µg/l	NA	NA	NA	NA	NA
Vanadium	Dissolved	µg/l	11	< 5	< 5	NA	< 5
Zinc	Dissolved	µg/l	17	< 6	< 6	NA	< 6
Zinc	Total	µg/l	NA	NA	NA	NA	NA

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for MW-13 2012-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	17	39.1	74.9	59.0	60.2
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	11	10.9	39.9	24.2	24.0
Carbon, total organic	NA	mg/l	17	10.3	39.2	27.2	27.3
Chemical Oxygen Demand	NA	mg/l	11	34.2	116	71.4	75.0
Chloride	NA	mg/l	17	0.62	52.8	4.45	0.75
Cyanide	NA	mg/l	NA	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	17	< 0.1	3.07	1.00	< 0.1
Fluoride	NA	mg/l	17	< 0.1	0.52	0.08	< 0.1
Hardness, as CaCO3	NA	mg/l	17	48.5	72.8	59.3	57.3
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	17	< 0.1	0.12	0.06	< 0.1
Nitrogen, ammonia, as N	NA	mg/l	17	0.26	1.9	1.34	1.5
pH	NA	pH units	23	5.75	6.9	6.08	6.09
Phosphorus, total, as P	NA	mg/l	NA	NA	NA	NA	NA
Redox (oxidation potential)	NA	mV	17	-38	368	150	148
Solids, total dissolved	NA	mg/l	17	91	238	200	201
Specific Conductance @ 25 °C	NA	µmhos/cm	17	154.5	210.4	180.3	179.3
Sulfate, as SO4	NA	mg/l	17	5.6	104	20.4	16.8
Temperature	NA	deg C	17	3	16.71	7.39	6.76
Turbidity	NA	NTU	17	0	8	1.79	0.3
Metals							
Aluminum	Dissolved	µg/l	17	108	477	272	267
Aluminum	Total	µg/l	NA	NA	NA	NA	NA
Antimony	Dissolved	µg/l	17	< 0.5	< 0.5	NA	< 0.5
Antimony	Total	µg/l	NA	NA	NA	NA	NA
Arsenic	Dissolved	µg/l	17	0.55	1.5	0.87	0.85
Arsenic	Total	µg/l	NA	NA	NA	NA	NA
Barium	Dissolved	µg/l	6	23	29.6	24.5	23.5
Barium	Total	µg/l	11	30.9	72.8	51.9	52.8
Beryllium	Dissolved	µg/l	6	< 0.2	0.22	0.14	< 0.2
Beryllium	Total	µg/l	11	< 0.2	0.27	0.13	< 0.2
Boron	Dissolved	µg/l	6	< 100	< 100	NA	< 100
Boron	Total	µg/l	11	< 50	< 50	NA	< 50
Cadmium	Dissolved	µg/l	17	< 0.2	< 0.2	NA	< 0.2
Cadmium	Total	µg/l	NA	NA	NA	NA	NA
Calcium	Total	mg/l	17	10.9	16.9	13.3	12.9
Chromium	Dissolved	µg/l	17	< 1	3.2	1.36	1.35
Chromium	Total	µg/l	NA	NA	NA	NA	NA
Cobalt	Dissolved	µg/l	17	1.2	8.6	4.25	4.17
Cobalt	Total	µg/l	NA	NA	NA	NA	NA
Copper	Dissolved	µg/l	17	0.63	5.29	1.50	0.90
Copper	Total	µg/l	NA	NA	NA	NA	NA
Iron	Dissolved	µg/l	17	5470	23700	15788	17600
Iron	Total	µg/l	NA	NA	NA	NA	NA
Lead	Dissolved	µg/l	6	< 0.5	< 0.5	NA	< 0.5
Lead	Total	µg/l	11	< 0.5	0.55	0.28	< 0.5
Magnesium	Total	mg/l	17	5.1	7.74	6.31	6.20
Manganese	Dissolved	µg/l	17	252	1150	508	485
Manganese	Total	µg/l	NA	NA	NA	NA	NA
Mercury	Total	ng/l	17	< 0.5	1.5	0.95	1.0
Methyl Mercury	Total	ng/l	NA	NA	NA	NA	NA
Molybdenum	Dissolved	µg/l	17	< 0.3	1.08	0.35	0.33
Molybdenum	Total	µg/l	NA	NA	NA	NA	NA
Nickel	Dissolved	µg/l	17	2.2	20.5	9.38	10.2
Nickel	Total	µg/l	NA	NA	NA	NA	NA
Palladium	Total	µg/l	NA	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA	NA
Potassium	Total	mg/l	17	1	2.43	1.57	1.48
Selenium	Dissolved	µg/l	17	< 1	< 1	NA	< 1
Selenium	Total	µg/l	NA	NA	NA	NA	NA
Silver	Dissolved	µg/l	11	< 0.2	< 0.2	NA	< 0.2
Silver	Total	µg/l	NA	NA	NA	NA	NA
Sodium	Total	mg/l	17	2.29	9.8	6.44	6.65
Strontium	Total	µg/l	NA	NA	NA	NA	NA
Thallium	Dissolved	µg/l	6	< 0.02	< 0.2	NA	0.11
Thallium	Total	µg/l	11	< 0.017	< 0.2	NA	< 0.2
Titanium	Total	µg/l	NA	NA	NA	NA	NA
Vanadium	Dissolved	µg/l	11	< 5	14.9	8.24	8.25
Zinc	Dissolved	µg/l	17	< 6	21.6	10.8	8.6
Zinc	Total	µg/l	NA	NA	NA	NA	NA

NA No data available.

(1) Field duplicates not included in count of samples.

(2) Minimum and maximum determined with non-detect samples at the detection limit.

(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.

(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for MW-14 2012-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	17	33	62.3	41.8	39.6
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	11	1.5	3.57	1.95	1.8
Carbon, total organic	NA	mg/l	17	< 1	2.03	1.47	1.50
Chemical Oxygen Demand	NA	mg/l	11	< 10	17.3	7.38	< 10
Chloride	NA	mg/l	17	< 0.5	< 1	0.39	< 0.5
Cyanide	NA	mg/l	NA	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	17	8.8	10.68	9.88	10.16
Fluoride	NA	mg/l	17	< 0.1	< 0.1	NA	< 0.1
Hardness, as CaCO3	NA	mg/l	17	35.6	67	44.6	42.5
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	17	0.31	0.77	0.48	0.45
Nitrogen, ammonia, as N	NA	mg/l	17	< 0.05	0.15	0.05	< 0.1
pH	NA	pH units	23	6.22	8.57	6.75	6.55
Phosphorus, total, as P	NA	mg/l	NA	NA	NA	NA	NA
Redox (oxidation potential)	NA	mV	17	254	623	427	387
Solids, total dissolved	NA	mg/l	17	58	143	99.1	98.5
Specific Conductance @ 25 °C	NA	µmhos/cm	17	57.5	135.3	87.2	85.4
Sulfate, as SO4	NA	mg/l	17	6.3	7.73	6.91	7.0
Temperature	NA	deg C	17	4.2	9.42	6.29	6.33
Turbidity	NA	NTU	17	0	3.9	0.85	0
Metals							
Aluminum	Dissolved	µg/l	17	< 10	113	20.0	< 20
Aluminum	Total	µg/l	NA	NA	NA	NA	NA
Antimony	Dissolved	µg/l	17	< 0.5	< 0.5	NA	< 0.5
Antimony	Total	µg/l	NA	NA	NA	NA	NA
Arsenic	Dissolved	µg/l	17	< 0.31	0.71	0.28	< 0.5
Arsenic	Total	µg/l	NA	NA	NA	NA	NA
Barium	Dissolved	µg/l	6	4	4.8	4.48	4.55
Barium	Total	µg/l	11	5.1	11.3	7.98	8.15
Beryllium	Dissolved	µg/l	6	< 0.2	< 0.2	NA	< 0.2
Beryllium	Total	µg/l	11	< 0.2	< 0.2	NA	< 0.2
Boron	Dissolved	µg/l	6	< 100	< 100	NA	< 100
Boron	Total	µg/l	11	< 50	< 50	NA	< 50
Cadmium	Dissolved	µg/l	17	< 0.2	< 0.2	NA	< 0.2
Cadmium	Total	µg/l	NA	NA	NA	NA	NA
Calcium	Total	mg/l	17	8.9	21.1	12.1	11.3
Chromium	Dissolved	µg/l	17	1.7	5.77	2.82	2.45
Chromium	Total	µg/l	NA	NA	NA	NA	NA
Cobalt	Dissolved	µg/l	17	< 0.2	< 0.2	NA	< 0.2
Cobalt	Total	µg/l	NA	NA	NA	NA	NA
Copper	Dissolved	µg/l	17	< 0.5	2.7	0.81	0.79
Copper	Total	µg/l	NA	NA	NA	NA	NA
Iron	Dissolved	µg/l	17	< 50	< 50	NA	< 50
Iron	Total	µg/l	NA	NA	NA	NA	NA
Lead	Dissolved	µg/l	6	< 0.5	< 0.5	NA	< 0.5
Lead	Total	µg/l	11	< 0.5	< 0.5	NA	< 0.5
Magnesium	Total	mg/l	17	3.3	3.7	3.52	3.5
Manganese	Dissolved	µg/l	17	< 0.5	22.4	4.19	3.60
Manganese	Total	µg/l	NA	NA	NA	NA	NA
Mercury	Total	ng/l	17	< 0.5	0.77	0.30	< 0.5
Methyl Mercury	Total	ng/l	NA	NA	NA	NA	NA
Molybdenum	Dissolved	µg/l	17	0.29	2.2	0.49	0.35
Molybdenum	Total	µg/l	NA	NA	NA	NA	NA
Nickel	Dissolved	µg/l	17	< 0.5	0.85	0.34	< 0.5
Nickel	Total	µg/l	NA	NA	NA	NA	NA
Palladium	Total	µg/l	NA	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA	NA
Potassium	Total	mg/l	17	0.651	0.98	0.81	0.81
Selenium	Dissolved	µg/l	17	< 1	< 1	NA	< 1
Selenium	Total	µg/l	NA	NA	NA	NA	NA
Silver	Dissolved	µg/l	11	< 0.2	< 0.2	NA	< 0.2
Silver	Total	µg/l	NA	NA	NA	NA	NA
Sodium	Total	mg/l	17	2.5	3	2.72	2.7
Strontium	Total	µg/l	NA	NA	NA	NA	NA
Thallium	Dissolved	µg/l	6	< 0.02	< 0.2	NA	0.11
Thallium	Total	µg/l	11	< 0.017	< 0.2	NA	< 0.2
Titanium	Total	µg/l	NA	NA	NA	NA	NA
Vanadium	Dissolved	µg/l	11	< 5	< 5	NA	< 5
Zinc	Dissolved	µg/l	17	< 6	8.4	3.28	< 6
Zinc	Total	µg/l	NA	NA	NA	NA	NA

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for MW-15 2012-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	16	55.6	87.9	75.4	76.2
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	10	3.5	18.7	15.2	16.1
Carbon, total organic	NA	mg/l	16	3.8	21.8	16.6	16.1
Chemical Oxygen Demand	NA	mg/l	10	36.5	70.8	47.5	46.3
Chloride	NA	mg/l	16	< 0.5	< 1	0.42	0.58
Cyanide	NA	mg/l	NA	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	16	0.01	2.51	0.79	0.48
Fluoride	NA	mg/l	16	< 0.1	< 0.1	NA	< 0.1
Hardness, as CaCO3	NA	mg/l	16	59	74.8	65.6	64.7
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	16	< 0.1	< 0.1	NA	< 0.1
Nitrogen, ammonia, as N	NA	mg/l	16	< 0.1	3.5	2.91	3.1
pH	NA	pH units	22	5.88	6.7	6.18	6.11
Phosphorus, total, as P	NA	mg/l	NA	NA	NA	NA	NA
Redox (oxidation potential)	NA	mV	16	32	543	240	229
Solids, total dissolved	NA	mg/l	16	131	215	151	145
Specific Conductance @ 25 °C	NA	µmhos/cm	16	127.3	189.3	161	162
Sulfate, as SO4	NA	mg/l	16	< 1	< 2	0.77	< 1
Temperature	NA	deg C	16	4.62	11.08	7.93	7.61
Turbidity	NA	NTU	16	0	7.9	2.07	1.55
Metals							
Aluminum	Dissolved	µg/l	16	< 20	66.1	38.5	39.3
Aluminum	Total	µg/l	NA	NA	NA	NA	NA
Antimony	Dissolved	µg/l	16	< 0.5	< 0.5	NA	< 0.5
Antimony	Total	µg/l	NA	NA	NA	NA	NA
Arsenic	Dissolved	µg/l	16	< 0.5	0.97	0.60	0.59
Arsenic	Total	µg/l	NA	NA	NA	NA	NA
Barium	Dissolved	µg/l	6	27.7	33.7	29.7	28.4
Barium	Total	µg/l	10	29.9	58.1	41.2	39.7
Beryllium	Dissolved	µg/l	6	< 0.2	< 0.2	NA	< 0.2
Beryllium	Total	µg/l	10	< 0.2	< 0.2	NA	< 0.2
Boron	Dissolved	µg/l	6	< 100	< 100	NA	< 100
Boron	Total	µg/l	10	< 50	< 50	NA	< 50
Cadmium	Dissolved	µg/l	16	< 0.2	< 0.2	NA	< 0.2
Cadmium	Total	µg/l	NA	NA	NA	NA	NA
Calcium	Total	mg/l	16	13.7	17.9	15.2	15.0
Chromium	Dissolved	µg/l	16	< 1	1.6	0.57	< 1
Chromium	Total	µg/l	NA	NA	NA	NA	NA
Cobalt	Dissolved	µg/l	16	1.1	3.2	1.87	1.6
Cobalt	Total	µg/l	NA	NA	NA	NA	NA
Copper	Dissolved	µg/l	16	< 0.5	0.87	0.44	< 0.5
Copper	Total	µg/l	NA	NA	NA	NA	NA
Iron	Dissolved	µg/l	16	3360	10700	7201	6660
Iron	Total	µg/l	NA	NA	NA	NA	NA
Lead	Dissolved	µg/l	6	< 0.5	< 0.5	NA	< 0.5
Lead	Total	µg/l	10	< 0.5	< 0.5	NA	< 0.5
Magnesium	Total	mg/l	16	6	7.5	6.71	6.65
Manganese	Dissolved	µg/l	16	229	656	358	320
Manganese	Total	µg/l	NA	NA	NA	NA	NA
Mercury	Total	ng/l	16	< 0.5	1.23	0.39	< 0.5
Methyl Mercury	Total	ng/l	NA	NA	NA	NA	NA
Molybdenum	Dissolved	µg/l	16	< 0.2	0.35	0.16	< 0.3
Molybdenum	Total	µg/l	NA	NA	NA	NA	NA
Nickel	Dissolved	µg/l	16	0.66	1.9	1.17	1.2
Nickel	Total	µg/l	NA	NA	NA	NA	NA
Palladium	Total	µg/l	NA	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA	NA
Potassium	Total	mg/l	16	0.512	1.1	0.71	0.70
Selenium	Dissolved	µg/l	16	< 1	< 1	NA	< 1
Selenium	Total	µg/l	NA	NA	NA	NA	NA
Silver	Dissolved	µg/l	10	< 0.2	< 0.2	NA	< 0.2
Silver	Total	µg/l	NA	NA	NA	NA	NA
Sodium	Total	mg/l	16	2.7	3.7	3.11	3.05
Strontium	Total	µg/l	NA	NA	NA	NA	NA
Thallium	Dissolved	µg/l	6	< 0.02	< 0.2	NA	0.11
Thallium	Total	µg/l	10	< 0.017	< 0.2	NA	< 0.2
Titanium	Total	µg/l	NA	NA	NA	NA	NA
Vanadium	Dissolved	µg/l	10	< 5	< 5	NA	< 5
Zinc	Dissolved	µg/l	16	< 6	8.9	4.48	< 6
Zinc	Total	µg/l	NA	NA	NA	NA	NA

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for MW-16 2012-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	17	42.5	86.3	50.7	46.3
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	11	1.1	3.6	2.24	2.0
Carbon, total organic	NA	mg/l	17	< 1	3.2	1.74	1.6
Chemical Oxygen Demand	NA	mg/l	11	< 10	15.5	6.66	< 10
Chloride	NA	mg/l	17	< 0.5	1.14	0.52	< 1
Cyanide	NA	mg/l	NA	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	17	1.61	4.31	3.40	3.52
Fluoride	NA	mg/l	17	< 0.1	< 0.1	NA	< 0.1
Hardness, as CaCO3	NA	mg/l	17	42.7	68.4	50.2	47.4
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	17	< 0.1	0.22	0.13	0.14
Nitrogen, ammonia, as N	NA	mg/l	17	< 0.05	0.1	0.05	< 0.1
pH	NA	pH units	23	6.46	7.2	6.81	6.81
Phosphorus, total, as P	NA	mg/l	NA	NA	NA	NA	NA
Redox (oxidation potential)	NA	mV	17	150	562	399	409
Solids, total dissolved	NA	mg/l	17	67	204	96.8	94.0
Specific Conductance @ 25 °C	NA	µmhos/cm	17	67.8	167.3	103	100
Sulfate, as SO4	NA	mg/l	17	6.9	10.7	8.24	8.1
Temperature	NA	deg C	17	4.3	10.38	7.53	7.46
Turbidity	NA	NTU	17	0	7.9	2.42	1.9
Metals							
Aluminum	Dissolved	µg/l	17	< 10	863	59.3	< 20
Aluminum	Total	µg/l	NA	NA	NA	NA	NA
Antimony	Dissolved	µg/l	17	< 0.5	< 0.5	NA	< 0.5
Antimony	Total	µg/l	NA	NA	NA	NA	NA
Arsenic	Dissolved	µg/l	17	< 0.31	0.59	0.26	< 0.5
Arsenic	Total	µg/l	NA	NA	NA	NA	NA
Barium	Dissolved	µg/l	6	3	3.5	3.28	3.3
Barium	Total	µg/l	11	4.3	18.6	9.12	6.9
Beryllium	Dissolved	µg/l	6	< 0.2	< 0.2	NA	< 0.2
Beryllium	Total	µg/l	11	< 0.2	< 0.2	NA	< 0.2
Boron	Dissolved	µg/l	6	< 100	< 100	NA	< 100
Boron	Total	µg/l	11	< 50	< 50	NA	< 50
Cadmium	Dissolved	µg/l	17	< 0.2	< 0.2	NA	< 0.2
Cadmium	Total	µg/l	NA	NA	NA	NA	NA
Calcium	Total	mg/l	17	8.5	14.3	10.0	9.4
Chromium	Dissolved	µg/l	17	< 1	1.4	0.62	< 1
Chromium	Total	µg/l	NA	NA	NA	NA	NA
Cobalt	Dissolved	µg/l	17	< 0.2	1.32	0.33	< 0.2
Cobalt	Total	µg/l	NA	NA	NA	NA	NA
Copper	Dissolved	µg/l	17	< 0.5	2.8	1.73	1.8
Copper	Total	µg/l	NA	NA	NA	NA	NA
Iron	Dissolved	µg/l	17	< 50	369	45.5	< 50
Iron	Total	µg/l	NA	NA	NA	NA	NA
Lead	Dissolved	µg/l	6	< 0.5	< 0.5	NA	< 0.5
Lead	Total	µg/l	11	< 0.5	< 0.5	NA	< 0.5
Magnesium	Total	mg/l	17	5.2	7.94	6.09	5.8
Manganese	Dissolved	µg/l	17	< 0.5	339	39.1	1.1
Manganese	Total	µg/l	NA	NA	NA	NA	NA
Mercury	Total	ng/l	17	< 0.5	1.3	0.49	< 0.5
Methyl Mercury	Total	ng/l	NA	NA	NA	NA	NA
Molybdenum	Dissolved	µg/l	17	0.3	15	2.68	0.74
Molybdenum	Total	µg/l	NA	NA	NA	NA	NA
Nickel	Dissolved	µg/l	17	< 0.5	4	1.85	1.8
Nickel	Total	µg/l	NA	NA	NA	NA	NA
Palladium	Total	µg/l	NA	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA	NA
Potassium	Total	mg/l	17	0.99	1.6	1.21	1.2
Selenium	Dissolved	µg/l	17	< 1	< 1	NA	< 1
Selenium	Total	µg/l	NA	NA	NA	NA	NA
Silver	Dissolved	µg/l	11	< 0.2	< 0.2	NA	< 0.2
Silver	Total	µg/l	NA	NA	NA	NA	NA
Sodium	Total	mg/l	17	3.2	11.9	4.71	3.7
Strontium	Total	µg/l	NA	NA	NA	NA	NA
Thallium	Dissolved	µg/l	6	< 0.02	< 0.2	NA	0.11
Thallium	Total	µg/l	11	< 0.017	0.22	0.10	< 0.2
Titanium	Total	µg/l	NA	NA	NA	NA	NA
Vanadium	Dissolved	µg/l	11	< 5	< 5	NA	< 5
Zinc	Dissolved	µg/l	17	< 6	< 6	NA	< 6
Zinc	Total	µg/l	NA	NA	NA	NA	NA

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for MW-17 2012-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	17	118	166	139	142
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	11	13.8	45.8	30.9	30.8
Carbon, total organic	NA	mg/l	17	14.1	42.7	31.1	31.9
Chemical Oxygen Demand	NA	mg/l	11	62.3	433	126	97.8
Chloride	NA	mg/l	17	0.6	1.64	0.76	< 1
Cyanide	NA	mg/l	NA	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	17	< 0.1	4.71	0.98	< 0.1
Fluoride	NA	mg/l	17	< 0.1	0.14	0.07	< 0.1
Hardness, as CaCO3	NA	mg/l	17	110	141	126	125
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	17	< 0.1	0.12	0.05	< 0.1
Nitrogen, ammonia, as N	NA	mg/l	17	0.56	1.4	1.12	1.14
pH	NA	pH units	23	6.33	8.1	6.65	6.58
Phosphorus, total, as P	NA	mg/l	NA	NA	NA	NA	NA
Redox (oxidation potential)	NA	mV	17	-56	193	77.8	74
Solids, total dissolved	NA	mg/l	17	195	350	282	298
Specific Conductance @ 25 °C	NA	µmhos/cm	17	238.9	383.5	319	330
Sulfate, as SO4	NA	mg/l	17	< 1	8.86	1.75	< 2
Temperature	NA	deg C	17	3.05	13.71	8.76	7.93
Turbidity	NA	NTU	17	0	24.9	4.64	2.10
Metals							
Aluminum	Dissolved	µg/l	17	45.2	227	108	101
Aluminum	Total	µg/l	NA	NA	NA	NA	NA
Antimony	Dissolved	µg/l	17	< 0.5	< 0.5	NA	< 0.5
Antimony	Total	µg/l	NA	NA	NA	NA	NA
Arsenic	Dissolved	µg/l	17	< 0.5	1.1	0.81	0.89
Arsenic	Total	µg/l	NA	NA	NA	NA	NA
Barium	Dissolved	µg/l	6	41.2	47.5	44.0	42.9
Barium	Total	µg/l	11	50.3	67.2	57.1	56.7
Beryllium	Dissolved	µg/l	6	< 0.2	< 0.2	NA	< 0.2
Beryllium	Total	µg/l	11	< 0.2	< 0.2	NA	< 0.2
Boron	Dissolved	µg/l	6	< 100	< 100	NA	< 100
Boron	Total	µg/l	11	< 50	55.2	31.3	< 50
Cadmium	Dissolved	µg/l	17	< 0.2	< 0.2	NA	< 0.2
Cadmium	Total	µg/l	NA	NA	NA	NA	NA
Calcium	Total	mg/l	17	20.1	26	22.9	22.4
Chromium	Dissolved	µg/l	17	2.8	6.1	4.66	4.7
Chromium	Total	µg/l	NA	NA	NA	NA	NA
Cobalt	Dissolved	µg/l	17	1.1	5.47	2.66	2.45
Cobalt	Total	µg/l	NA	NA	NA	NA	NA
Copper	Dissolved	µg/l	17	1.4	49	6.93	3.3
Copper	Total	µg/l	NA	NA	NA	NA	NA
Iron	Dissolved	µg/l	17	10400	36500	22688	25200
Iron	Total	µg/l	NA	NA	NA	NA	NA
Lead	Dissolved	µg/l	6	< 0.5	< 0.5	NA	< 0.5
Lead	Total	µg/l	11	< 0.5	3.43	0.66	< 0.5
Magnesium	Total	mg/l	17	13.5	20.1	16.7	17.2
Manganese	Dissolved	µg/l	17	964	1350	1144	1150
Manganese	Total	µg/l	NA	NA	NA	NA	NA
Mercury	Total	ng/l	17	< 0.5	2.3	1.06	0.92
Methyl Mercury	Total	ng/l	NA	NA	NA	NA	NA
Molybdenum	Dissolved	µg/l	17	0.79	3.45	1.81	1.45
Molybdenum	Total	µg/l	NA	NA	NA	NA	NA
Nickel	Dissolved	µg/l	17	1.4	19.4	6.82	6.03
Nickel	Total	µg/l	NA	NA	NA	NA	NA
Palladium	Total	µg/l	NA	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA	NA
Potassium	Total	mg/l	17	0.621	1.7	1.11	1.0
Selenium	Dissolved	µg/l	17	< 1	< 1	NA	< 1
Selenium	Total	µg/l	NA	NA	NA	NA	NA
Silver	Dissolved	µg/l	11	< 0.2	< 0.2	NA	< 0.2
Silver	Total	µg/l	NA	NA	NA	NA	NA
Sodium	Total	mg/l	17	7.21	16.2	10.9	10.3
Strontium	Total	µg/l	NA	NA	NA	NA	NA
Thallium	Dissolved	µg/l	6	< 0.02	< 0.2	NA	< 0.02
Thallium	Total	µg/l	11	< 0.2	0.25	0.11	< 0.2
Titanium	Total	µg/l	NA	NA	NA	NA	NA
Vanadium	Dissolved	µg/l	11	8	13.1	10.4	10.4
Zinc	Dissolved	µg/l	17	< 6	12.9	4.68	< 6
Zinc	Total	µg/l	NA	NA	NA	NA	NA

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for MW-18 2012-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	17	84.5	142	119	122
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	11	5.3	14	8.12	7.5
Carbon, total organic	NA	mg/l	17	4.1	13.3	6.65	6.8
Chemical Oxygen Demand	NA	mg/l	11	16.6	82.1	30.9	25.4
Chloride	NA	mg/l	17	0.78	74.9	7.39	1.4
Cyanide	NA	mg/l	NA	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	17	0.75	10.68	7.34	7.44
Fluoride	NA	mg/l	17	< 0.1	0.14	0.10	0.11
Hardness, as CaCO3	NA	mg/l	17	110	223	140	134
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	17	< 0.1	1.19	0.18	0.11
Nitrogen, ammonia, as N	NA	mg/l	17	< 0.05	0.16	0.06	0.10
pH	NA	pH units	23	6.6	8.41	7.27	7.21
Phosphorus, total, as P	NA	mg/l	NA	NA	NA	NA	NA
Redox (oxidation potential)	NA	mV	17	177	603	362	323
Solids, total dissolved	NA	mg/l	17	156	239	190	190
Specific Conductance @ 25 °C	NA	µmhos/cm	17	0	494.2	254	250
Sulfate, as SO4	NA	mg/l	17	8.8	30.2	14.1	13.6
Temperature	NA	deg C	17	3.72	24.55	13.5	11.3
Turbidity	NA	NTU	17	5.1	1111	112	45
Metals							
Aluminum	Dissolved	µg/l	17	11.7	45.6	17.1	< 20
Aluminum	Total	µg/l	NA	NA	NA	NA	NA
Antimony	Dissolved	µg/l	17	< 0.5	0.54	0.27	< 0.5
Antimony	Total	µg/l	NA	NA	NA	NA	NA
Arsenic	Dissolved	µg/l	17	< 0.5	< 0.65	0.28	< 0.5
Arsenic	Total	µg/l	NA	NA	NA	NA	NA
Barium	Dissolved	µg/l	6	20.2	31.9	24.6	23.3
Barium	Total	µg/l	11	38.4	247	69.7	46.8
Beryllium	Dissolved	µg/l	6	< 0.2	< 0.2	NA	< 0.2
Beryllium	Total	µg/l	11	< 0.2	0.57	0.14	< 0.2
Boron	Dissolved	µg/l	6	< 100	< 100	NA	< 100
Boron	Total	µg/l	11	< 50	< 50	NA	< 50
Cadmium	Dissolved	µg/l	17	< 0.2	< 0.2	NA	< 0.2
Cadmium	Total	µg/l	NA	NA	NA	NA	NA
Calcium	Total	mg/l	17	25.1	47.1	31.4	30.7
Chromium	Dissolved	µg/l	17	< 1	2.5	0.64	< 1
Chromium	Total	µg/l	NA	NA	NA	NA	NA
Cobalt	Dissolved	µg/l	17	< 0.2	0.79	0.26	< 0.2
Cobalt	Total	µg/l	NA	NA	NA	NA	NA
Copper	Dissolved	µg/l	17	1.4	6.5	3.38	3.3
Copper	Total	µg/l	NA	NA	NA	NA	NA
Iron	Dissolved	µg/l	17	< 50	112	35.4	< 50
Iron	Total	µg/l	NA	NA	NA	NA	NA
Lead	Dissolved	µg/l	6	< 0.5	< 0.5	NA	< 0.5
Lead	Total	µg/l	11	< 0.5	8.09	1.31	0.65
Magnesium	Total	mg/l	17	11.2	25.6	14.9	14.1
Manganese	Dissolved	µg/l	17	22.6	422	177	137
Manganese	Total	µg/l	NA	NA	NA	NA	NA
Mercury	Total	ng/l	17	1.1	18.2	2.93	1.8
Methyl Mercury	Total	ng/l	NA	NA	NA	NA	NA
Molybdenum	Dissolved	µg/l	17	4	9.1	6.34	6.8
Molybdenum	Total	µg/l	NA	NA	NA	NA	NA
Nickel	Dissolved	µg/l	17	< 0.5	3.82	1.60	1.2
Nickel	Total	µg/l	NA	NA	NA	NA	NA
Palladium	Total	µg/l	NA	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA	NA
Potassium	Total	mg/l	17	1.8	6.35	2.46	2.2
Selenium	Dissolved	µg/l	17	< 1	2.73	0.63	< 1
Selenium	Total	µg/l	NA	NA	NA	NA	NA
Silver	Dissolved	µg/l	11	< 0.2	< 0.2	NA	< 0.2
Silver	Total	µg/l	NA	NA	NA	NA	NA
Sodium	Total	mg/l	17	7.5	45.5	13.7	9.5
Strontium	Total	µg/l	NA	NA	NA	NA	NA
Thallium	Dissolved	µg/l	6	< 0.02	< 0.2	NA	0.11
Thallium	Total	µg/l	11	< 0.2	0.44	0.14	< 0.2
Titanium	Total	µg/l	NA	NA	NA	NA	NA
Vanadium	Dissolved	µg/l	11	< 5	< 5	NA	< 5
Zinc	Dissolved	µg/l	17	< 6	8.05	3.40	< 6
Zinc	Total	µg/l	NA	NA	NA	NA	NA

NA No data available.

(1) Field duplicates not included in count of samples.

(2) Minimum and maximum determined with non-detect samples at the detection limit.

(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.

(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for MW-05-02 2005-2015							
Parameter	Fraction	Units	# of Samples[1]	Minimum[2]	Maximum[2]	Average[3]	Median[4]
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	5	36	75	48.5	39.8
Alkalinity, carbonate, as CaCO3	NA	mg/l	5	< 10	< 10	NA	< 10
Alkalinity, total, as CaCO3	NA	mg/l	21	27.9	88.3	48.0	37.6
Biochemical Oxygen Demand (5-day)	NA	mg/l	5	< 2.4	< 3	NA	< 2.4
Carbon, dissolved organic	NA	mg/l	13	1.7	5.4	2.59	2.2
Carbon, total organic	NA	mg/l	21	1.4	8	2.63	2.2
Chemical Oxygen Demand	NA	mg/l	16	< 10	43.2	12.1	< 10
Chloride	NA	mg/l	21	< 0.5	1.3	0.52	< 0.5
Cyanide	NA	mg/l	8	< 0.01	< 0.02	NA	< 0.02
Dissolved oxygen	NA	mg/l	20	2.91	12.11	8.94	9.97
Fluoride	NA	mg/l	21	< 0.1	0.21	0.06	< 0.1
Hardness, as CaCO3	NA	mg/l	21	31.1	89.6	53.2	44.0
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	21	0.12	1.42	0.45	0.37
Nitrogen, ammonia, as N	NA	mg/l	21	< 0.05	0.25	0.07	< 0.1
pH	NA	pH units	33	6.24	10.14	7.12	7.0
Phosphorus, total, as P	NA	mg/l	8	< 0.1	0.84	0.16	< 0.1
Redox (oxidation potential)	NA	mV	21	11.9	663	392	433
Solids, total dissolved	NA	mg/l	18	52	6080	431	88
Specific Conductance @ 25 °C	NA	µmhos/cm	21	39.5	512	122	76
Sulfate, as SO4	NA	mg/l	21	5.7	23	10.0	7.2
Temperature	NA	deg C	21	2.98	14.64	8.86	10.29
Turbidity	NA	NTU	19	0	570	32.9	1.1
Metals							
Aluminum	Dissolved	µg/l	21	< 10	< 100	14.1	< 20
Aluminum	Total	µg/l	8	31.6	22400	3033	144
Antimony	Dissolved	µg/l	13	< 0.5	< 0.5	NA	< 0.5
Antimony	Total	µg/l	8	< 0.5	< 3	NA	< 0.5
Arsenic	Dissolved	µg/l	17	< 0.5	2.1	0.49	< 0.5
Arsenic	Total	µg/l	8	< 0.5	4.41	1.43	< 1
Barium	Dissolved	µg/l	6	2.1	5.1	3.35	3.26
Barium	Total	µg/l	16	2.4	102	12.3	7.4
Beryllium	Dissolved	µg/l	5	< 0.2	< 0.2	NA	< 0.2
Beryllium	Total	µg/l	16	< 0.2	0.48	0.12	< 0.2
Boron	Dissolved	µg/l	6	< 50	< 100	NA	< 100
Boron	Total	µg/l	16	< 35	< 50	NA	< 50
Cadmium	Dissolved	µg/l	21	< 0.2	0.2	0.10	< 0.2
Cadmium	Total	µg/l	8	< 0.2	0.56	0.16	< 0.2
Calcium	Total	mg/l	21	6.8	30.1	13.1	10.2
Chromium	Dissolved	µg/l	21	< 1	7	1.05	< 1
Chromium	Total	µg/l	8	< 1	29.2	4.66	1.20
Cobalt	Dissolved	µg/l	14	< 0.2	4.9	0.76	< 0.2
Cobalt	Total	µg/l	8	< 0.2	13.7	2.09	0.71
Copper	Dissolved	µg/l	21	0.56	8.2	3.14	1.87
Copper	Total	µg/l	8	2.2	95.1	16.3	2.87
Iron	Dissolved	µg/l	17	< 50	638	76.9	< 50
Iron	Total	µg/l	8	54.3	27400	3685	167
Lead	Dissolved	µg/l	6	< 0.5	< 0.5	NA	< 0.5
Lead	Total	µg/l	16	< 0.5	7.24	0.82	< 0.5
Magnesium	Total	mg/l	21	2.3	11.4	4.97	4.4
Manganese	Dissolved	µg/l	18	< 0.5	869	100	1.95
Manganese	Total	µg/l	8	3.95	698	114	< 30
Mercury	Total	ng/l	21	< 0.5	7	1.12	0.74
Methyl Mercury	Total	ng/l	8	< 0.025	< 0.146	0.052	< 0.1
Molybdenum	Dissolved	µg/l	21	< 0.2	13.1	1.02	< 0.3
Molybdenum	Total	µg/l	8	< 0.2	16.1	2.69	0.41
Nickel	Dissolved	µg/l	21	1.1	10.3	2.54	1.87
Nickel	Total	µg/l	8	1.68	47	8.06	2.5
Palladium	Total	µg/l	8	< 0.1	< 25	NA	< 0.5
Platinum	Total	µg/l	8	< 0.01	< 25	NA	< 0.5
Potassium	Total	mg/l	21	0.85	4.7	1.42	1.1
Selenium	Dissolved	µg/l	21	< 0.2	< 2	NA	< 1
Selenium	Total	µg/l	8	0.33	< 2	0.60	< 1
Silver	Dissolved	µg/l	16	< 0.2	< 1	NA	< 0.2
Silver	Total	µg/l	8	< 0.2	< 2	NA	< 0.2
Sodium	Total	mg/l	21	2.1	11.9	3.68	2.43
Strontium	Total	µg/l	8	27.3	191	80.7	64.2
Thallium	Dissolved	µg/l	5	< 0.02	< 0.2	NA	< 0.02
Thallium	Total	µg/l	16	< 0.017	< 2	NA	< 0.2
Titanium	Total	µg/l	8	< 10	930	129	< 20
Vanadium	Dissolved	µg/l	8	< 5	< 25	NA	< 5
Zinc	Dissolved	µg/l	21	< 6	< 25	4.39	< 6
Zinc	Total	µg/l	8	< 6	60.6	11.7	< 6

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for MW-05-08 2005-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	6	51.7	55.2	53.7	54.1
Alkalinity, carbonate, as CaCO3	NA	mg/l	6	< 10	< 10	NA	< 10
Alkalinity, total, as CaCO3	NA	mg/l	27	51.6	107	57.4	54.3
Biochemical Oxygen Demand (5-day)	NA	mg/l	6	< 2.4	< 3	NA	< 2.4
Carbon, dissolved organic	NA	mg/l	18	< 1	3.4	1.61	1.5
Carbon, total organic	NA	mg/l	27	< 1	3.8	1.29	1.2
Chemical Oxygen Demand	NA	mg/l	21	8.8	18	6.83	< 10
Chloride	NA	mg/l	27	< 0.5	1.5	0.67	0.63
Cyanide	NA	mg/l	9	< 0.01	0.037	0.011	< 0.02
Dissolved oxygen	NA	mg/l	26	< 0.1	6.65	1.79	1.02
Fluoride	NA	mg/l	27	< 0.1	0.19	0.07	< 0.1
Hardness, as CaCO3	NA	mg/l	27	54.5	68.8	58.3	57.5
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	27	0.14	0.9	0.31	0.3
Nitrogen, ammonia, as N	NA	mg/l	27	< 0.05	0.42	0.07	< 0.1
pH	NA	pH units	41	6.6	8.54	7.37	7.3
Phosphorus, total, as P	NA	mg/l	9	< 0.1	0.17	0.08	< 0.1
Redox (oxidation potential)	NA	mV	27	-196.5	521	331	368
Solids, total dissolved	NA	mg/l	24	85	142	104	103
Specific Conductance @ 25 ºC	NA	µmhos/cm	27	81.8	212	125	123
Sulfate, as SO4	NA	mg/l	27	8.7	21.2	9.74	9.2
Temperature	NA	deg C	27	3.01	13.2	7.87	8.21
Turbidity	NA	NTU	25	0	487	27.4	0.6
Metals							
Aluminum	Dissolved	µg/l	27	< 10	214	25.6	< 20
Aluminum	Total	µg/l	9	136	5140	1488	1040
Antimony	Dissolved	µg/l	18	< 0.5	< 0.5	NA	< 0.5
Antimony	Total	µg/l	9	< 0.5	< 3	NA	< 0.5
Arsenic	Dissolved	µg/l	23	< 0.31	< 1	0.29	< 0.5
Arsenic	Total	µg/l	9	< 0.5	4.4	1.0	< 1
Barium	Dissolved	µg/l	6	10	11.1	10.7	10.9
Barium	Total	µg/l	21	11.4	44.1	17.6	13.6
Beryllium	Dissolved	µg/l	6	< 0.2	< 0.2	NA	< 0.2
Beryllium	Total	µg/l	21	< 0.2	< 0.2	NA	< 0.2
Boron	Dissolved	µg/l	8	< 50	< 100	NA	< 100
Boron	Total	µg/l	21	< 35	< 50	27.8	< 50
Cadmium	Dissolved	µg/l	27	< 0.03	< 0.2	NA	< 0.2
Cadmium	Total	µg/l	9	0.08	0.28	0.11	< 0.2
Calcium	Total	mg/l	27	11.2	14.9	12.2	11.9
Chromium	Dissolved	µg/l	27	< 1	2.5	0.81	< 1
Chromium	Total	µg/l	9	< 1	6.72	2.40	3.17
Cobalt	Dissolved	µg/l	18	< 0.2	< 0.2	NA	< 0.2
Cobalt	Total	µg/l	9	< 0.2	3.17	0.88	< 1
Copper	Dissolved	µg/l	27	0.49	6.4	0.69	< 0.7
Copper	Total	µg/l	9	0.8	10	3.9	5.2
Iron	Dissolved	µg/l	23	< 50	99.5	33.1	< 50
Iron	Total	µg/l	9	113	4450	1313	1600
Lead	Dissolved	µg/l	6	< 0.5	< 0.5	NA	< 0.5
Lead	Total	µg/l	21	< 0.5	1.97	0.44	< 0.5
Magnesium	Total	mg/l	27	6.33	8.23	6.79	6.70
Manganese	Dissolved	µg/l	24	26	73.4	43.3	41.1
Manganese	Total	µg/l	9	61.2	227	124	116
Mercury	Total	ng/l	27	< 0.5	5.3	0.69	< 0.5
Methyl Mercury	Total	ng/l	9	< 0.025	0.44	0.076	< 0.1
Molybdenum	Dissolved	µg/l	27	0.58	34.4	2.10	0.71
Molybdenum	Total	µg/l	9	0.87	35.6	5.00	1.11
Nickel	Dissolved	µg/l	27	< 0.5	< 2	0.41	< 0.6
Nickel	Total	µg/l	9	0.82	11.8	3.66	3.0
Palladium	Total	µg/l	9	< 0.1	< 25	NA	< 0.5
Platinum	Total	µg/l	9	< 0.02	< 25	NA	< 0.5
Potassium	Total	mg/l	27	1.1	1.82	1.33	1.30
Selenium	Dissolved	µg/l	27	0.4	< 2	0.54	< 1
Selenium	Total	µg/l	9	0.57	< 2	0.62	< 1
Silver	Dissolved	µg/l	21	< 0.2	< 1	NA	< 0.2
Silver	Total	µg/l	9	< 0.2	< 2	NA	< 0.2
Sodium	Total	mg/l	27	3.5	15.7	4.63	4.07
Strontium	Total	µg/l	9	32.6	47.5	36.1	35.9
Thallium	Dissolved	µg/l	6	< 0.02	< 0.2	NA	< 0.2
Thallium	Total	µg/l	21	< 0.017	< 2	0.20	< 0.2
Titanium	Total	µg/l	9	< 10	130	45.7	52.0
Vanadium	Dissolved	µg/l	12	< 5	< 10	NA	< 5
Zinc	Dissolved	µg/l	27	< 6	< 25	4.23	< 6
Zinc	Total	µg/l	9	< 6	< 25	6.33	8.26

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for MW-05-09 2005-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	7	15.8	20.7	18.2	18.6
Alkalinity, carbonate, as CaCO3	NA	mg/l	7	< 10	< 10	NA	< 10
Alkalinity, total, as CaCO3	NA	mg/l	30	12.2	47	18.6	16.7
Biochemical Oxygen Demand (5-day)	NA	mg/l	7	< 2.4	< 4	NA	< 2.4
Carbon, dissolved organic	NA	mg/l	22	2.8	18.6	4.72	4.0
Carbon, total organic	NA	mg/l	30	2.47	17.3	4.25	3.70
Chemical Oxygen Demand	NA	mg/l	24	6.9	42.6	20.7	22.0
Chloride	NA	mg/l	30	< 0.5	5.5	0.60	< 0.5
Cyanide	NA	mg/l	9	< 0.01	< 0.02	NA	< 0.02
Dissolved oxygen	NA	mg/l	29	1.8	12.31	9.55	10.3
Fluoride	NA	mg/l	30	< 0.1	0.1	0.05	0.1
Hardness, as CaCO3	NA	mg/l	30	10.3	75.1	25.6	23.0
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	30	< 0.1	0.39	0.16	0.18
Nitrogen, ammonia, as N	NA	mg/l	30	< 0.05	0.15	0.05	< 0.1
pH	NA	pH units	45	6.11	9.2	7.02	6.86
Phosphorus, total, as P	NA	mg/l	10	< 0.1	1.75	0.37	0.18
Redox (oxidation potential)	NA	mV	30	89	505	358	384
Solids, total dissolved	NA	mg/l	27	39	202	85.3	78
Specific Conductance @ 25 °C	NA	µmhos/cm	30	0	139	51.7	51
Sulfate, as SO4	NA	mg/l	30	2.9	19.7	8.55	8.6
Temperature	NA	deg C	30	4.2	25.09	11.5	10.6
Turbidity	NA	NTU	28	0	860	116	53.8
Metals							
Aluminum	Dissolved	µg/l	31	36.2	910	273	299
Aluminum	Total	µg/l	10	4200	32300	11816	6550
Antimony	Dissolved	µg/l	21	< 0.5	< 0.5	NA	< 0.5
Antimony	Total	µg/l	10	< 0.5	< 3	0.66	< 0.5
Arsenic	Dissolved	µg/l	27	< 0.31	< 1	NA	< 0.5
Arsenic	Total	µg/l	10	1.82	5.84	2.84	2.38
Barium	Dissolved	µg/l	6	7.5	11.8	10.3	10.7
Barium	Total	µg/l	24	17	301	82.8	65.6
Beryllium	Dissolved	µg/l	6	< 0.2	< 0.2	NA	< 0.2
Beryllium	Total	µg/l	24	< 0.2	0.84	0.24	< 0.2
Boron	Dissolved	µg/l	8	< 50	< 100	NA	< 100
Boron	Total	µg/l	24	40.2	< 50	28.3	< 50
Cadmium	Dissolved	µg/l	31	< 0.03	0.25	0.11	< 0.2
Cadmium	Total	µg/l	10	< 0.2	0.37	0.18	< 0.2
Calcium	Total	mg/l	30	2.4	12.6	5.37	4.82
Chromium	Dissolved	µg/l	31	< 1	2.86	1.13	1.15
Chromium	Total	µg/l	10	8.5	55	25.9	20.6
Cobalt	Dissolved	µg/l	21	< 0.2	0.73	0.21	0.22
Cobalt	Total	µg/l	10	2.83	23	6.98	4.88
Copper	Dissolved	µg/l	31	1.3	18.2	4.44	3.3
Copper	Total	µg/l	10	13.9	99.6	42.1	36.0
Iron	Dissolved	µg/l	27	< 50	685	291	317
Iron	Total	µg/l	10	5210	44400	14768	8600
Lead	Dissolved	µg/l	6	< 0.5	< 0.5	NA	< 0.5
Lead	Total	µg/l	24	< 0.5	11.5	3.07	1.9
Magnesium	Total	mg/l	30	0.99	10.6	2.96	2.43
Manganese	Dissolved	µg/l	28	4.8	42.8	15.0	12.7
Manganese	Total	µg/l	10	194	1770	517	330
Mercury	Total	ng/l	30	4.3	87.6	14.8	7.74
Methyl Mercury	Total	ng/l	9	0.043	0.52	0.134	< 0.1
Molybdenum	Dissolved	µg/l	31	0.22	8.8	2.28	1.90
Molybdenum	Total	µg/l	10	1	12.4	5.80	4.81
Nickel	Dissolved	µg/l	31	0.8	3.14	1.48	1.34
Nickel	Total	µg/l	10	8.2	45.2	19.0	11.2
Palladium	Total	µg/l	10	< 0.1	< 25	NA	< 0.5
Platinum	Total	µg/l	10	< 0.02	< 25	NA	< 0.5
Potassium	Total	µg/l	30	0.64	6.87	1.95	1.70
Selenium	Dissolved	µg/l	31	< 0.2	< 2	NA	< 1
Selenium	Total	µg/l	10	0.59	< 2	0.61	< 1
Silver	Dissolved	µg/l	25	< 0.2	< 1	NA	< 0.2
Silver	Total	µg/l	10	< 0.2	< 1	NA	< 0.2
Sodium	Total	µg/l	30	2.6	12	6.77	6.5
Strontium	Total	µg/l	10	31.1	98.1	47.1	38.1
Thallium	Dissolved	µg/l	6	< 0.02	< 0.2	NA	0.11
Thallium	Total	µg/l	24	< 0.017	< 2	0.18	< 0.2
Titanium	Total	µg/l	10	175	1300	540	390
Vanadium	Dissolved	µg/l	15	< 5	< 10	NA	< 5
Zinc	Dissolved	µg/l	31	< 6	< 25	6.79	6.26
Zinc	Total	µg/l	10	11.8	64.5	26.9	18.9

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for OB-1 2006-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	6	28.6	98	45.2	36
Alkalinity, carbonate, as CaCO3	NA	mg/l	6	< 10	< 20	NA	< 10
Alkalinity, total, as CaCO3	NA	mg/l	10	28.6	98	44.0	36
Biochemical Oxygen Demand (5-day)	NA	mg/l	7	< 2.4	< 8	NA	3.5
Carbon, dissolved organic	NA	mg/l	6	1.3	2.5	1.73	1.5
Carbon, total organic	NA	mg/l	10	1	1.8	1.29	1.2
Chemical Oxygen Demand	NA	mg/l	8	< 10	54.7	12.4	< 10
Chloride	NA	mg/l	10	1.1	15.7	3.46	2.39
Cyanide	NA	mg/l	8	< 0.01	< 0.02	0.01	0.01
Dissolved oxygen	NA	mg/l	10	0.06	9.59	2.55	1.69
Fluoride	NA	mg/l	10	< 0.1	0.16	0.11	0.11
Hardness, as CaCO3	NA	mg/l	10	43.2	119	71.8	53.8
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	10	< 0.1	< 0.1	NA	< 0.1
Nitrogen, ammonia, as N	NA	mg/l	10	0.06	0.2	0.07	< 0.1
pH	NA	pH units	20	6.78	10.4	9.12	9.10
Phosphorus, total, as P	NA	mg/l	8	< 0.1	< 0.1	NA	< 0.1
Redox (oxidation potential)	NA	mV	10	-47	409	229	216
Solids, total dissolved	NA	mg/l	8	76	115	97.4	103
Specific Conductance @ 25 °C	NA	µmhos/cm	10	104.7	261	151	148
Sulfate, as SO4	NA	mg/l	10	18.2	37.2	26.4	25.1
Temperature	NA	deg C	10	4.9	10.93	7.49	6.98
Turbidity	NA	NTU	9	0	193.4	37.3	19.0
Metals							
Aluminum	Dissolved	µg/l	10	16.6	127	53.2	45.1
Aluminum	Total	µg/l	8	23.4	4740	1265	443
Antimony	Dissolved	µg/l	2	< 0.5	< 0.5	NA	< 0.5
Antimony	Total	µg/l	8	< 0.5	< 3	0.59	< 0.5
Arsenic	Dissolved	µg/l	7	< 0.5	1.15	0.74	0.795
Arsenic	Total	µg/l	8	0.91	2.43	1.36	1.52
Barium	Dissolved	µg/l	5	0.8	3.7	1.53	0.97
Barium	Total	µg/l	8	0.75	29.9	10.9	< 10
Beryllium	Dissolved	µg/l	2	< 0.2	< 0.2	NA	< 0.2
Beryllium	Total	µg/l	8	< 0.2	0.36	0.13	< 0.2
Boron	Dissolved	µg/l	5	< 50	< 100	NA	< 50
Boron	Total	µg/l	8	< 50	< 50	NA	< 50
Cadmium	Dissolved	µg/l	10	< 0.2	< 0.2	NA	< 0.2
Cadmium	Total	µg/l	8	< 0.2	< 0.2	NA	< 0.2
Calcium	Total	mg/l	10	10.2	32.5	20.3	15.7
Chromium	Dissolved	µg/l	10	< 1	1.1	0.56	< 1
Chromium	Total	µg/l	8	< 1	9.29	2.78	1.70
Cobalt	Dissolved	µg/l	5	< 0.2	< 0.2	NA	< 0.2
Cobalt	Total	µg/l	8	< 0.2	3.01	0.86	0.91
Copper	Dissolved	µg/l	10	< 0.5	2.2	0.90	0.81
Copper	Total	µg/l	8	0.96	18.8	5.96	2.55
Iron	Dissolved	µg/l	7	< 50	< 50	NA	< 50
Iron	Total	µg/l	8	< 50	20700	6122	1590
Lead	Dissolved	µg/l	5	< 0.5	< 0.5	NA	< 0.5
Lead	Total	µg/l	8	< 0.5	< 2	0.42	< 0.5
Magnesium	Total	mg/l	10	2.8	9.14	5.10	4.8
Manganese	Dissolved	µg/l	8	0.83	< 10	4.11	4.9
Manganese	Total	µg/l	8	< 10	247	67	20
Mercury	Total	ng/l	10	< 0.5	0.7	0.32	< 0.5
Methyl Mercury	Total	ng/l	8	< 0.03	< 0.1	0.04	0.08
Molybdenum	Dissolved	µg/l	10	0.62	< 5	1.64	1.74
Molybdenum	Total	µg/l	8	0.62	< 5	2.03	2.13
Nickel	Dissolved	µg/l	10	0.86	2.84	1.60	1.9
Nickel	Total	µg/l	8	< 2	20.5	6.64	4.22
Palladium	Total	µg/l	8	< 0.1	< 0.5	NA	< 0.5
Platinum	Total	µg/l	8	< 0.02	< 0.5	NA	< 0.5
Potassium	Total	mg/l	10	1.2	2.38	1.67	1.67
Selenium	Dissolved	µg/l	10	< 1	< 2	NA	< 1
Selenium	Total	µg/l	8	< 1	< 2	NA	< 1
Silver	Dissolved	µg/l	8	< 0.2	< 1	NA	< 0.2
Silver	Total	µg/l	8	< 0.2	< 1	NA	< 0.2
Sodium	Total	mg/l	10	3.7	12.3	8.77	8.74
Strontium	Total	µg/l	8	51.5	112	83.6	87.2
Thallium	Dissolved	µg/l	2	< 0.02	< 0.2	NA	0.11
Thallium	Total	µg/l	8	< 0.2	< 2	NA	< 0.2
Titanium	Total	µg/l	8	< 10	340	79.3	22
Vanadium	Dissolved	µg/l	NA	NA	NA	NA	NA
Zinc	Dissolved	µg/l	10	< 6	< 25	4.84	< 6
Zinc	Total	µg/l	8	< 6	43.7	12.0	7.6

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for OB-2 2006-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	6	79.5	96.4	92.3	94.2
Alkalinity, carbonate, as CaCO3	NA	mg/l	6	< 10	< 20	NA	< 10
Alkalinity, total, as CaCO3	NA	mg/l	10	< 10	98.3	84.4	94.2
Biochemical Oxygen Demand (5-day)	NA	mg/l	6	< 2.4	4.3	1.95	< 3
Carbon, dissolved organic	NA	mg/l	6	1.6	3.3	2.19	2.1
Carbon, total organic	NA	mg/l	10	1.5	2.8	1.89	1.8
Chemical Oxygen Demand	NA	mg/l	8	< 10	22.8	10.5	< 10
Chloride	NA	mg/l	10	< 0.5	1.1	0.61	0.66
Cyanide	NA	mg/l	8	< 0.01	< 0.02	NA	< 0.02
Dissolved oxygen	NA	mg/l	10	0.03	2.4	0.92	0.39
Fluoride	NA	mg/l	10	< 0.1	0.22	0.14	0.14
Hardness, as CaCO3	NA	mg/l	10	76.4	98.9	91.9	92.6
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	10	< 0.1	0.18	0.06	< 0.1
Nitrogen, ammonia, as N	NA	mg/l	10	< 0.05	< 0.1	NA	< 0.1
pH	NA	pH units	20	6.79	8.09	7.58	7.60
Phosphorus, total, as P	NA	mg/l	8	< 0.1	< 0.1	NA	< 0.1
Redox (oxidation potential)	NA	mV	10	-148	492	121	59
Solids, total dissolved	NA	mg/l	8	103	147	125	118
Specific Conductance @ 25 °C	NA	µmhos/cm	10	180	301	201	187
Sulfate, as SO4	NA	mg/l	10	4.53	10.9	8.30	8.89
Temperature	NA	deg C	10	5.3	8.6	6.63	6.2
Turbidity	NA	NTU	9	0	251.5	42.2	19.3
Metals							
Aluminum	Dissolved	µg/l	10	< 10	< 25	NA	< 25
Aluminum	Total	µg/l	8	< 20	132	49.1	60.6
Antimony	Dissolved	µg/l	2	< 0.5	< 0.5	NA	< 0.5
Antimony	Total	µg/l	8	< 0.5	< 3	NA	< 0.5
Arsenic	Dissolved	µg/l	7	< 0.5	< 1	NA	< 0.5
Arsenic	Total	µg/l	8	< 0.5	< 2	NA	< 1
Barium	Dissolved	µg/l	4	< 0.5	0.75	0.66	0.71
Barium	Total	µg/l	8	0.77	< 10	1.76	1.35
Beryllium	Dissolved	µg/l	2	< 0.2	< 0.2	NA	< 0.2
Beryllium	Total	µg/l	8	< 0.2	< 0.2	NA	< 0.2
Boron	Dissolved	µg/l	5	< 50	< 100	50.3	83.0
Boron	Total	µg/l	8	< 50	93.1	40.5	< 50
Cadmium	Dissolved	µg/l	10	< 0.2	< 0.2	NA	< 0.2
Cadmium	Total	µg/l	8	< 0.2	< 0.2	NA	< 0.2
Calcium	Total	mg/l	10	10.8	14.9	13.7	14.0
Chromium	Dissolved	µg/l	10	< 1	< 1	NA	< 1
Chromium	Total	µg/l	8	< 1	5	1.06	< 1
Cobalt	Dissolved	µg/l	4	0.25	0.49	0.37	0.36
Cobalt	Total	µg/l	8	0.35	3.18	1.22	0.96
Copper	Dissolved	µg/l	10	< 0.5	3.07	0.68	< 0.7
Copper	Total	µg/l	8	< 0.5	6.18	2.53	2.30
Iron	Dissolved	µg/l	7	142	2300	988	876
Iron	Total	µg/l	8	334	25600	7792	5870
Lead	Dissolved	µg/l	4	< 0.5	< 0.5	NA	< 0.5
Lead	Total	µg/l	8	< 0.5	< 1	NA	< 0.5
Magnesium	Total	mg/l	10	12	15.1	14.0	14.2
Manganese	Dissolved	µg/l	8	85.5	216	167	182
Manganese	Total	µg/l	8	41.6	280	174	179
Mercury	Total	ng/l	11	< 0.5	1.6	0.54	0.50
Methyl Mercury	Total	ng/l	9	< 0.03	< 0.1	NA	< 0.1
Molybdenum	Dissolved	µg/l	10	1.2	< 5	1.89	1.7
Molybdenum	Total	µg/l	8	0.76	< 5	1.63	1.5
Nickel	Dissolved	µg/l	10	0.69	8.31	3.02	2.8
Nickel	Total	µg/l	8	1	48.5	13.1	5.67
Palladium	Total	µg/l	8	< 0.1	< 0.5	NA	< 0.5
Platinum	Total	µg/l	8	< 0.02	< 0.5	NA	< 0.5
Potassium	Total	mg/l	10	1.2	1.57	1.44	1.46
Selenium	Dissolved	µg/l	10	< 1	< 2	NA	< 1
Selenium	Total	µg/l	8	< 1	< 10	NA	< 1
Silver	Dissolved	µg/l	8	< 0.2	< 1	NA	< 0.2
Silver	Total	µg/l	8	< 0.2	< 1	NA	< 0.2
Sodium	Total	mg/l	10	3.46	19.7	8.03	5.40
Strontium	Total	µg/l	8	44.2	66	58.4	60.2
Thallium	Dissolved	µg/l	2	< 0.02	< 0.2	NA	< 0.2
Thallium	Total	µg/l	8	< 0.2	< 2	NA	< 0.2
Titanium	Total	µg/l	8	< 10	< 20	NA	< 10
Vanadium	Dissolved	µg/l	NA	NA	NA	NA	NA
Zinc	Dissolved	µg/l	10	< 6	< 25	5.34	< 6
Zinc	Total	µg/l	8	< 6	< 25	NA	< 6

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for OB-3 2006-2015							
Parameter	Fraction	Units	# of Samples[1]	Minimum[2]	Maximum[2]	Average[3]	Median[4]
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	6	80	115	97.7	104
Alkalinity, carbonate, as CaCO3	NA	mg/l	6	< 10	< 20	NA	< 10
Alkalinity, total, as CaCO3	NA	mg/l	10	66.2	115	94.9	104
Biochemical Oxygen Demand (5-day)	NA	mg/l	6	< 2.4	< 4	NA	< 3
Carbon, dissolved organic	NA	mg/l	6	2.6	3.9	3.03	2.9
Carbon, total organic	NA	mg/l	10	2.5	3.8	2.98	2.9
Chemical Oxygen Demand	NA	mg/l	8	< 10	26.7	12.7	13.5
Chloride	NA	mg/l	10	0.57	93.1	10.0	0.81
Cyanide	NA	mg/l	8	< 0.01	< 0.02	NA	< 0.02
Dissolved oxygen	NA	mg/l	10	0.05	2	0.68	0.20
Fluoride	NA	mg/l	10	< 0.1	0.97	0.19	0.12
Hardness, as CaCO3	NA	mg/l	10	122	151	136	134
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	10	< 0.1	0.12	0.06	< 0.1
Nitrogen, ammonia, as N	NA	mg/l	10	0.09	0.14	0.07	< 0.1
pH	NA	pH units	20	6.6	8	7.33	7.3
Phosphorus, total, as P	NA	mg/l	8	< 0.1	4.4	0.65	< 0.1
Redox (oxidation potential)	NA	mV	10	-63	476	140	106
Solids, total dissolved	NA	mg/l	8	146	221	189	174
Specific Conductance @ 25 °C	NA	µmhos/cm	10	198	440	281	275
Sulfate, as SO4	NA	mg/l	10	19.4	68.9	44.9	35.6
Temperature	NA	deg C	10	5.9	12.09	8.40	8.44
Turbidity	NA	NTU	9	0.7	75.4	13.5	7.5
Metals							
Aluminum	Dissolved	µg/l	11	< 10	< 25	NA	< 25
Aluminum	Total	µg/l	9	20.9	8210	1082	327
Antimony	Dissolved	µg/l	2	< 0.5	< 0.5	NA	< 0.5
Antimony	Total	µg/l	9	< 0.5	< 3	0.69	< 0.5
Arsenic	Dissolved	µg/l	7	< 0.5	< 1	0.61	0.97
Arsenic	Total	µg/l	9	< 1	26.6	5.71	2.83
Barium	Dissolved	µg/l	4	1.3	2.3	1.88	1.95
Barium	Total	µg/l	9	2.2	15.8	4.70	2.96
Beryllium	Dissolved	µg/l	2	< 0.2	< 0.2	NA	< 0.2
Beryllium	Total	µg/l	9	< 0.2	0.21	0.11	< 0.2
Boron	Dissolved	µg/l	5	< 50	< 100	NA	< 50
Boron	Total	µg/l	9	< 50	< 50	NA	< 50
Cadmium	Dissolved	µg/l	10	< 0.2	0.92	0.18	< 0.2
Cadmium	Total	µg/l	9	< 0.2	48	5.47	< 0.2
Calcium	Total	mg/l	11	20.6	24.9	22.3	22.2
Chromium	Dissolved	µg/l	10	< 1	< 1	NA	< 1
Chromium	Total	µg/l	9	< 1	5.53	1.77	1.35
Cobalt	Dissolved	µg/l	4	4.6	5	4.78	4.75
Cobalt	Total	µg/l	9	4.1	23.3	9.06	7.23
Copper	Dissolved	µg/l	11	< 0.5	< 5	1.06	0.85
Copper	Total	µg/l	9	0.7	67.1	12.8	4.7
Iron	Dissolved	µg/l	7	204	3240	2138	2460
Iron	Total	µg/l	9	3600	44300	13027	4380
Lead	Dissolved	µg/l	4	< 0.5	< 0.5	NA	< 0.5
Lead	Total	µg/l	9	< 0.5	4.09	0.87	< 0.5
Magnesium	Total	mg/l	11	17.1	21.6	19.6	19.2
Manganese	Dissolved	µg/l	8	177	218	205	208
Manganese	Total	µg/l	9	207	383	276	233
Mercury	Total	ng/l	11	< 0.5	1.7	0.51	< 0.5
Methyl Mercury	Total	ng/l	9	< 0.03	< 0.1	0.04	< 0.1
Molybdenum	Dissolved	µg/l	11	0.74	< 5	1.27	0.91
Molybdenum	Total	µg/l	9	0.29	< 5	1.27	0.90
Nickel	Dissolved	µg/l	11	91	158	114	118
Nickel	Total	µg/l	9	103	445	203	157
Palladium	Total	µg/l	8	< 0.1	< 0.5	NA	< 0.5
Platinum	Total	µg/l	8	< 0.02	< 0.5	NA	< 0.5
Potassium	Total	mg/l	11	1.64	3.47	2.08	1.93
Selenium	Dissolved	µg/l	10	< 1	< 2	NA	< 1
Selenium	Total	µg/l	9	< 1	< 2	NA	< 1
Silver	Dissolved	µg/l	8	< 0.2	< 1	NA	< 0.2
Silver	Total	µg/l	9	< 0.2	< 1	NA	< 0.2
Sodium	Total	mg/l	11	6.33	14.3	8.00	7.60
Strontium	Total	µg/l	9	74.8	93.8	86.3	85.4
Thallium	Dissolved	µg/l	2	< 0.02	< 0.2	NA	0.11
Thallium	Total	µg/l	9	< 0.2	< 2	0.32	< 0.2
Titanium	Total	µg/l	9	< 10	101	17.9	13.5
Vanadium	Dissolved	µg/l	NA	NA	NA	NA	NA
Zinc	Dissolved	µg/l	11	< 6	< 25	6.41	< 6
Zinc	Total	µg/l	9	< 6	44.6	12.2	7.5

NA No data available.

(1) Field duplicates not included in count of samples.

(2) Minimum and maximum determined with non-detect samples at the detection limit.

(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.

(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for OB-4 2006-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	6	14.1	25.9	17.5	17.7
Alkalinity, carbonate, as CaCO3	NA	mg/l	6	< 10	< 20	NA	< 10
Alkalinity, total, as CaCO3	NA	mg/l	10	10.4	26.7	17.3	17.3
Biochemical Oxygen Demand (5-day)	NA	mg/l	6	< 2.4	< 3	NA	2.7
Carbon, dissolved organic	NA	mg/l	6	1.3	2.7	1.72	1.7
Carbon, total organic	NA	mg/l	10	1	2.2	1.51	1.55
Chemical Oxygen Demand	NA	mg/l	8	< 10	30.5	9.35	< 10
Chloride	NA	mg/l	10	< 0.5	1.1	0.59	0.74
Cyanide	NA	mg/l	8	< 0.01	< 0.02	0.008	0.011
Dissolved oxygen	NA	mg/l	10	1.34	9.23	6.92	7.82
Fluoride	NA	mg/l	10	< 0.1	< 0.1	NA	< 0.1
Hardness, as CaCO3	NA	mg/l	10	17.8	38.9	28.3	24.0
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	10	< 0.1	0.15	0.06	< 0.1
Nitrogen, ammonia, as N	NA	mg/l	10	< 0.05	< 0.1	NA	< 0.1
pH	NA	pH units	20	5.6	7.1	6.30	6.3
Phosphorus, total, as P	NA	mg/l	8	< 0.1	0.19	0.07	< 0.1
Redox (oxidation potential)	NA	mV	10	119	643	422	428
Solids, total dissolved	NA	mg/l	8	51	99	67.4	62
Specific Conductance @ 25 °C	NA	µmhos/cm	10	39.2	117	62.1	55.4
Sulfate, as SO4	NA	mg/l	10	< 1	14.7	10.6	8.53
Temperature	NA	deg C	10	5.1	10	7.63	7.48
Turbidity	NA	NTU	9	0	216.9	52.1	5.8
Metals							
Aluminum	Dissolved	µg/l	10	< 10	< 25	NA	< 25
Aluminum	Total	µg/l	8	< 20	4850	1785	134
Antimony	Dissolved	µg/l	2	< 0.5	< 0.5	NA	< 0.5
Antimony	Total	µg/l	8	< 0.5	< 3	0.55	< 0.5
Arsenic	Dissolved	µg/l	7	< 0.5	2.47	0.61	< 0.5
Arsenic	Total	µg/l	8	< 0.5	11	2.97	< 2
Barium	Dissolved	µg/l	4	0.5	0.77	0.58	0.56
Barium	Total	µg/l	8	0.64	32.4	9.76	< 10
Beryllium	Dissolved	µg/l	2	< 0.2	< 0.2	NA	< 0.2
Beryllium	Total	µg/l	8	< 0.2	< 0.2	NA	< 0.2
Boron	Dissolved	µg/l	5	< 50	< 100	NA	< 50
Boron	Total	µg/l	8	< 50	< 50	NA	< 50
Cadmium	Dissolved	µg/l	10	< 0.2	0.24	0.11	< 0.2
Cadmium	Total	µg/l	8	< 0.2	0.31	0.12	< 0.2
Calcium	Total	mg/l	10	4	8.06	6.07	5.44
Chromium	Dissolved	µg/l	10	< 1	< 1	NA	< 1
Chromium	Total	µg/l	8	< 1	36.2	8.45	< 1
Cobalt	Dissolved	µg/l	4	< 0.2	< 0.2	NA	< 0.2
Cobalt	Total	µg/l	8	< 0.2	3.96	1.16	< 1
Copper	Dissolved	µg/l	10	0.51	3.33	1.42	1.49
Copper	Total	µg/l	8	0.57	33.8	7.24	< 2
Iron	Dissolved	µg/l	7	< 50	56.8	31.0	< 50
Iron	Total	µg/l	8	< 50	14400	2908	168
Lead	Dissolved	µg/l	4	< 0.5	< 0.5	NA	< 0.5
Lead	Total	µg/l	8	< 0.5	1	0.45	0.51
Magnesium	Total	mg/l	10	1.8	4.65	3.17	2.51
Manganese	Dissolved	µg/l	8	0.52	31.1	6.18	2.0
Manganese	Total	µg/l	8	0.72	92	28.3	< 10
Mercury	Total	ng/l	11	< 0.5	3.7	0.81	0.68
Methyl Mercury	Total	ng/l	9	< 0.03	0.11	0.05	< 0.1
Molybdenum	Dissolved	µg/l	10	< 0.2	< 5	0.85	< 0.3
Molybdenum	Total	µg/l	8	< 0.2	< 5	1.30	0.45
Nickel	Dissolved	µg/l	10	< 0.5	5.1	1.93	1.67
Nickel	Total	µg/l	8	< 0.5	16.8	5.80	2.29
Palladium	Total	µg/l	8	< 0.1	< 0.5	NA	< 0.5
Platinum	Total	µg/l	8	< 0.1	< 0.5	NA	< 0.5
Potassium	Total	mg/l	10	0.71	3.44	1.40	0.985
Selenium	Dissolved	µg/l	10	< 1	< 2	NA	< 1
Selenium	Total	µg/l	8	< 1	< 10	NA	< 1
Silver	Dissolved	µg/l	8	< 0.2	< 1	NA	< 0.2
Silver	Total	µg/l	8	< 0.2	< 1	NA	< 0.2
Sodium	Total	mg/l	10	1.2	7.7	2.19	< 2
Strontium	Total	µg/l	8	16.1	23.9	19.9	18.8
Thallium	Dissolved	µg/l	2	< 0.02	< 0.2	NA	< 0.02
Thallium	Total	µg/l	8	< 0.2	< 2	NA	< 0.2
Titanium	Total	µg/l	8	< 10	410	133	< 20
Vanadium	Dissolved	µg/l	NA	NA	NA	NA	NA
Zinc	Dissolved	µg/l	10	< 6	< 25	7.25	< 6
Zinc	Total	µg/l	8	< 6	33.6	12.2	15.3

NA No data available.

(1) Field duplicates not included in count of samples.

(2) Minimum and maximum determined with non-detect samples at the detection limit.

(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.

(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for OB-5 2006-2015							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	6	18.7	85.1	33.0	25.2
Alkalinity, carbonate, as CaCO3	NA	mg/l	6	< 10	< 20	NA	< 10
Alkalinity, total, as CaCO3	NA	mg/l	10	8.2	85.1	27.2	23.7
Biochemical Oxygen Demand (5-day)	NA	mg/l	7	< 2.4	< 8	NA	2.7
Carbon, dissolved organic	NA	mg/l	6	1.5	2.7	1.95	1.80
Carbon, total organic	NA	mg/l	10	1.3	2.7	1.88	1.95
Chemical Oxygen Demand	NA	mg/l	8	< 10	32.9	11.7	< 10
Chloride	NA	mg/l	10	< 0.5	1.08	0.49	0.52
Cyanide	NA	mg/l	8	< 0.01	0.0253	0.011	< 0.02
Dissolved oxygen	NA	mg/l	11	6.82	9.6	8.28	8.49
Fluoride	NA	mg/l	10	< 0.1	< 0.1	NA	< 0.1
Hardness, as CaCO3	NA	mg/l	10	24.3	40.6	31.0	31.3
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	10	< 0.1	0.18	0.06	< 0.1
Nitrogen, ammonia, as N	NA	mg/l	10	< 0.05	< 0.1	NA	< 0.1
pH	NA	pH units	21	5.6	7.3	6.56	6.5
Phosphorus, total, as P	NA	mg/l	8	< 0.1	0.15	0.06	< 0.1
Redox (oxidation potential)	NA	mV	11	183	598	425	454
Solids, total dissolved	NA	mg/l	8	51	129	82.1	70
Specific Conductance @ 25 °C	NA	µmhos/cm	11	45	92	62.0	56.2
Sulfate, as SO4	NA	mg/l	10	8.24	15.3	9.91	9.64
Temperature	NA	deg C	11	4.2	11	7.97	8.06
Turbidity	NA	NTU	10	0	1106	140	26.5
Metals							
Aluminum	Dissolved	µg/l	10	< 10	< 25	NA	< 25
Aluminum	Total	µg/l	8	< 20	3290	1106	726
Antimony	Dissolved	µg/l	2	< 0.5	< 0.5	NA	< 0.5
Antimony	Total	µg/l	8	< 0.5	< 3	NA	< 0.5
Arsenic	Dissolved	µg/l	7	< 0.5	< 1	NA	< 0.5
Arsenic	Total	µg/l	8	< 0.5	2.94	1.11	1.50
Barium	Dissolved	µg/l	4	1.5	1.8	1.68	1.7
Barium	Total	µg/l	8	1.7	20.4	8.02	5.25
Beryllium	Dissolved	µg/l	2	< 0.2	< 0.2	NA	< 0.2
Beryllium	Total	µg/l	8	< 0.2	< 0.2	NA	< 0.2
Boron	Dissolved	µg/l	5	< 50	< 100	NA	< 50
Boron	Total	µg/l	8	< 50	< 50	NA	< 50
Cadmium	Dissolved	µg/l	10	< 0.2	< 0.2	NA	< 0.2
Cadmium	Total	µg/l	8	< 0.2	0.54	0.16	< 0.2
Calcium	Total	mg/l	10	5.6	9.59	7.25	7.34
Chromium	Dissolved	µg/l	10	< 1	1.2	0.59	< 1
Chromium	Total	µg/l	8	< 1	9.7	3.38	1.65
Cobalt	Dissolved	µg/l	4	< 0.2	< 0.2	NA	< 0.2
Cobalt	Total	µg/l	8	< 0.2	5.49	1.39	0.99
Copper	Dissolved	µg/l	10	1.73	3.6	2.89	3.02
Copper	Total	µg/l	8	3.3	46.3	15.3	7.0
Iron	Dissolved	µg/l	7	< 50	< 50	NA	< 50
Iron	Total	µg/l	8	140	35500	12057	8978
Lead	Dissolved	µg/l	4	< 0.5	< 0.5	NA	< 0.5
Lead	Total	µg/l	8	< 0.5	1.31	0.60	0.54
Magnesium	Total	mg/l	10	2.4	4.47	3.12	3.15
Manganese	Dissolved	µg/l	8	0.86	47.4	10.3	1.5
Manganese	Total	µg/l	8	1.3	356	62.4	15.3
Mercury	Total	ng/l	10	< 0.5	4.9	1.99	1.12
Methyl Mercury	Total	ng/l	8	< 0.03	< 0.1	0.04	< 0.1
Molybdenum	Dissolved	µg/l	10	< 0.2	< 5	0.44	0.23
Molybdenum	Total	µg/l	8	< 0.2	< 5	0.77	0.52
Nickel	Dissolved	µg/l	10	4.38	8.6	5.40	5.41
Nickel	Total	µg/l	8	4.6	38.4	13.1	8.74
Palladium	Total	µg/l	8	< 0.1	< 0.5	NA	< 0.5
Platinum	Total	µg/l	8	< 0.1	< 0.5	NA	< 0.5
Potassium	Total	mg/l	10	0.78	1.76	1.22	1.26
Selenium	Dissolved	µg/l	10	< 1	< 2	NA	< 1
Selenium	Total	µg/l	8	< 1	< 10	NA	< 1
Silver	Dissolved	µg/l	8	< 0.2	< 1	NA	< 0.2
Silver	Total	µg/l	8	< 0.2	< 1	NA	< 0.2
Sodium	Total	mg/l	10	1.5	7.3	1.78	< 2
Strontium	Total	µg/l	8	19.3	41.3	25.8	24.8
Thallium	Dissolved	µg/l	2	< 0.02	< 0.2	NA	0.11
Thallium	Total	µg/l	8	< 0.2	< 2	NA	< 0.2
Titanium	Total	µg/l	8	< 10	230	52.6	26.9
Vanadium	Dissolved	µg/l	NA	NA	NA	NA	NA
Zinc	Dissolved	µg/l	9	< 6	< 25	8.28	7.99
Zinc	Total	µg/l	8	< 6	< 25	10.2	10.7

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for P-1 2006							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	1	< 10	NA	NA	< 10
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	NA	NA	NA	NA	NA
Carbon, total organic	NA	mg/l	1	NA	NA	2.3	2.3
Chemical Oxygen Demand	NA	mg/l	1	< 10	NA	NA	< 10
Chloride	NA	mg/l	1	NA	NA	6.6	6.6
Cyanide	NA	mg/l	1	< 0.02	NA	NA	< 0.02
Dissolved oxygen	NA	mg/l	NA	NA	NA	NA	NA
Fluoride	NA	mg/l	1	NA	NA	1.1	1.1
Hardness, as CaCO3	NA	mg/l	1	NA	NA	15	15
Nitrate + Nitrite, as N	NA	mg/l	1	< 0.1	NA	NA	< 0.1
Nitrogen, ammonia as N	NA	mg/l	1	< 0.1	NA	NA	< 0.1
pH	NA	pH units	1	NA	NA	8.5	8.5
Phosphorus, total, as P	NA	mg/l	1	< 0.1	NA	NA	< 0.1
Redox (oxidation potential)	NA	mV	NA	NA	NA	NA	NA
Solids, total dissolved	NA	mg/l	NA	NA	NA	NA	NA
Specific Conductance @ 25 °C	NA	µmhos/cm	NA	NA	NA	NA	NA
Sulfate, as SO4	NA	mg/l	1	NA	NA	1200	1200
Temperature, °C	NA	deg C	NA	NA	NA	NA	NA
Turbidity	NA	NTU	NA	NA	NA	NA	NA
Metals							
Aluminum	Dissolved	µg/l	1	< 25	NA	NA	< 25
Aluminum	Total	µg/l	1	NA	NA	59.1	59.1
Antimony	Dissolved	µg/l	NA	NA	NA	NA	NA
Antimony	Total	µg/l	1	< 3	NA	NA	< 3
Arsenic	Dissolved	µg/l	NA	NA	NA	NA	NA
Arsenic	Total	µg/l	1	NA	NA	2.2	2.2
Barium	Dissolved	µg/l	NA	NA	NA	NA	NA
Barium	Total	µg/l	1	< 10	NA	NA	< 10
Beryllium	Dissolved	µg/l	NA	NA	NA	NA	NA
Beryllium	Total	µg/l	1	< 0.2	NA	NA	< 0.2
Boron	Dissolved	µg/l	NA	NA	NA	NA	NA
Boron	Total	µg/l	1	NA	NA	518	518
Cadmium	Dissolved	µg/l	1	< 0.2	NA	NA	< 0.2
Cadmium	Total	µg/l	1	< 0.2	NA	NA	< 0.2
Calcium	Total	mg/l	1	NA	NA	6.2	6.2
Chromium	Dissolved	µg/l	1	< 1	NA	NA	< 1
Chromium	Total	µg/l	1	NA	NA	1.9	1.9
Cobalt	Dissolved	µg/l	NA	NA	NA	NA	NA
Cobalt	Total	µg/l	1	< 1	NA	NA	< 1
Copper	Dissolved	µg/l	1	< 2	NA	NA	< 2
Copper	Total	µg/l	1	< 2	NA	NA	< 2
Iron	Dissolved	µg/l	NA	NA	NA	NA	NA
Iron	Total	µg/l	1	NA	NA	100	100
Lead	Dissolved	µg/l	NA	NA	NA	NA	NA
Lead	Total	µg/l	1	< 1	NA	NA	< 1
Magnesium	Total	mg/l	1	< 2	NA	NA	< 2
Manganese	Dissolved	µg/l	NA	NA	NA	NA	NA
Manganese	Total	µg/l	1	NA	NA	10	10
Mercury	Total	µg/l	1	< 0.0005	NA	NA	< 0.0005
Methyl Mercury	Total	µg/l	1	< 0.000025	NA	NA	< 0.000025
Molybdenum	Dissolved	µg/l	1	< 5	NA	NA	< 5
Molybdenum	Total	µg/l	1	< 5	NA	NA	< 5
Nickel	Dissolved	µg/l	1	< 2	NA	NA	< 2
Nickel	Total	µg/l	1	< 2	NA	NA	< 2
Palladium	Total	µg/l	1	< 0.1	NA	NA	< 0.1
Platinum	Total	µg/l	1	< 0.02	NA	NA	< 0.02
Potassium	Total	mg/l	1	NA	NA	1.2	1.2
Selenium	Dissolved	µg/l	1	< 2	NA	NA	< 2
Selenium	Total	µg/l	1	< 2	NA	NA	< 2
Silver	Dissolved	µg/l	1	< 1	NA	NA	< 1
Silver	Total	µg/l	1	< 1	NA	NA	< 1
Sodium	Total	mg/l	1	NA	NA	43.9	43.9
Strontium	Total	µg/l	1	NA	NA	33.4	33.4
Thallium	Dissolved	µg/l	NA	NA	NA	NA	NA
Thallium	Total	µg/l	1	< 2	NA	NA	< 2
Titanium	Total	µg/l	1	< 10	NA	NA	< 10
Vanadium	Dissolved	µg/l	NA	NA	NA	NA	NA
Zinc	Dissolved	µg/l	1	< 25	NA	NA	< 25
Zinc	Total	µg/l	1	NA	NA	17.9	17.9

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for P-2 2005-2006							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	5	74	108	97.3	101
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	NA	NA	NA	NA	NA
Carbon, total organic	NA	mg/l	5	2.4	5.3	3.9	3.9
Chemical Oxygen Demand	NA	mg/l	5	< 10	< 10	NA	< 10
Chloride	NA	mg/l	5	1.29	1.8	1.43	1.35
Cyanide	NA	mg/l	5	< 0.02	< 0.02	NA	< 0.02
Dissolved oxygen	NA	mg/l	NA	NA	NA	NA	NA
Fluoride	NA	mg/l	5	0.13	0.53	0.30	0.31
Hardness, as CaCO3	NA	mg/l	5	56.5	82.9	69.8	68.6
Nitrate + Nitrite, as N	NA	mg/l	5	< 0.1	< 0.1	NA	< 0.1
Nitrogen, ammonia as N	NA	mg/l	5	< 0.1	0.27	0.09	< 0.1
pH	NA	pH units	5	7.1	8.4	7.7	7.7
Phosphorus, total, as P	NA	mg/l	5	< 0.1	0.11	0.06	< 0.1
Redox (oxidation potential)	NA	mV	NA	NA	NA	NA	NA
Solids, total dissolved	NA	mg/l	NA	NA	NA	NA	NA
Specific Conductance @ 25 °C	NA	µmhos/cm	NA	NA	NA	NA	NA
Sulfate, as SO4	NA	mg/l	5	5.76	10.5	7.95	7.88
Temperature, °C	NA	deg C	NA	NA	NA	NA	NA
Turbidity	NA	NTU	NA	NA	NA	NA	NA
Metals							
Aluminum	Dissolved	µg/l	5	< 25	< 25	NA	< 25
Aluminum	Total	µg/l	5	< 25	< 25	NA	< 25
Antimony	Dissolved	µg/l	NA	NA	NA	NA	NA
Antimony	Total	µg/l	5	< 3	< 3	NA	< 3
Arsenic	Dissolved	µg/l	NA	NA	NA	NA	NA
Arsenic	Total	µg/l	5	< 2	< 2	NA	< 2
Barium	Dissolved	µg/l	NA	NA	NA	NA	NA
Barium	Total	µg/l	5	< 10	< 10	NA	< 10
Beryllium	Dissolved	µg/l	NA	NA	NA	NA	NA
Beryllium	Total	µg/l	5	< 0.2	0.2	0.14	< 0.2
Boron	Dissolved	µg/l	NA	NA	NA	NA	NA
Boron	Total	µg/l	5	148	194	167	168
Cadmium	Dissolved	µg/l	5	< 0.2	0.2	0.12	< 0.2
Cadmium	Total	µg/l	5	< 0.2	< 0.2	NA	< 0.2
Calcium	Total	mg/l	5	11.6	16.7	14.0	13.5
Chromium	Dissolved	µg/l	5	< 1	< 1	NA	< 1
Chromium	Total	µg/l	5	< 1	1.1	0.62	< 1
Cobalt	Dissolved	µg/l	NA	NA	NA	NA	NA
Cobalt	Total	µg/l	5	< 1	< 1	NA	< 1
Copper	Dissolved	µg/l	5	< 2	< 2	NA	< 2
Copper	Total	µg/l	5	< 2	< 2	NA	< 2
Iron	Dissolved	µg/l	NA	NA	NA	NA	NA
Iron	Total	µg/l	5	140	351	268	271
Lead	Dissolved	µg/l	NA	NA	NA	NA	NA
Lead	Total	µg/l	5	< 1	< 5	NA	< 1
Magnesium	Total	mg/l	5	6.7	10	8.5	8.5
Manganese	Dissolved	µg/l	NA	NA	NA	NA	NA
Manganese	Total	µg/l	5	20	27.3	23.8	23.6
Mercury	Total	µg/l	5	< 0.0005	0.0005	0.00030	< 0.0005
Methyl Mercury	Total	µg/l	5	< 0.000056	0.00007	0.00004	< 0.000056
Molybdenum	Dissolved	µg/l	5	< 5	< 5	NA	< 5
Molybdenum	Total	µg/l	5	< 5	< 5	NA	< 5
Nickel	Dissolved	µg/l	5	< 2	< 2	NA	< 2
Nickel	Total	µg/l	5	< 2	< 2	NA	< 2
Palladium	Total	µg/l	5	< 0.1	< 0.1	NA	< 0.1
Platinum	Total	µg/l	5	< 0.02	< 0.02	NA	< 0.02
Potassium	Total	mg/l	5	1.03	1.1	1.06	1.04
Selenium	Dissolved	µg/l	5	< 2	< 2	NA	< 2
Selenium	Total	µg/l	5	< 2	4	1.8	< 2
Silver	Dissolved	µg/l	5	< 1	< 1	NA	< 1
Silver	Total	µg/l	5	< 1	< 1	NA	< 1
Sodium	Total	mg/l	5	23.2	24.4	23.8	23.9
Strontium	Total	µg/l	5	37.9	74.9	59.9	60.7
Thallium	Dissolved	µg/l	NA	NA	NA	NA	NA
Thallium	Total	µg/l	5	< 2	< 2	NA	< 2
Titanium	Total	µg/l	5	< 10	< 20	NA	< 20
Vanadium	Dissolved	µg/l	NA	NA	NA	NA	NA
Zinc	Dissolved	µg/l	5	< 10	134	77.7	68.2
Zinc	Total	µg/l	5	< 10	125	77.0	67.7

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for P-3 2006							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	1	NA	NA	97.2	97.2
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	NA	NA	NA	NA	NA
Carbon, total organic	NA	mg/l	1	NA	NA	7.6	7.6
Chemical Oxygen Demand	NA	mg/l	1	NA	NA	485	485
Chloride	NA	mg/l	1	NA	NA	2.1	2.1
Cyanide	NA	mg/l	1	< 0.02	NA	NA	< 0.02
Dissolved oxygen	NA	mg/l	NA	NA	NA	NA	NA
Fluoride	NA	mg/l	1	NA	NA	0.64	0.64
Hardness, as CaCO3	NA	mg/l	1	NA	NA	113	113
Nitrate + Nitrite, as N	NA	mg/l	1	< 0.1	NA	NA	< 0.1
Nitrogen, ammonia as N	NA	mg/l	1	< 0.1	NA	NA	< 0.1
pH	NA	pH units	1	NA	NA	6.6	6.6
Phosphorus, total, as P	NA	mg/l	1	< 0.1	NA	NA	< 0.1
Redox (oxidation potential)	NA	mV	NA	NA	NA	NA	NA
Solids, total dissolved	NA	mg/l	NA	NA	NA	NA	NA
Specific Conductance @ 25 °C	NA	µmhos/cm	NA	NA	NA	NA	NA
Sulfate, as SO4	NA	mg/l	1	NA	NA	32.9	32.9
Temperature, °C	NA	deg C	NA	NA	NA	NA	NA
Turbidity	NA	NTU	NA	NA	NA	NA	NA
Metals							
Aluminum	Dissolved	µg/l	1	< 25	NA	NA	< 25
Aluminum	Total	µg/l	1	< 25	NA	NA	< 25
Antimony	Dissolved	µg/l	NA	NA	NA	NA	NA
Antimony	Total	µg/l	1	< 3	NA	NA	< 3
Arsenic	Dissolved	µg/l	NA	NA	NA	NA	NA
Arsenic	Total	µg/l	1	< 2	NA	NA	< 2
Barium	Dissolved	µg/l	NA	NA	NA	NA	NA
Barium	Total	µg/l	1	< 10	NA	NA	< 10
Beryllium	Dissolved	µg/l	NA	NA	NA	NA	NA
Beryllium	Total	µg/l	1	< 0.2	NA	NA	< 0.2
Boron	Dissolved	µg/l	NA	NA	NA	NA	NA
Boron	Total	µg/l	1	NA	NA	76.3	76.3
Cadmium	Dissolved	µg/l	1	< 0.2	NA	NA	< 0.2
Cadmium	Total	µg/l	1	< 0.2	NA	NA	< 0.2
Calcium	Total	mg/l	1	NA	NA	20.4	20.4
Chromium	Dissolved	µg/l	1	< 1	NA	NA	< 1
Chromium	Total	µg/l	1	NA	NA	1.2	1.2
Cobalt	Dissolved	µg/l	NA	NA	NA	NA	NA
Cobalt	Total	µg/l	1	< 1	NA	NA	< 1
Copper	Dissolved	µg/l	1	< 2	NA	NA	< 2
Copper	Total	µg/l	1	< 2	NA	NA	< 2
Iron	Dissolved	µg/l	NA	NA	NA	NA	NA
Iron	Total	µg/l	1	NA	NA	4370	4370
Lead	Dissolved	µg/l	NA	NA	NA	NA	NA
Lead	Total	µg/l	1	< 1	NA	NA	< 1
Magnesium	Total	mg/l	1	NA	NA	15	15
Manganese	Dissolved	µg/l	NA	NA	NA	NA	NA
Manganese	Total	µg/l	1	NA	NA	140	140
Mercury	Total	µg/l	1	< 0.0005	NA	NA	< 0.0005
Methyl Mercury	Total	µg/l	1	< 0.000025	NA	NA	< 0.000025
Molybdenum	Dissolved	µg/l	1	< 5	NA	NA	< 5
Molybdenum	Total	µg/l	1	< 5	NA	NA	< 5
Nickel	Dissolved	µg/l	1	< 2	NA	NA	< 2
Nickel	Total	µg/l	1	< 2	NA	NA	< 2
Palladium	Total	µg/l	1	NA	NA	0.3	0.3
Platinum	Total	µg/l	1	< 0.02	NA	NA	< 0.02
Potassium	Total	mg/l	1	NA	NA	2.1	2.1
Selenium	Dissolved	µg/l	1	< 2	NA	NA	< 2
Selenium	Total	µg/l	1	< 2	NA	NA	< 2
Silver	Dissolved	µg/l	1	< 1	NA	NA	< 1
Silver	Total	µg/l	1	< 1	NA	NA	< 1
Sodium	Total	mg/l	1	NA	NA	7.5	7.5
Strontium	Total	µg/l	1	NA	NA	75.2	75.2
Thallium	Dissolved	µg/l	NA	NA	NA	NA	NA
Thallium	Total	µg/l	1	< 2	NA	NA	< 2
Titanium	Total	µg/l	1	< 10	NA	NA	< 10
Vanadium	Dissolved	µg/l	NA	NA	NA	NA	NA
Zinc	Dissolved	µg/l	1	< 25	NA	NA	< 25
Zinc	Total	µg/l	1	NA	NA	11.3	11.3

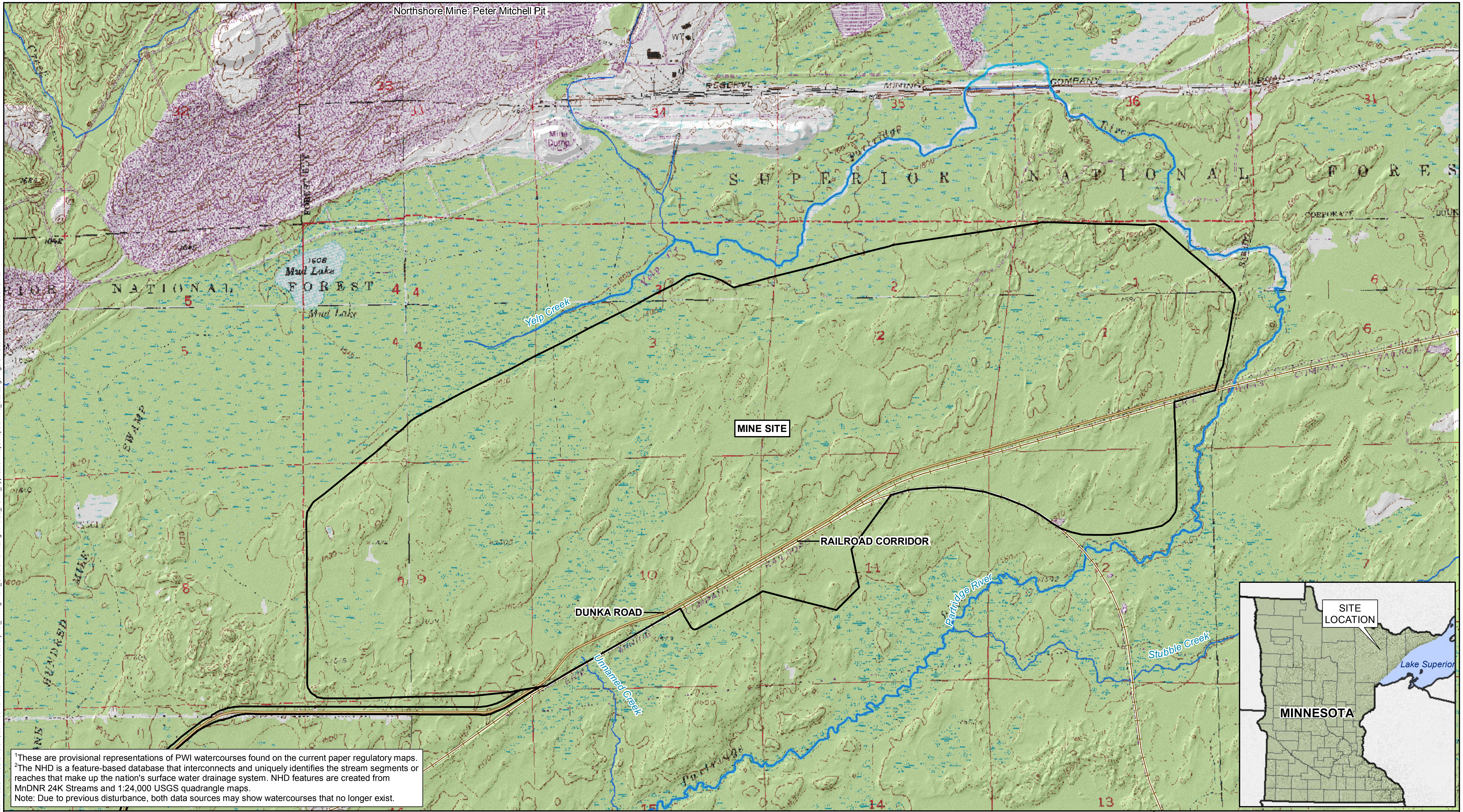
NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water Quality Data for P-4 2005							
Parameter	Fraction	Units	# of Samples(1)	Minimum(2)	Maximum(2)	Average(3)	Median(4)
General Parameters							
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, carbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	1	NA	NA	69.2	69.2
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	NA	NA	NA	NA	NA
Carbon, total organic	NA	mg/l	1	NA	NA	2.2	2.2
Chemical Oxygen Demand	NA	mg/l	1	NA	NA	17	17
Chloride	NA	mg/l	1	< 0.5	NA	NA	< 0.5
Cyanide	NA	mg/l	1	< 0.02	NA	NA	< 0.02
Dissolved oxygen	NA	mg/l	NA	NA	NA	NA	NA
Fluoride	NA	mg/l	1	NA	NA	0.35	0.35
Hardness, as CaCO3	NA	mg/l	1	NA	NA	76.2	76.2
Nitrate + Nitrite, as N	NA	mg/l	1	< 0.1	NA	NA	NA
Nitrogen, ammonia as N	NA	mg/l	1	NA	NA	0.11	0.11
pH	NA	pH units	1	NA	NA	8.1	8.1
Phosphorus, total, as P	NA	mg/l	1	< 0.1	NA	NA	< 0.1
Redox (oxidation potential)	NA	mV	NA	NA	NA	NA	NA
Solids, total dissolved	NA	mg/l	NA	NA	NA	NA	NA
Specific Conductance @ 25 °C	NA	µmhos/cm	NA	NA	NA	NA	NA
Sulfate, as SO4	NA	mg/l	1	NA	NA	14.1	14.1
Temperature, °C	NA	deg C	NA	NA	NA	NA	NA
Turbidity	NA	NTU	NA	NA	NA	NA	NA
Metals							
Aluminum	Dissolved	µg/l	1	< 25	NA	NA	< 25
Aluminum	Total	µg/l	1	NA	NA	57.2	57.2
Antimony	Dissolved	µg/l	NA	NA	NA	NA	NA
Antimony	Total	µg/l	1	< 3	NA	NA	< 3
Arsenic	Dissolved	µg/l	NA	NA	NA	NA	NA
Arsenic	Total	µg/l	1	NA	NA	5.7	5.7
Barium	Dissolved	µg/l	NA	NA	NA	NA	NA
Barium	Total	µg/l	1	< 10	NA	NA	< 10
Beryllium	Dissolved	µg/l	NA	NA	NA	NA	NA
Beryllium	Total	µg/l	1	< 0.2	NA	NA	< 0.2
Boron	Dissolved	µg/l	NA	NA	NA	NA	NA
Boron	Total	µg/l	1	NA	NA	55	55
Cadmium	Dissolved	µg/l	1	< 0.2	NA	NA	< 0.2
Cadmium	Total	µg/l	1	< 0.2	NA	NA	< 0.2
Calcium	Total	mg/l	1	NA	NA	17.7	17.7
Chromium	Dissolved	µg/l	1	< 1	NA	NA	< 1
Chromium	Total	µg/l	1	< 1	NA	NA	< 1
Cobalt	Dissolved	µg/l	NA	NA	NA	NA	NA
Cobalt	Total	µg/l	1	< 1	NA	NA	< 1
Copper	Dissolved	µg/l	1	< 2	NA	NA	< 2
Copper	Total	µg/l	1	< 2	NA	NA	< 2
Iron	Dissolved	µg/l	NA	NA	NA	NA	NA
Iron	Total	µg/l	1	NA	NA	190	190
Lead	Dissolved	µg/l	NA	NA	NA	NA	NA
Lead	Total	µg/l	1	< 1	NA	NA	< 1
Magnesium	Total	mg/l	1	NA	NA	7.8	7.8
Manganese	Dissolved	µg/l	NA	NA	NA	NA	NA
Manganese	Total	µg/l	1	NA	NA	60	60
Mercury	Total	µg/l	1	NA	NA	0.00070	0.00070
Methyl Mercury	Total	µg/l	1	< 0.000025	NA	NA	< 0.000025
Molybdenum	Dissolved	µg/l	1	NA	NA	28.9	28.9
Molybdenum	Total	µg/l	1	NA	NA	34.5	34.5
Nickel	Dissolved	µg/l	1	< 2	NA	NA	< 2
Nickel	Total	µg/l	1	< 2	NA	NA	< 2
Palladium	Total	µg/l	1	< 0.1	NA	NA	< 0.1
Platinum	Total	µg/l	1	< 0.02	NA	NA	< 0.02
Potassium	Total	mg/l	1	NA	NA	1.7	1.7
Selenium	Dissolved	µg/l	1	< 2	NA	NA	< 2
Selenium	Total	µg/l	1	< 2	NA	NA	< 2
Silver	Dissolved	µg/l	1	< 1	NA	NA	< 1
Silver	Total	µg/l	1	< 1	NA	NA	< 1
Sodium	Total	mg/l	1	NA	NA	4.4	4.4
Strontium	Total	µg/l	1	NA	NA	45.5	45.5
Thallium	Dissolved	µg/l	NA	NA	NA	NA	NA
Thallium	Total	µg/l	1	< 2	NA	NA	< 2
Titanium	Total	µg/l	1	< 10	NA	NA	< 10
Vanadium	Dissolved	µg/l	NA	NA	NA	NA	NA
Zinc	Dissolved	µg/l	1	< 10	NA	NA	< 10
Zinc	Total	µg/l	1	< 10	NA	NA	< 10

NA No data available.
(1) Field duplicates not included in count of samples.
(2) Minimum and maximum determined with non-detect samples at the detection limit.
(3) Average calculated with non-detect samples at half the detection limit. An average was not calculated if all samples were non-detects.
(4) Median calculated with non-detect samples at the detection limit. Median values that are non-detects are shown with <.

Water quality data is not available for OB-3A because it is redundant with adjacent groundwater monitoring wells and was not included in the baseline groundwater monitoring network.

Large Figures



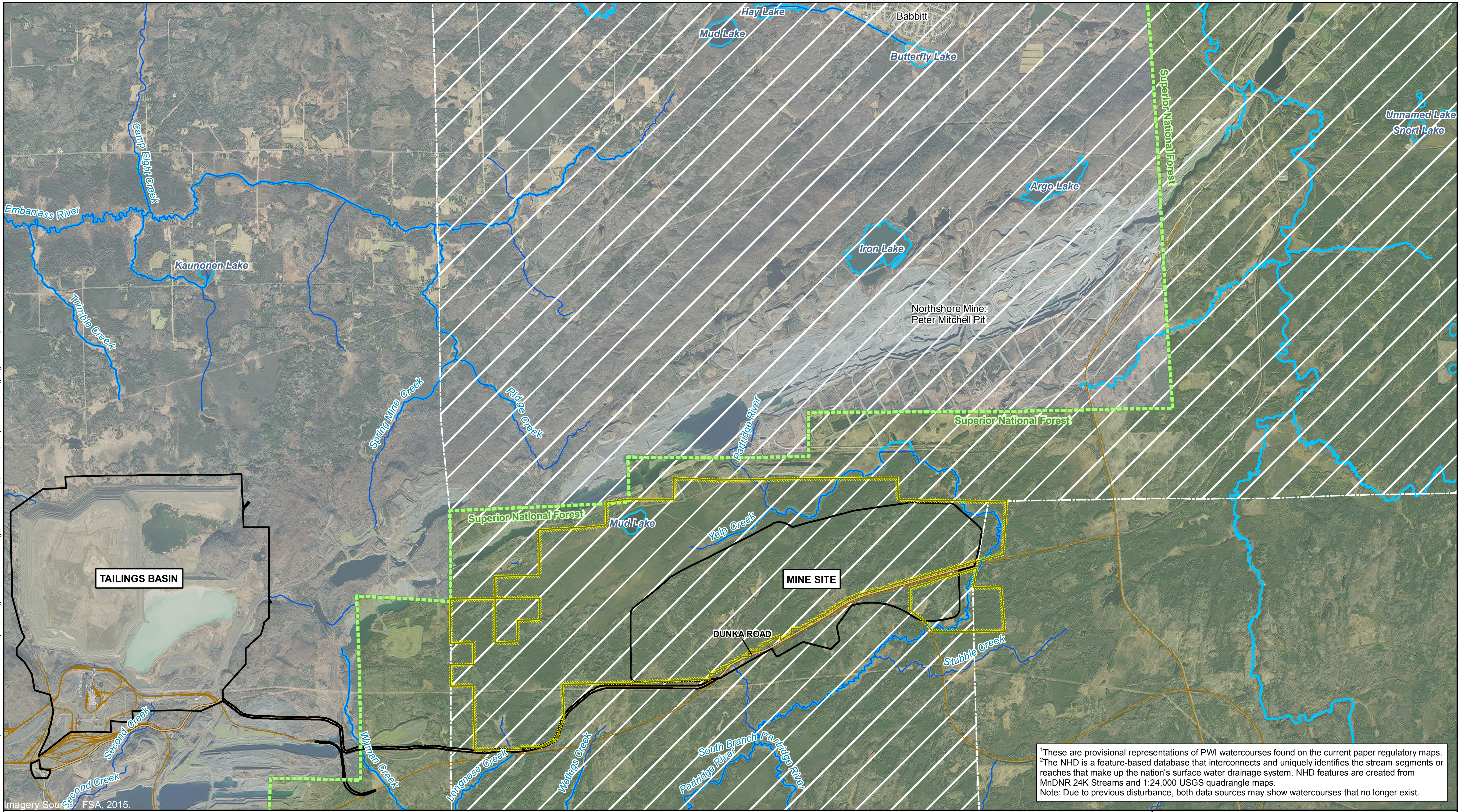
[1]These are provisional representations of PWI watercourses found on the current paper regulatory maps.
[2]The NHD is a feature-based database that interconnects and uniquely identifies the stream segments or reaches that make up the nation's surface water drainage system. NHD features are created from MnDNR 24K Streams and 1:24,000 USGS quadrangle maps.
Note: Due to previous disturbance, both data sources may show watercourses that no longer exist.

EIS Projects Areas
Dunka Road
Existing Railroad
Public Waters Inventory (PWI) Watercourses[1]
National Hydrography Dataset (NHD) Rivers & Streams[2]

0 1,000 2,000 4,000
Feet

SITE LOCATION
NorthMet Project
Poly Met Mining, Inc.

Large Figure 1
NPDES/SDS Permit Application Volume II: Mine Site
Permit Application Update – October 2017



[1]These are provisional representations of PWI watercourses found on the current paper regulatory maps.
[2]The NHD is a feature-based database that interconnects and uniquely identifies the stream segments or reaches that make up the nation's surface water drainage system. NHD features are created from MnDNR 24K Streams and 1:24,000 USGS quadrangle maps.
Note: Due to previous disturbance, both data sources may show watercourses that no longer exist.

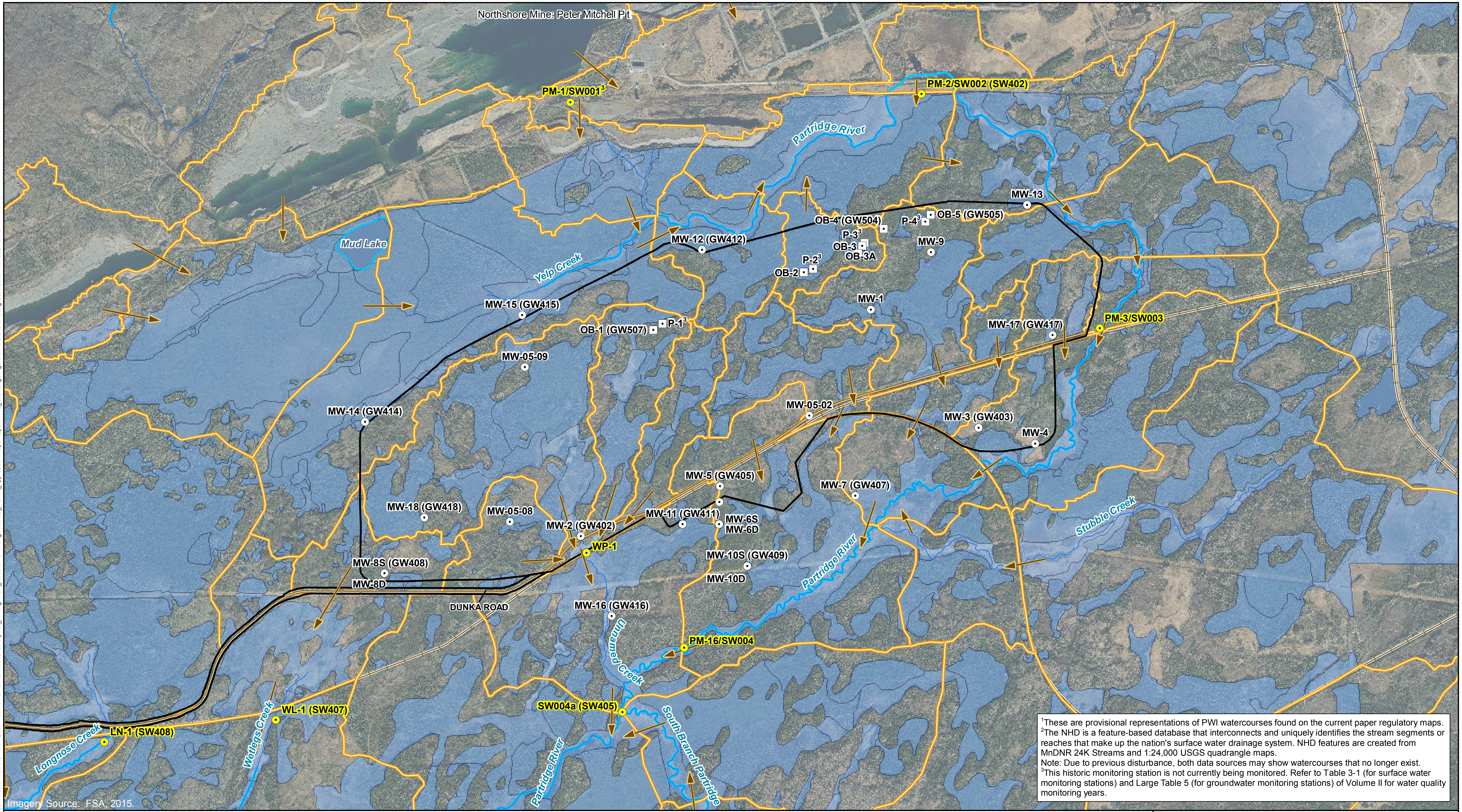
Barr Footer: ArcGIS 10.5.1, 2017-09-15 14:48 File: I:\Client\PolyMet_Mining\Work_Orders\Permitting\NPDES_Permit_Application\Maps\Report\Mine_Site\Large Figure 2 Existing Land Use.mxd User: arm2

- EIS Projects Areas
- Babbitt Municipal Boundary
- National Forest Boundary
- Federal Land Exchange Parcels
- Dunka Road
- Existing Railroad
- Public Waters Inventory (PWI) Watercourses[1]
- National Hydrography Dataset (NHD) Rivers & Streams[2]

0 0.5 1 2
Miles

MINE SITE EXISTING LAND USE
NorthMet Project
Poly Met Mining, Inc.

Large Figure 2
NPDES/SDS Permit Application Volume II: Mine Site
Permit Application Update – October 2017



[1]These are provisional representations of PWI watercourses found on the current paper regulatory maps.
[2]The NHD is a feature-based database that interconnects and uniquely identifies the stream segments or reaches that make up the nation's surface water drainage system. NHD features are created from MnDNR 24K Streams and 1:24,000 USGS quadrangle maps.
Note: Due to previous disturbance, both data sources may show watercourses that no longer exist.
[3]This historic monitoring station is not currently being monitored. Refer to Table 3-1 (for surface water monitoring stations) and Large Table 5 (for groundwater monitoring stations) of Volume II for water quality monitoring years.

Barr Footer: ArcGIS 10.5.1, 2017-09-13 18:18 File: I:\Client\PolyMet_Mining\Work_Orders\Permitting\NPDES_Permit_Application\Maps\Report\Mine_Site\Large Figure 3 Mine Site Existing Conditions.mxd User: arm2

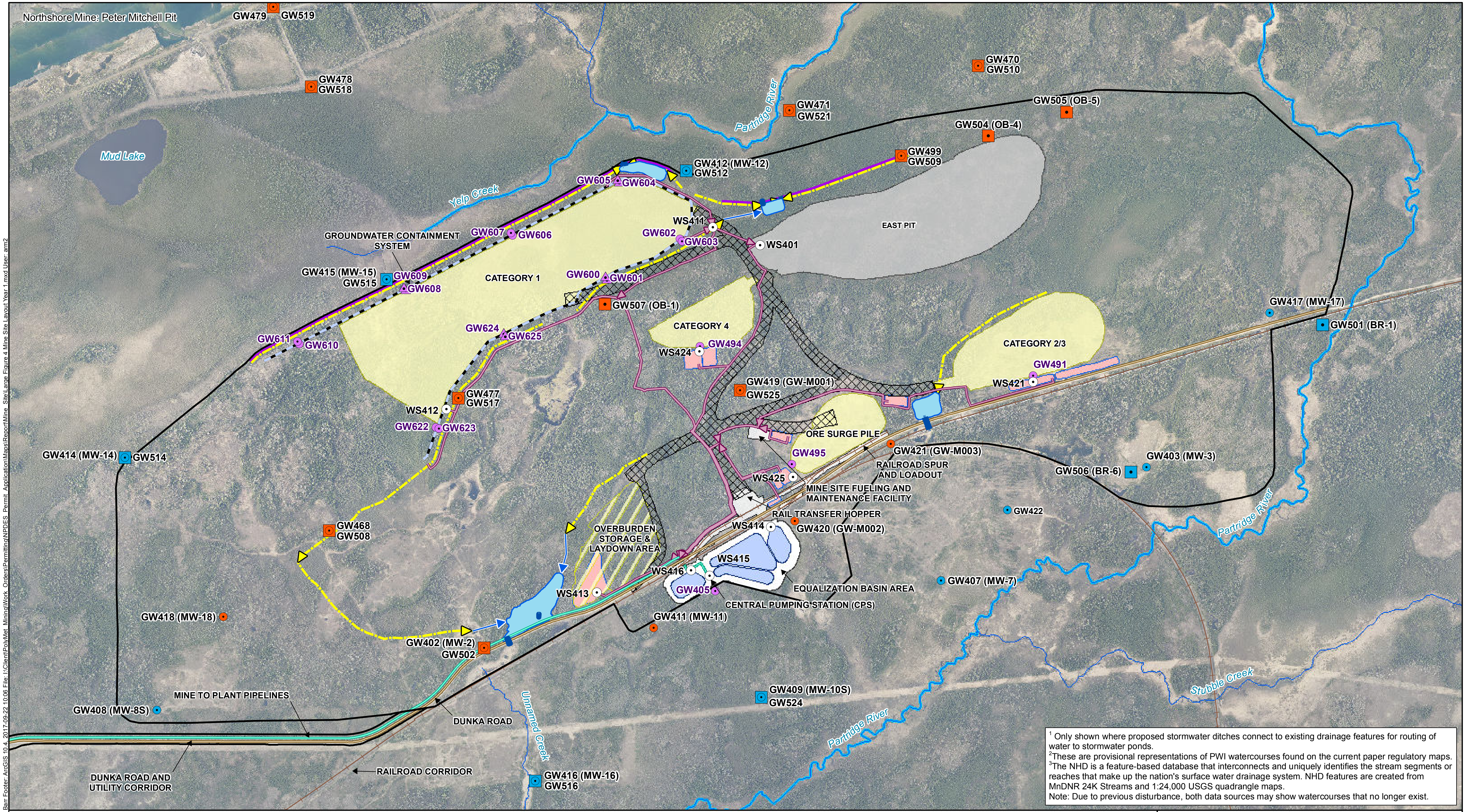
Existing Surface Water Monitoring Stations
Existing Monitoring Wells
Surficial Aquifer
Bedrock Aquifer
MW-5 (GW405) Current Monitoring Station ID (Proposed NPDES/SDS Monitoring Station ID)
EIS Projects Areas
Existing Railroad
Subwatershed Flow Direction
Partridge River Subwatersheds
Wetlands
Public Waters Inventory (PWI) Watercourses[1]
National Hydrography Dataset (NHD) Rivers & Streams[2]

0 1,250 2,500 5,000
Feet

Note: This figure only shows existing monitoring stations associated with the Mine Site. Additional existing monitoring stations are shown in Large Figure 2 of Volume IV, Large Figure 2 of Volume V, Large Figure 2 of Volume VI, and Large Figure 2 of Volume VII.

MINE SITE
EXISTING CONDITIONS
NorthMet Project
Poly Met Mining, Inc.

Large Figure 3
NPDES/SDS Permit Application Volume II: Mine Site
Permit Application Update – October 2017



[1] Only shown where proposed stormwater ditches connect to existing drainage features for routing of water to stormwater ponds.
[2] These are provisional representations of PWI watercourses found on the current paper regulatory maps.
[3] The NHD is a feature-based database that interconnects and uniquely identifies the stream segments or reaches that make up the nation's surface water drainage system. NHD features are created from MnDNR 24K Streams and 1:24,000 USGS quadrangle maps.
Note: Due to previous disturbance, both data sources may show watercourses that no longer exist.

Internal Waste Stream Monitor Only

Proposed Surficial Aquifer Monitoring Stations
- Compliance Well
- Indicator Well
- Performance Well
- Performance Piezometer

Proposed Bedrock Monitoring Stations
- Compliance
- Indicator

GW405 (MW-5) Proposed NPDES/SDS Monitoring Station ID (Current Monitoring Station ID)

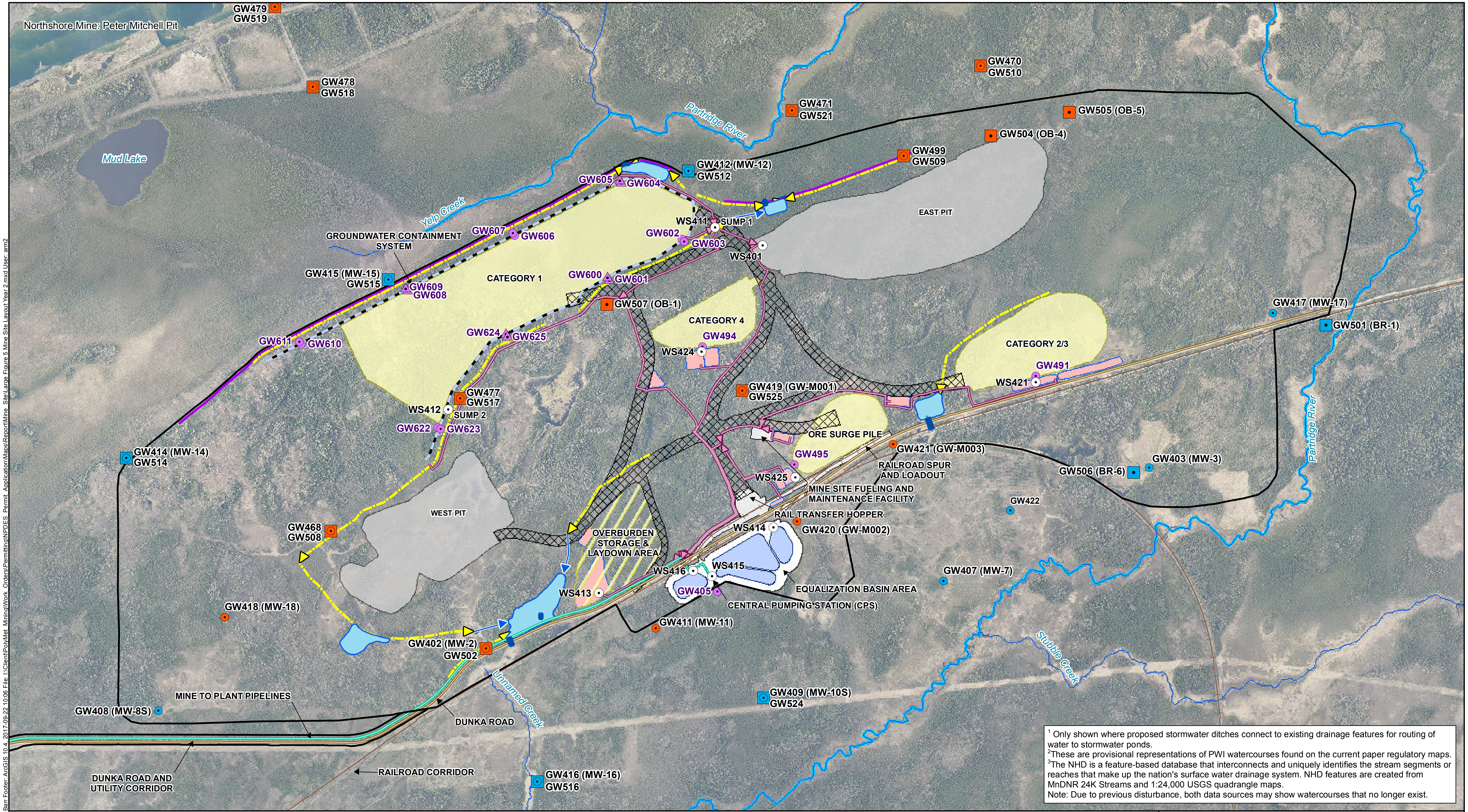
Note: This figure only shows proposed monitoring stations associated with the Mine Site. Additional proposed monitoring stations are shown in Large Figures 6, 7, 8, 10, and 11 of Volume I.

- EIS Project Areas
- Mine Pit
- Active Stockpile
- Storage & Laydown Area
- Haul Roads
- Groundwater Containment System
- Mine to Plant Pipelines
- Mine Water Pipes
- Mine Water Ponds and Sumps
- Perimeter Dike
- Stormwater Ditches
- Existing Drainage[1]
- Stormwater Culverts
- Stormwater Ponds
- Public Waters Inventory (PWI) Watercourses[2]
- National Hydrography Dataset (NHD) Rivers & Streams[3]

0 750 1,500
Feet

MINE SITE LAYOUT - MINE YEAR 1
NorthMet Project
Poly Met Mining, Inc.

Large Figure 4
NPDES/SDS Permit Application Volume II: Mine Site
Permit Application Update – October 2017



[1] Only shown where proposed stormwater ditches connect to existing drainage features for routing of water to stormwater ponds.
[2] These are provisional representations of PWI watercourses found on the current paper regulatory maps.
[3] The NHD is a feature-based database that interconnects and uniquely identifies the stream segments or reaches that make up the nation's surface water drainage system. NHD features are created from MnDNR 24K Streams and 1:24,000 USGS quadrangle maps.
Note: Due to previous disturbance, both data sources may show watercourses that no longer exist.

- Internal Waste Stream Monitor Only

Proposed Surficial Aquifer Monitoring Stations
- Compliance Well
- Indicator Well
- Performance Well
- Performance Piezometer

Proposed Bedrock Monitoring Stations
- Compliance
- Indicator

GW405 (MW-5) Proposed NPDES/SDS Monitoring Station ID (Current Monitoring Station ID)

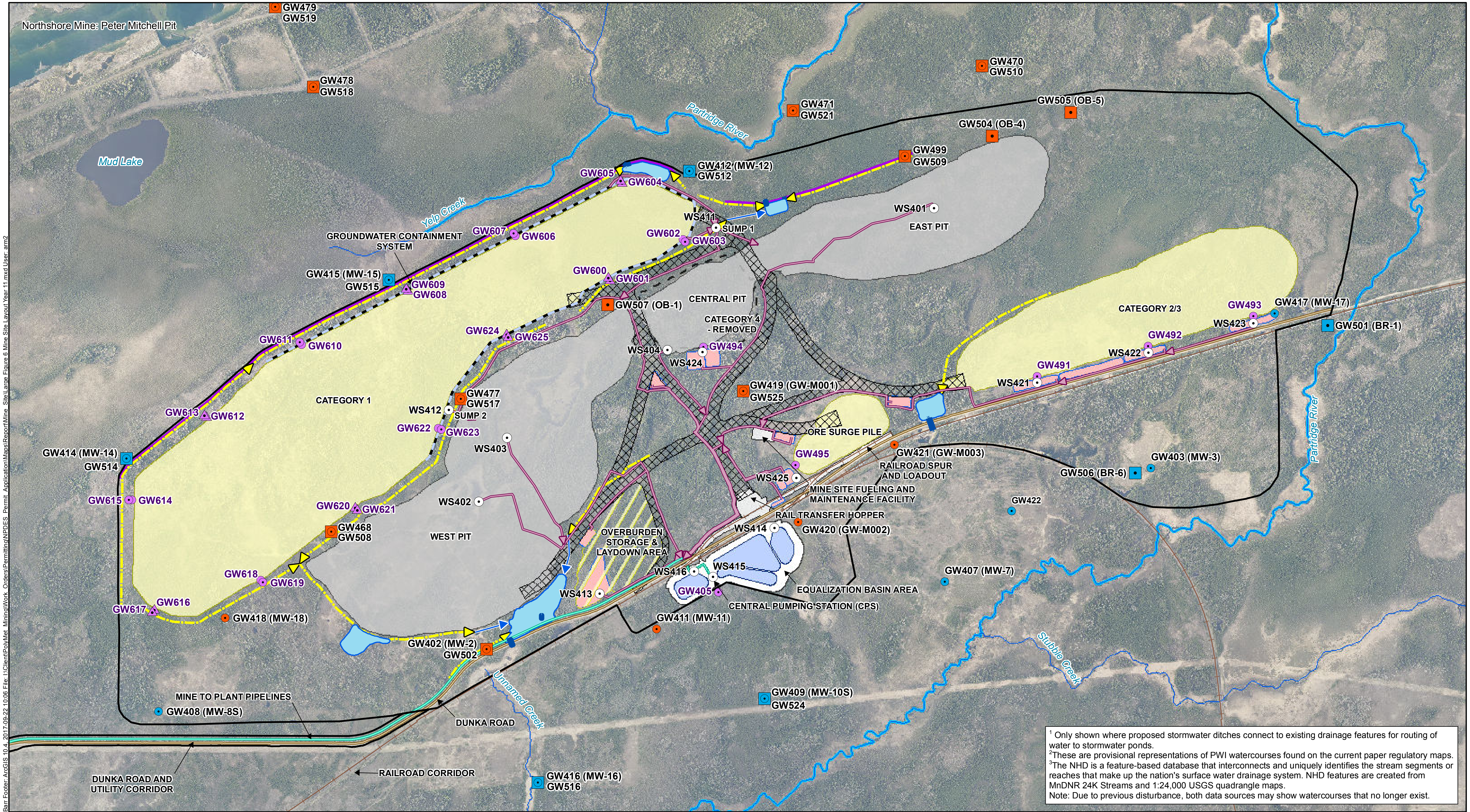
Note: This figure only shows proposed monitoring stations associated with the Mine Site. Additional proposed monitoring stations are shown in Large Figures 6, 7, 8, 10, and 11 of Volume I.

- EIS Project Areas
- Mine Pit
- Active Stockpile
- Storage & Laydown Area
- Haul Roads
- Groundwater Containment System
- Mine to Plant Pipelines
- Mine Water Pipes
- Mine Water Ponds and Sumps
- Perimeter Dike
- Stormwater Ditches
- Existing Drainage[1]
- Stormwater Culverts
- Stormwater Ponds
- Public Waters Inventory (PWI) Watercourses[2]
- National Hydrography Dataset (NHD) Rivers & Streams[3]

0 750 1,500
Feet

MINE SITE LAYOUT -
MINE YEAR 2
NorthMet Project
Poly Met Mining, Inc.

Large Figure 5
NPDES/SDS Permit Application Volume II: Mine Site
Permit Application Update – October 2017



[1] Only shown where proposed stormwater ditches connect to existing drainage features for routing of water to stormwater ponds.
[2] These are provisional representations of PWI watercourses found on the current paper regulatory maps.
[3] The NHD is a feature-based database that interconnects and uniquely identifies the stream segments or reaches that make up the nation's surface water drainage system. NHD features are created from MnDNR 24K Streams and 1:24,000 USGS quadrangle maps.
Note: Due to previous disturbance, both data sources may show watercourses that no longer exist.

Internal Waste Stream Monitor Only

Proposed Surficial Aquifer Monitoring Stations
- Compliance Well
- Indicator Well
- Performance Well
- Performance Piezometer

Proposed Bedrock Monitoring Stations
- Compliance
- Indicator

GW405 (MW-5) Proposed NPDES/SDS Monitoring Station ID (Current Monitoring Station ID)

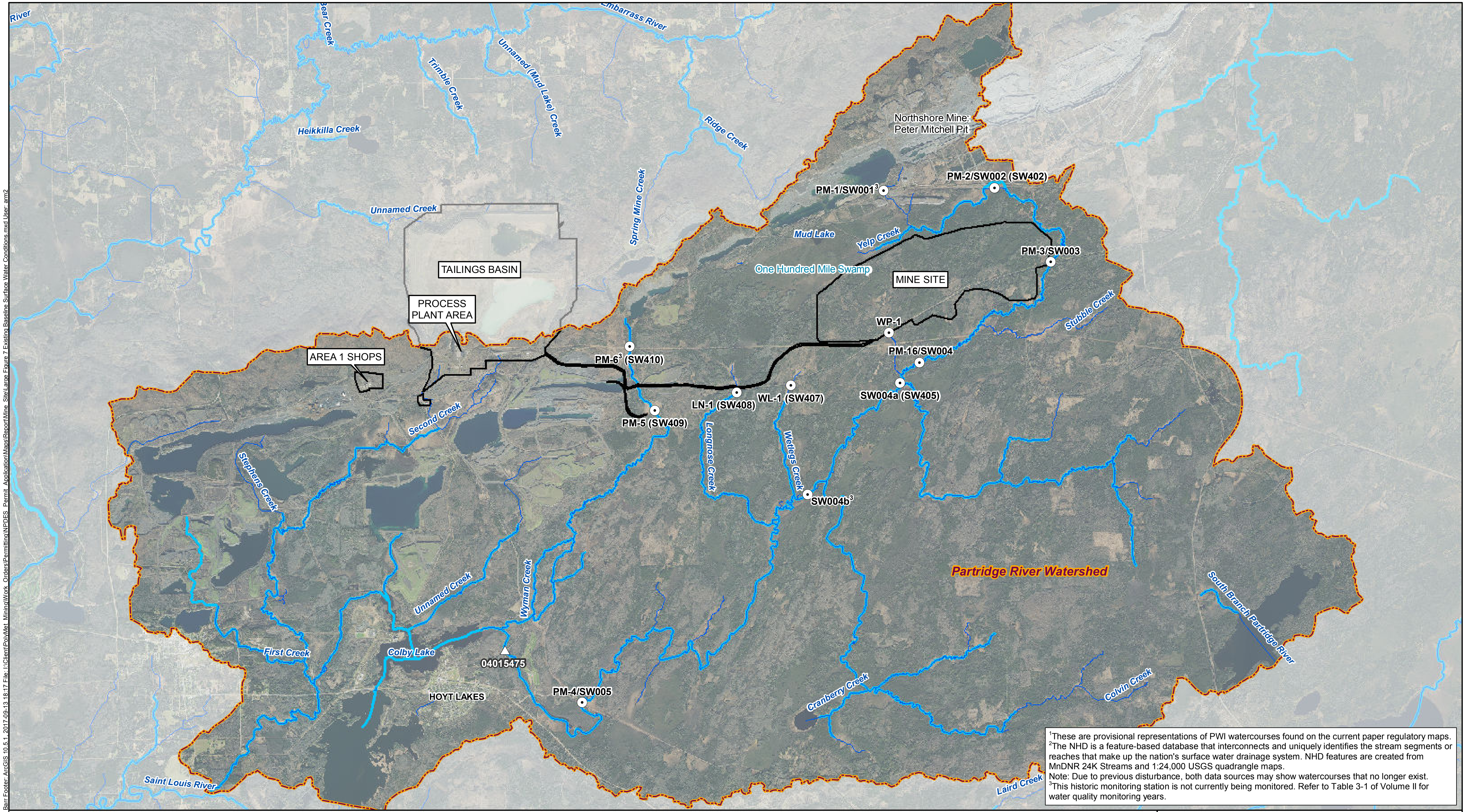
Note: This figure only shows proposed monitoring stations associated with the Mine Site. Additional proposed monitoring stations are shown in Large Figures 6, 7, 8, 10, and 11 of Volume I.

- EIS Project Areas
- Mine Pit
- Active Stockpile
- Storage & Laydown Area
- Removed Stockpile
- Haul Roads
- Groundwater Containment System
- Mine to Plant Pipelines
- Mine Water Pipes
- Mine Water Ponds and Sumps
- Perimeter Dike
- Stormwater Ditches
- Existing Drainage[1]
- Stormwater Culverts
- Stormwater Ponds
- Public Waters Inventory (PWI) Watercourses[2]
- National Hydrography Dataset (NHD) Rivers & Streams[3]

0 750 1,500
Feet

MINE SITE LAYOUT -
MINE YEAR 11
NorthMet Project
Poly Met Mining, Inc.

Large Figure 6
NPDES/SDS Permit Application Volume II: Mine Site
Permit Application Update – October 2017



¹These are provisional representations of PWI watercourses found on the current paper regulatory maps.
²The NHD is a feature-based database that interconnects and uniquely identifies the stream segments or reaches that make up the nation's surface water drainage system. NHD features are created from MnDNR 24K Streams and 1:24,000 USGS quadrangle maps.
Note: Due to previous disturbance, both data sources may show watercourses that no longer exist.
³This historic monitoring station is not currently being monitored. Refer to Table 3-1 of Volume II for water quality monitoring years.

⊙ PolyMet Mining's Past and Existing Surface Water Monitoring Stations
△ USGS Gage Station

PM-2/SW002 (SW402) Current Monitoring Station ID (Proposed NPDES/SDS Monitoring Station ID)

Other past and existing surface water monitoring stations in the Embarrass River watershed are shown in Large Figure 5 of Volume V.

EIS Project Areas
Watershed Boundary
Public Waters Inventory (PWI) Watercourses[1]
National Hydrography Dataset (NHD) Rivers & Streams[2]

N

0 0.75 1.5 3
Miles

EXISTING BASELINE SURFACE WATER CONDITIONS
NorthMet Project
Poly Met Mining, Inc.

Large Figure 7
NPDES/SDS Permit Application Volume II: Mine Site
Permit Application Update – October 2017

Appendices

Appendix A

Waste Water Treatment System Terminology Changes

Appendix A Waste Water Treatment System Terminology Changes

Some terminology associated with the Waste Water Treatment System (WWTS) has changed since the environmental review process was completed and the NPDES/SDS Permit Application was submitted in July 2016. Changes are associated with the relocation of the mine water treatment trains that were previously planned for the Mine Site Waste Water Treatment Facility (WWTF), which will now be in the Plant Site WWTS, and the relocation of the Mine Site equalization basins, Central Pumping Station (CPS), and Construction Mine Water Basin south of Dunka Road. There is no change to the level of treatment planned for the Project as a result of these relocations.

To facilitate the review of documents prepared for the NorthMet Mining Project and Land Exchange Final Environmental Impact Statement (FEIS) which are also referenced in this NPDES/SDS Permit Application, the following table explains WWTS terminology changes.

Former Name	New Name
Waste Water Treatment Plant (WWTP) and Waste Water Treatment Facility (WWTF)	Waste Water Treatment System (WWTS)(1)
Treated Water Pipeline	As a whole: • Mine to Plant Pipelines (MPP) Three individual pipes: • Construction Mine Water Pipeline • Low Concentration Mine Water Pipeline • High Concentration Mine Water Pipeline
Construction Mine Water Basin	Construction Mine Water Basin
West Equalization Basin	High Concentration Equalization Basin (HCEQ Basin)
East Equalization Basin 1	Low Concentration Equalization Basin 1 (LCEQ Basin 1)
East Equalization Basin 2	Low Concentration Equalization Basin 2 (LCEQ Basin 2)
WWTP effluent (discharged to receiving waters)	WWTS discharge
WWTF effluent (sent to the FTB via the Central Pumping Station)	Treated mine water(3) (WWTS stream pumped to the FTB)
Treated mine water(2)	Treated mine water(3)
Central Pumping Station	Central Pumping Station
--	Equalization Basin Area(4)
Splitter Structure	This structure will be integrated into the Central Pumping Station.
Central Pumping Station (CPS) Pond	This pond no longer exists.

(1) The two sets of treatment trains that were previously at two locations will now be housed under one roof at the Plant Site.
(2) "Treated mine water" formerly included WWTF effluent, OSLA runoff, and construction mine water and was all sent to the FTB.
(3) "Treated mine water" now consists of effluent from the chemical precipitation and membrane filtration portion of the WWTS that are sent to the FTB.
(4) New term describing pond area south of Dunka Road

Appendix B

Permit Application Support Drawings

Mine Site and Dunka Road Earthwork
Categories 1, 2/3, and 4 Stockpiles and Ore Surge Pile Design
Mine Site Stormwater
Mechanical Infrastructure
Category 1 Stockpile Groundwater Containment System

Mine Site and Dunka Road Earthwork
Permit Application Support Drawings

Errata Sheet

Poly Met Mining, Inc. NorthMet Project

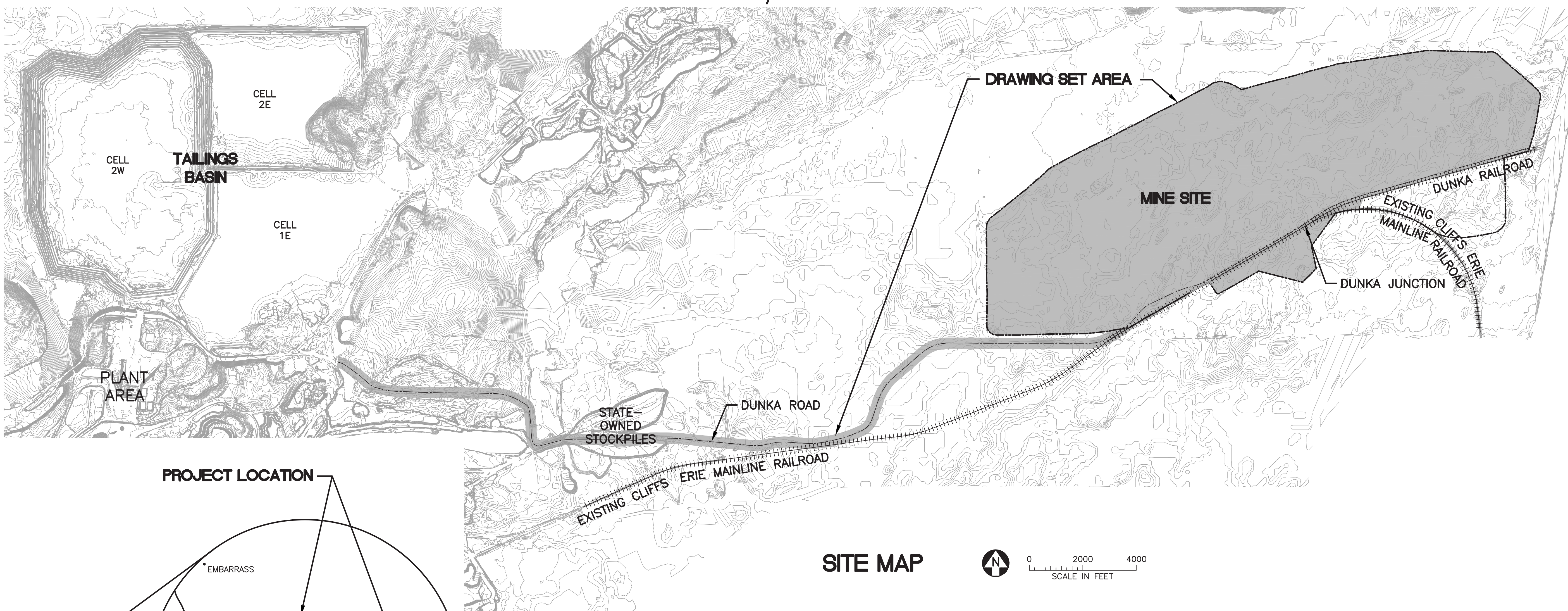
Permit Application Support Drawings: Mine Site and Dunka Road Earthwork

August 2017 (version 3)

Engineering design is currently in progress. The table below lists changes that have been identified to-date and have not yet been incorporated in the attached permit application support drawings within this set. Final design will incorporate these changes along with additional site-specific information (e.g., supplementary geotechnical data); therefore, additional adjustments may be made during final design that will be incorporated into the final design drawing set.

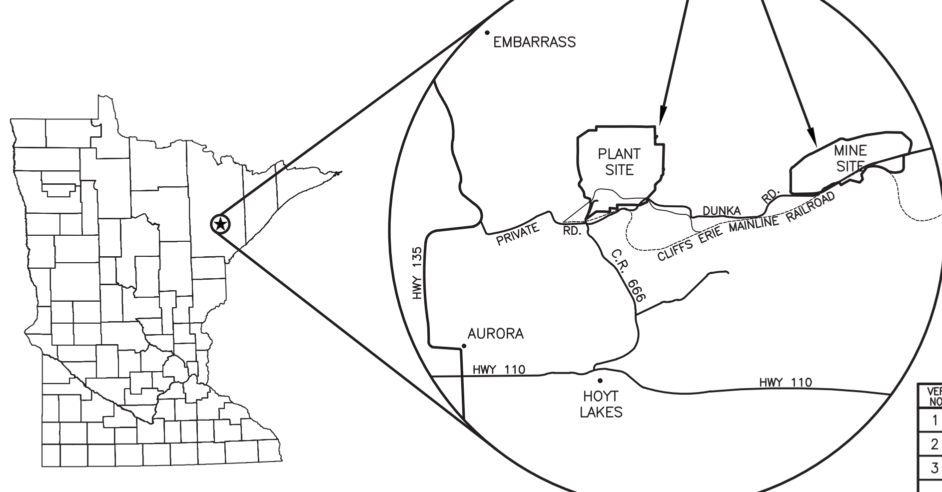
Drawing Sheet(s)	Change
Global change to all sheets, as needed	The terminology "mine drainage" as noted in these drawings will be changed to "mine water".
EW-003	Temporary sedimentation basins or stormwater infiltration basins may be added to meet construction stormwater requirements along Dunka Road. These construction stormwater features require additional site-specific data and will be evaluated in final design.
EW-002, EW-003, EW-005, EW-009, EW-010, EW-011	The "Mine Site Boundary" will be replaced by the "Mining Area Boundary" as shown on figures included in the Permit to Mine Application.
EW-010, EW-011	Note 3 will be modified to read: "Reclamation of the Haul Roads will consist of removing safety berms through grading, seeding the regraded surface, and establishing a 15-foot-wide access road near the centerline of all haul roads." Note 3 will be modified to read: "All active haul roads to be reclaimed."

POLY MET MINING, INC. NORTHMET PROJECT
PERMIT APPLICATION SUPPORT DRAWINGS
MINE SITE AND DUNKA ROAD EARTHWORK
HOYT LAKES, MINNESOTA



SITE MAP

PROJECT LOCATION



LOCATION MAP
NOT TO SCALE

VICINITY MAP
NOT TO SCALE

VER NO	DATE	DESCRIPTION
1	5/21/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
2	8/10/16	CORRECTION ON EW-009
3	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	3	6/7/2017
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE AND DUNKA ROAD EARTHWORK
LOCATION MAP AND SITE MAP

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. EW-001
REV B

CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-05-EW-001.DWG PLOT SCALE: 1:2 PLOT DATE: 6/1/2017 9:49 AM

INCHES 1 2

GENERAL LEGEND

EXISTING

1000	EXISTING CONTOUR – MAJOR
	EXISTING CONTOUR – MINOR
	EXISTING POWER POLE
	EXISTING RAILROAD
	WATER EDGE/CREEK CENTER LINE
	EXISTING ROAD
	EXISTING TRAIL
	EXISTING UNIMPROVED TRAIL
R/W	RIGHT OF WAY
	PROPERTY LINE
	MINE SITE BOUNDARY
	EXISTING STRUCTURES
	TREE LINE
	WETLAND BOUNDARY
OE	EXISTING OVERHEAD ELECTRIC
UE	EXISTING UNDERGROUND ELECTRIC
	EXISTING VALVE
	EXISTING CULVERT
	PROPOSED MINE WATER CULVERT

PROPOSED

1000	PROPOSED CONTOUR – MAJOR
	PROPOSED CONTOUR – MINOR
	PROPOSED ROADS

PROPOSED OTHER FACILITY

1000	OTHER FACILITY PROPOSED CONTOUR – MAJOR
	OTHER FACILITY PROPOSED CONTOUR – MINOR

NOTES

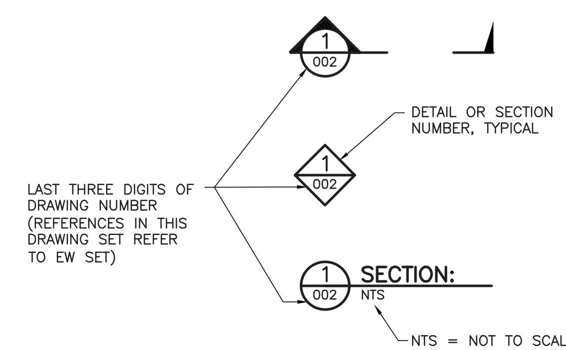
1. COORDINATE SYSTEM IS MINNESOTA STATE PLANE NORTH ZONE, NAD83.
2. ELEVATIONS ARE BASED ON MEAN SEA LEVEL (MSL), NAVD88.
3. EXISTING TOPOGRAPHIC INFORMATION SHOWN ON THE DRAWINGS WAS PREPARED BY AEROMETRIC, INC. FROM LIDAR DATA COLLECTED ON MARCH 17, 2010.

ABBREVIATIONS

CATEGORY 1 STOCKPILE	–	CATEGORY 1 WASTE ROCK STOCKPILE
CATEGORY 2/3 STOCKPILE	–	CATEGORY 2/3 WASTE ROCK STOCKPILE
CL	–	CENTERLINE
EW	–	EARTHWORK
MPP	–	MINE TO PLANT PIPELINES
OE	–	OVERHEAD ELECTRIC
STA	–	STATION
SWPPP	–	STORMWATER POLLUTION PREVENTION PLAN
TYP	–	TYPICAL
I, II, III, IV, V	–	ROMAN NUMERALS FOR RIPRAP CLASSIFICATION

SHEET INDEX

DRAWING NUMBERING



VER NO	DATE	DESCRIPTION
1	5/21/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
3	6/7/2017	PERMIT APPLICATION UPDATES

ISSUED	VERSION	DATE
FOR PERMITTING	3	6/7/2017
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB
CHECKED: ATS
BARR PROJECT NO.: 23/69–0C29
SCALE: AS SHOWN

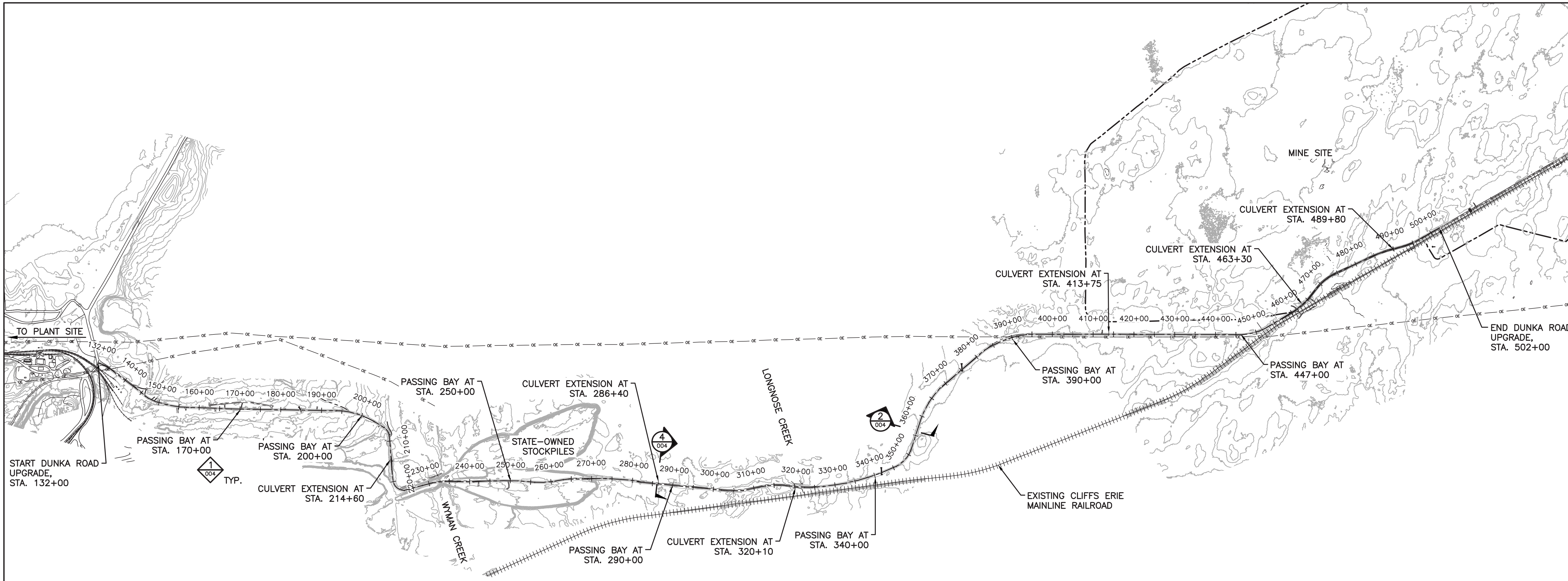
PLANT DRAWING NUMBER:

MINE SITE AND DUNKA ROAD EARTHWORK
LEGEND AND SHEET INDEX

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1–800–632–2277

DWG. NO. EW–002 REV B



1 PLAN: DUNKA ROAD UPGRADE

0 1200 2400
SCALE IN FEET

VER NO	DATE	DESCRIPTION
1	5/21/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
3	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	3	6/7/2017
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE AND DUNKA ROAD EARTHWORK
DUNKA ROAD UPGRADE
GENERAL LAYOUT

POLYMET MINING
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

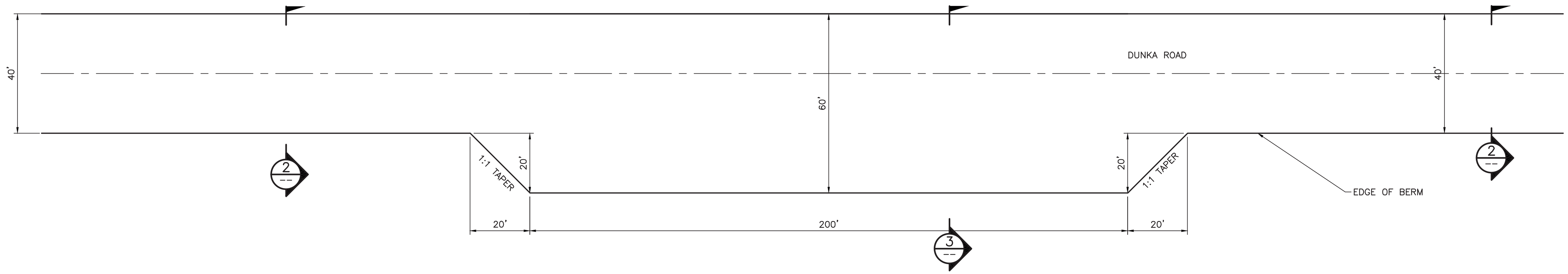
BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. EW-003
REV B

CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-05-EW-003.DWG PLOT SCALE: 1:2 PLOT DATE: 6/1/2017 9:48 AM

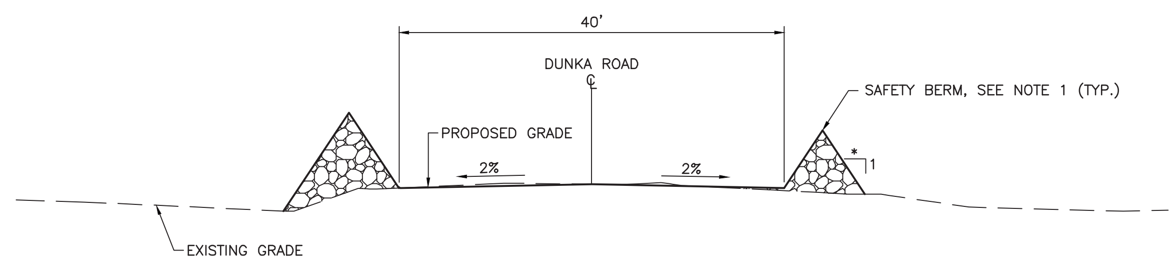
INCHES 1 2

CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-05-EW-004.DWG PLOT SCALE: 1:2 PLOT DATE: 6/5/2017 10:32 AM



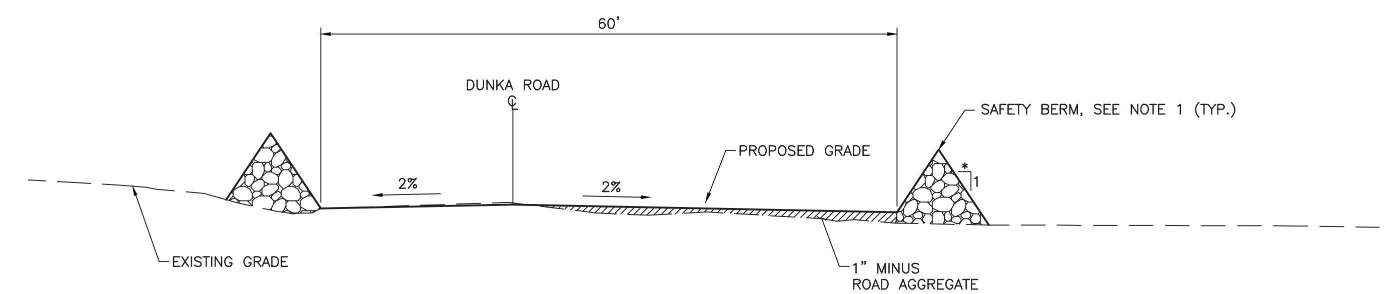
1/003 DETAIL: DUNKA ROAD PASSING BAY
0 20 40
SCALE IN FEET

APPROXIMATE PASSING BAY LOCATIONS
STA 170+00
STA 200+00
STA 250+00
STA 290+00
STA 340+00
STA 390+00
STA 447+00



2/003 SECTION: TYPICAL DUNKA ROAD
0 10 20
SCALE IN FEET

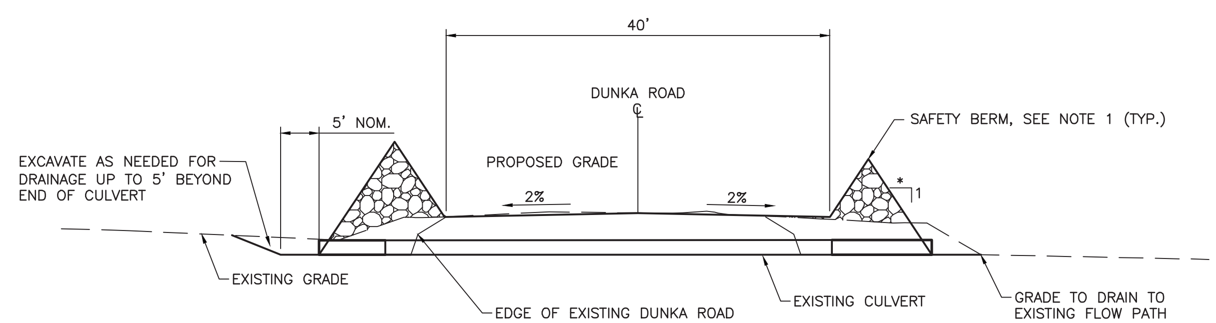
NOTES:
1. WHERE BERMS ARE REQUIRED.
2. * = ANGLE OF REPOSE



3/– SECTION: TYPICAL DUNKA ROAD PASSING BAY
0 10 20
SCALE IN FEET

NOTES:
1. WHERE BERMS ARE REQUIRED.
2. * = ANGLE OF REPOSE

APPROXIMATE CULVERT EXTENSION LOCATIONS
STA 214+60
STA 286+40
STA 320+10
STA 413+75
STA 463+30
STA 489+80



4/003 SECTION: TYPICAL DUNKA ROAD CULVERT EXTENSION
0 10 20
SCALE IN FEET

NOTES:
1. WHERE BERMS ARE REQUIRED.
2. * = ANGLE OF REPOSE

VER NO	DATE	DESCRIPTION	ISSUE STATUS		
			ISSUED	VERSION	DATE
1	5/21/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION	FOR PERMITTING	3	6/7/2017
3	6/7/2017	PERMIT APPLICATION UPDATES	FOR CONSTRUCTION		
			NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE AND DUNKA ROAD EARTHWORK
DUNKA ROAD UPGRADE
TYPICAL SECTION

POLYMET MINING
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. EW-004
REV B

INCHES 1 2

1 – PLAN: HAUL ROADS GENERAL LAYOUT – MINE YEAR 11

0 700 1400
SCALE IN FEET

NOTES

1. CULVERT SECTION SHOWN AS TYPICAL CALLOUT. ALL CULVERTS THAT CROSS THE HAUL ROADS, SHOWN ON THIS DRAWING WILL BE CONSTRUCTED AS SHOWN ON 2/007.

VER NO	DATE	DESCRIPTION
1	5/21/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
3	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	3	6/7/2017
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE AND DUNKA ROAD EARTHWORK
HAUL ROADS GENERAL LAYOUT
MINE YEAR 11

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

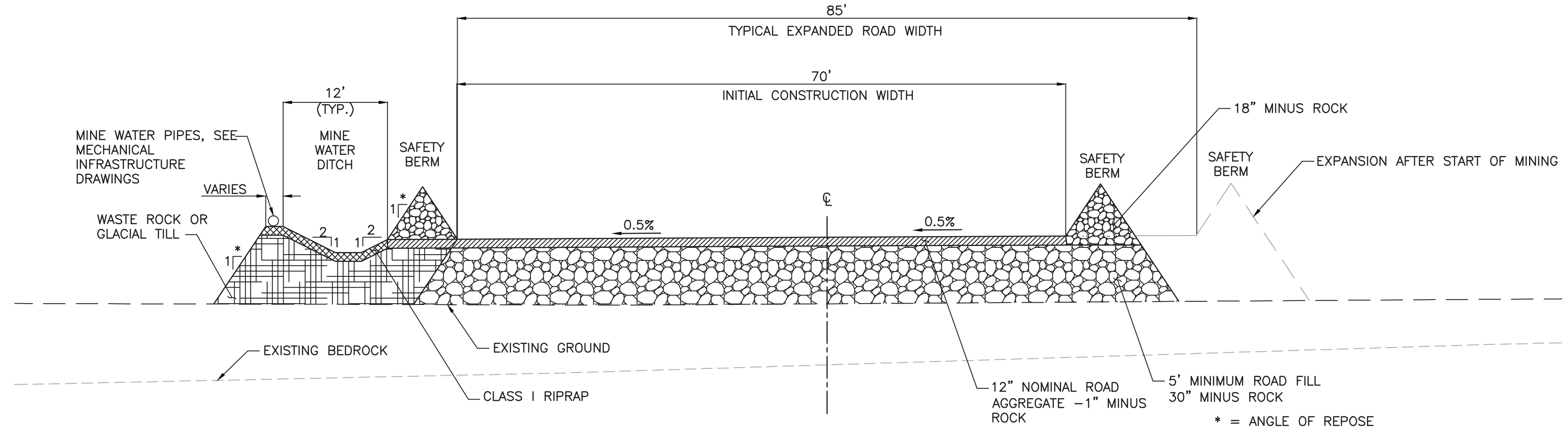
BARR

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. EW-005
REV B

CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-05-EW-005.DWG PLOT SCALE: 1:2 PLOT DATE: 6/5/2017 10:42 AM

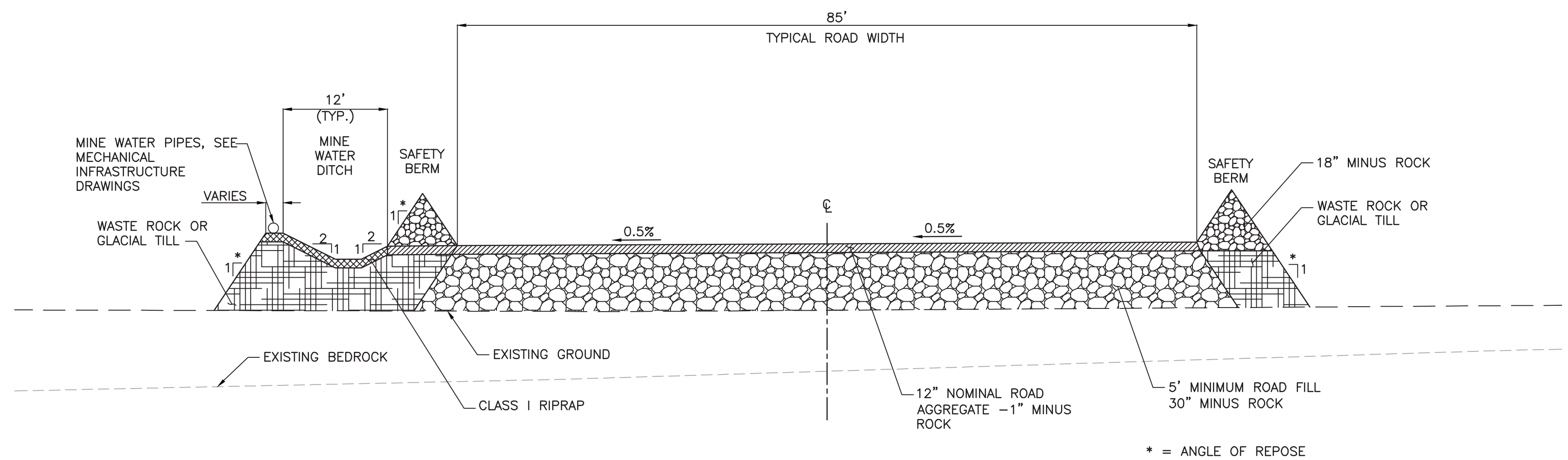
INCHES 1 2



1/005 **SECTION: TYPICAL PRE-MINING HAUL ROAD WITH EXPANSION**

SHOWN AT INITIAL CONSTRUCTION WIDTH

0 10 20
SCALE IN FEET



2/005 **SECTION: TYPICAL HAUL ROAD AFTER START OF MINING**

(AFTER MINE ROCK EXCAVATION BEGINS)

0 10 20
SCALE IN FEET

NOTES:

1. MINE WATER DITCH TO BE CONSTRUCTED WHERE NEEDED. DITCH MAY BE LOCATED ON EITHER OR BOTH SIDES OF ROAD.
2. SAFETY BERMS TO BE CONSTRUCTED OF WASTE ROCK OBTAINED FROM STATE-OWNED STOCKPILE (PRIOR TO START OF MINING) OR FROM CATEGORY 1 WASTE ROCK (AFTER START OF MINING).
3. DESIGN GRADE OF DITCHES BASED ON HYDRAULIC DESIGN REQUIREMENTS STARTING AT STORAGE POND ELEVATION.
4. ROAD GRADE ESTABLISHED TO PROVIDE POSITIVE DRAINAGE INTO DITCH WITH NO BACKUP OF WATER ONTO THE ROAD FOR THE 10-YEAR, 24-HOUR STORM.
5. DRAINAGE SYSTEM DESIGNED TO CONTROL/CONTAIN THE 100-YEAR, 24-HOUR STORM.
6. DRAINAGE PATH MUST BE PROVIDED THROUGH BERM BETWEEN ROAD AND DITCH. THIS CAN BE ACCOMPLISHED BY THE FOLLOWING OPTIONS IN APPROPRIATELY SPACED LOCATIONS.
   A. COARSE WASTE ROCK FROM STATE-OWNED STOCKPILE (PRIOR TO START OF MINING) OR FROM CATEGORY 1 WASTE ROCK (AFTER START OF MINING) (NO FINES)
   B. CULVERTS
   C. LARGE BOULDERS FROM PRE-STRIPPING
   D. GAP IN BERM
7. ROAD FILL TO BE CONSTRUCTED OF WASTE ROCK OBTAINED FROM STATE-OWNED STOCKPILE (PRIOR TO START OF MINING) OR FROM CATEGORY 1 WASTE ROCK (AFTER START OF MINING).
8. DISTURBED SOIL AREAS SHALL BE VEGETATED IN ACCORDANCE WITH THE CONSTRUCTION SWPPP.

VER NO	DATE	DESCRIPTION
1	5/21/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
3	6/7/2017	PERMIT APPLICATION UPDATES

ISSUED	VERSION	DATE
FOR PERMITTING	3	6/7/2017
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE AND DUNKA ROAD EARTHWORK
HAUL ROADS
TYPICAL SECTIONS AND DETAILS

POLYMET MINING

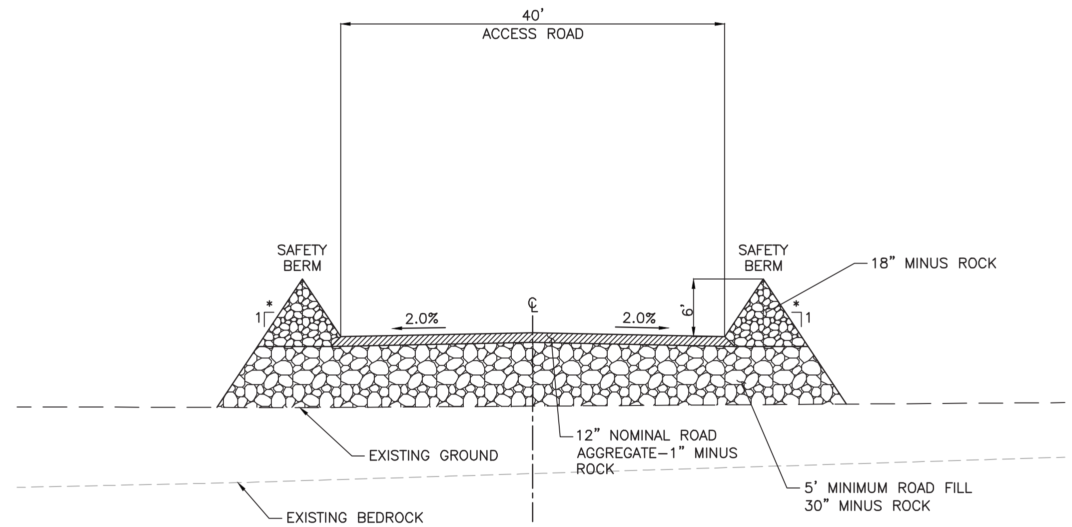
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. EW-006
REV B

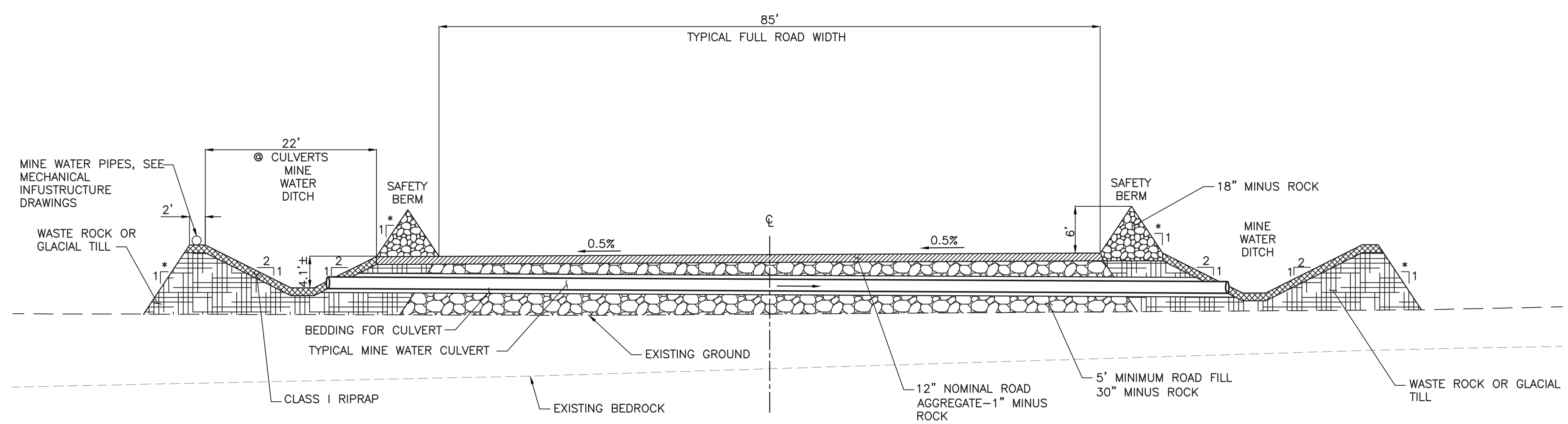
INCHES 1 2



NOTES:
* – ANGLE OF REPOSE

(1/005) SECTION: TYPICAL ACCESS ROAD (ROAD I)

0 10 20
SCALE IN FEET



NOTES:
* – ANGLE OF REPOSE

(2/005) SECTION: TYPICAL HAUL ROAD WITH MINE WATER CULVERT CROSSING

0 10 20
SCALE IN FEET

NOTES:

1. TYPICAL SECTION IS SHOWN TO ILLUSTRATE GENERALIZED DESIGN OF LOCATIONS WHERE ROAD DRAINAGE IS DIVERTED FROM ONE SIDE OF THE ROAD TO THE OTHER. ACTUAL DESIGN WILL VARY BY LOCATION. CROSS SLOPE ON ROAD WILL TRANSITION TO DRAIN SURFACE WATER TO DOWNSTREAM MINE DRAINAGE DITCH. CROSS SLOPE AT CULVERT MAY SLOPE EITHER DIRECTION, OR A PORTION OF THE ROAD MAY SLOPE BOTH DIRECTIONS, DEPENDING ON THE SPECIFIC CULVERT LOCATION.
2. REFER TO MINE SITE MINE WATER DRAWINGS FOR LOCATIONS.

VER NO	DATE	DESCRIPTION
1	5/21/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
3	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	3	6/7/2017
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE AND DUNKA ROAD EARTHWORK
HAUL ROADS
TYPICAL SECTIONS AND DETAILS

POLYMET MINING

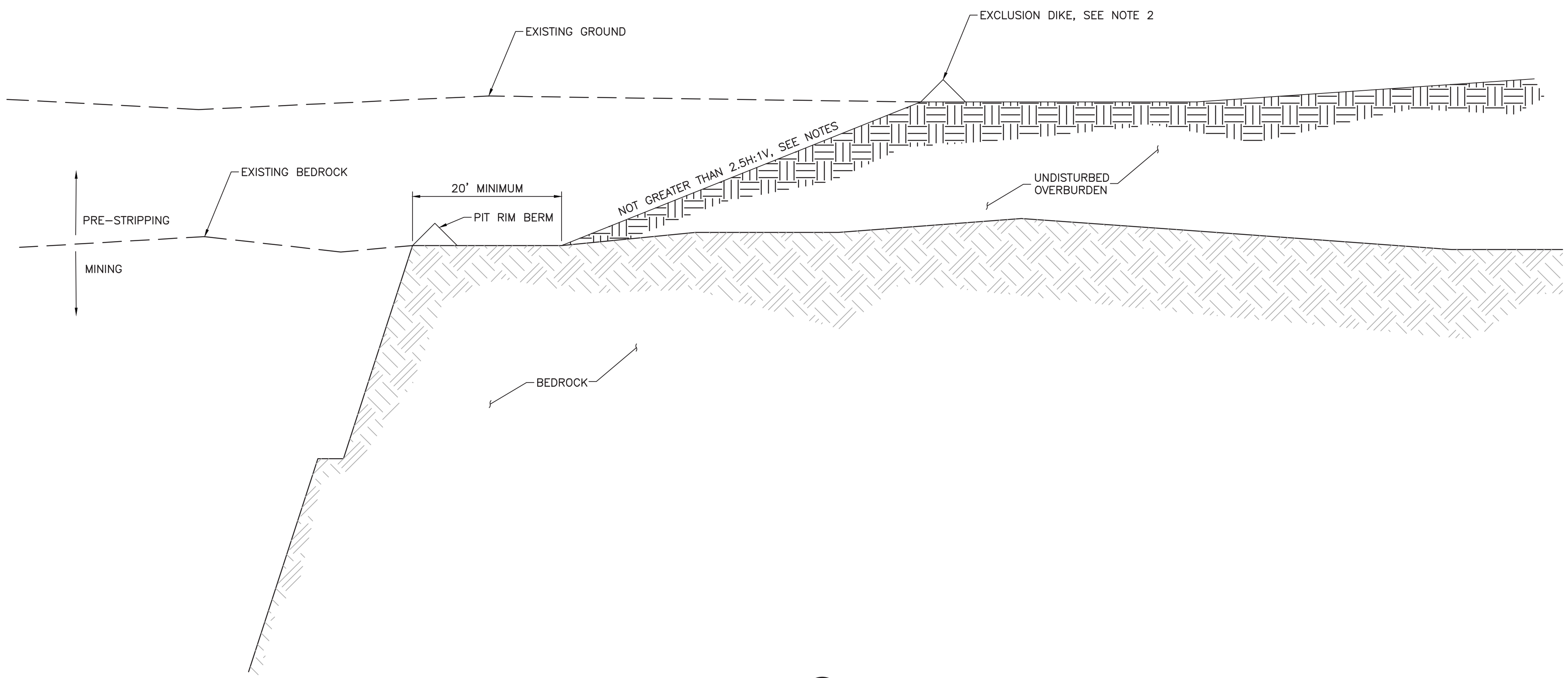
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. EW-007
REV B

INCHES 1 2



1 SECTION: TYPICAL EDGE OF PIT TO UNDISTURBED GROUND

0 10 20
SCALE IN FEET

NOTES:

1. PROPOSED FINISHED GRADE WITHIN PRE-STRIPPING AREA REFLECTS BEDROCK DATA PROVIDED BY POLYMET.
2. CONSTRUCT EXCLUSION DIKE AROUND PIT PERIMETER TO DIVERT SURFACE RUNOFF AWAY FROM PIT.
3. FINAL PIT SLOPES SHALL ADHERE TO CHAPTER 6132.23 OVERBURDEN PORTION OF PITWALLS OF MINNESOTA DNR STANDARDS. AFTER GRADING IS COMPLETED, RECLAIM FINAL PIT SLOPES IN ACCORDANCE WITH MINE RECLAMATION PLAN.
4. SLOPES IN AREAS WHERE ORGANIC SOILS AND WETLANDS ARE PRESENT MAY BE SLOPED AS NECESSARY TO MAINTAIN A STABLE SLOPE.
5. 20' BENCH SHALL BE ESTABLISHED FROM THE TOE OF THE OVERBURDEN TO THE FUTURE CREST OF ROCK IN ACCORDANCE WITH MINNESOTA DNR SIDEWALL DESIGN STANDARDS.
6. CONTRACTOR SHALL LEAVE TEMPORARY HAUL ROADS WITHIN PRE-STRIPPING LIMITS IN PLACE FOR OWNER'S ACCESS.
7. CONTRACTOR SHALL STOCKPILE OVERBURDEN IN LOCATIONS AND AT QUANTITIES TO BE APPROVED BY OWNER.

VER NO	DATE	DESCRIPTION
1	5/21/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
3	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	3	6/7/2017
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE AND DUNKA ROAD EARTHWORK
PRE-STRIPPING
PIT TYPICAL SECTION

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

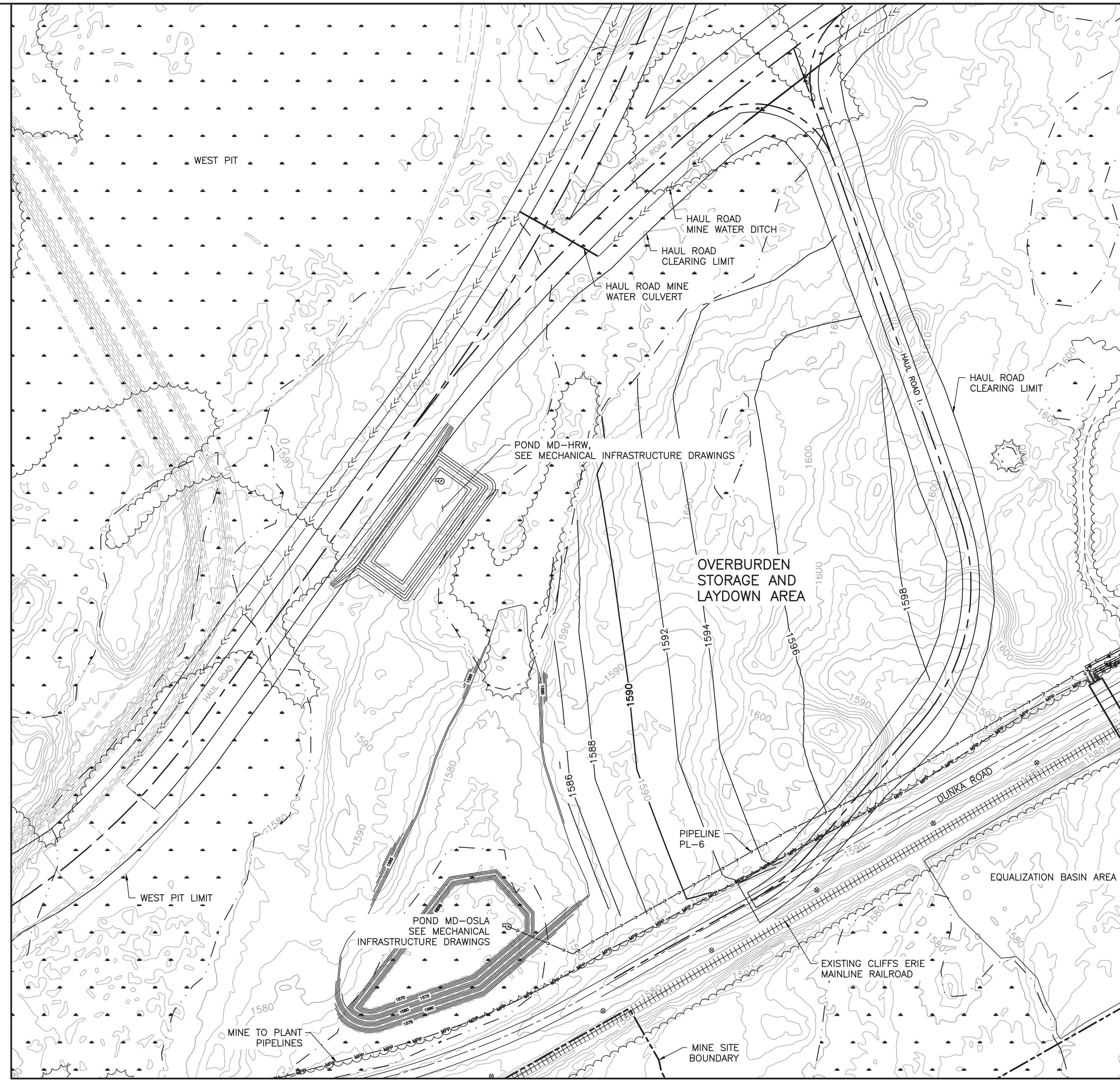
DWG. NO. EW-008

REV B

CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-05-EW-008.DWG PLOT SCALE: 1:2 PLOT DATE: 6/5/2017 10:46 AM

INCHES 1 2

CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-05-EW-009.DWG PLOT SCALE: 1:2 PLOT DATE: 6/5/2017 10:48 AM



1/005 PLAN: OVERBURDEN STORAGE AND LAYDOWN AREA

0 150 300
SCALE IN FEET

PLANT DRAWING NUMBER:

MINE SITE AND DUNKA ROAD EARTHWORK
OVERBURDEN STORAGE AND LAYDOWN AREA
GRADING PLAN

VER NO	DATE	DESCRIPTION
1	5/21/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
2	8/10/16	OSLA CONTOUR DISPLAY CORRECTED
3	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	3	6/7/2017
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

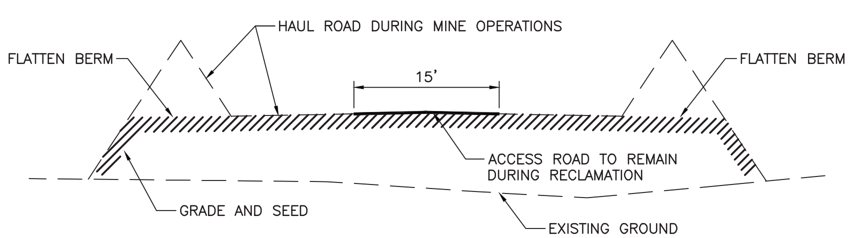
POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

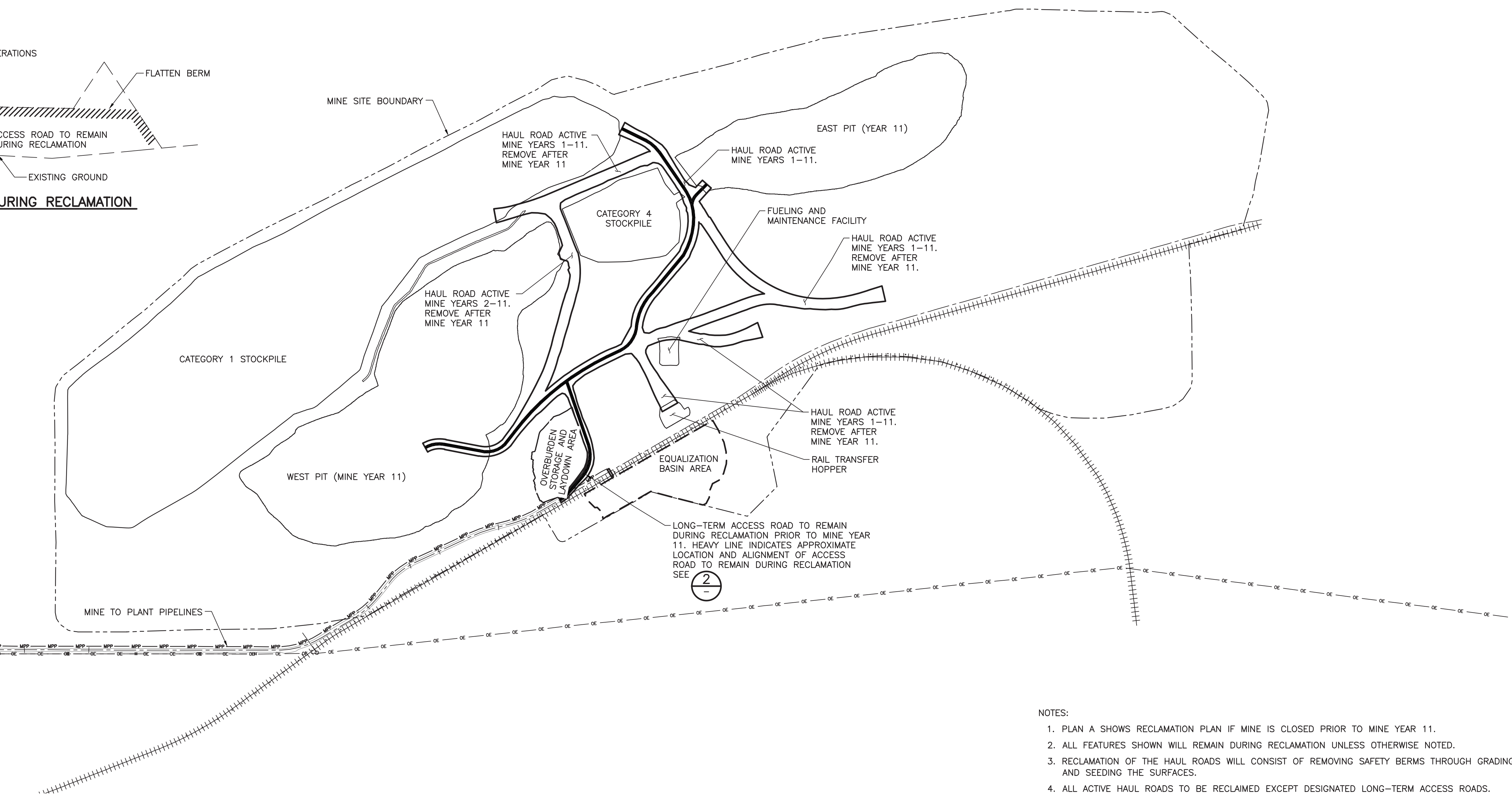
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. EW-009
REV B

INCHES 1 2



2 SECTION: ACCESS ROAD DURING RECLAMATION



1 PLAN: HAUL ROAD RECLAMATION PLAN A

0 1000 2000
SCALE IN FEET

NOTES:

1. PLAN A SHOWS RECLAMATION PLAN IF MINE IS CLOSED PRIOR TO MINE YEAR 11.
2. ALL FEATURES SHOWN WILL REMAIN DURING RECLAMATION UNLESS OTHERWISE NOTED.
3. RECLAMATION OF THE HAUL ROADS WILL CONSIST OF REMOVING SAFETY BERMS THROUGH GRADING AND SEEDING THE SURFACES.
4. ALL ACTIVE HAUL ROADS TO BE RECLAIMED EXCEPT DESIGNATED LONG–TERM ACCESS ROADS.

PLANT DRAWING NUMBER:

MINE SITE AND DUNKA ROAD EARTHWORK
HAUL ROAD RECLAMATION PLAN A
MINE YEARS 1–11

VER NO	DATE	DESCRIPTION
1	5/21/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
3	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	3	6/7/2017
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB
CHECKED: ATS
BARR PROJECT NO.: 23/69–0C29
SCALE: AS SHOWN

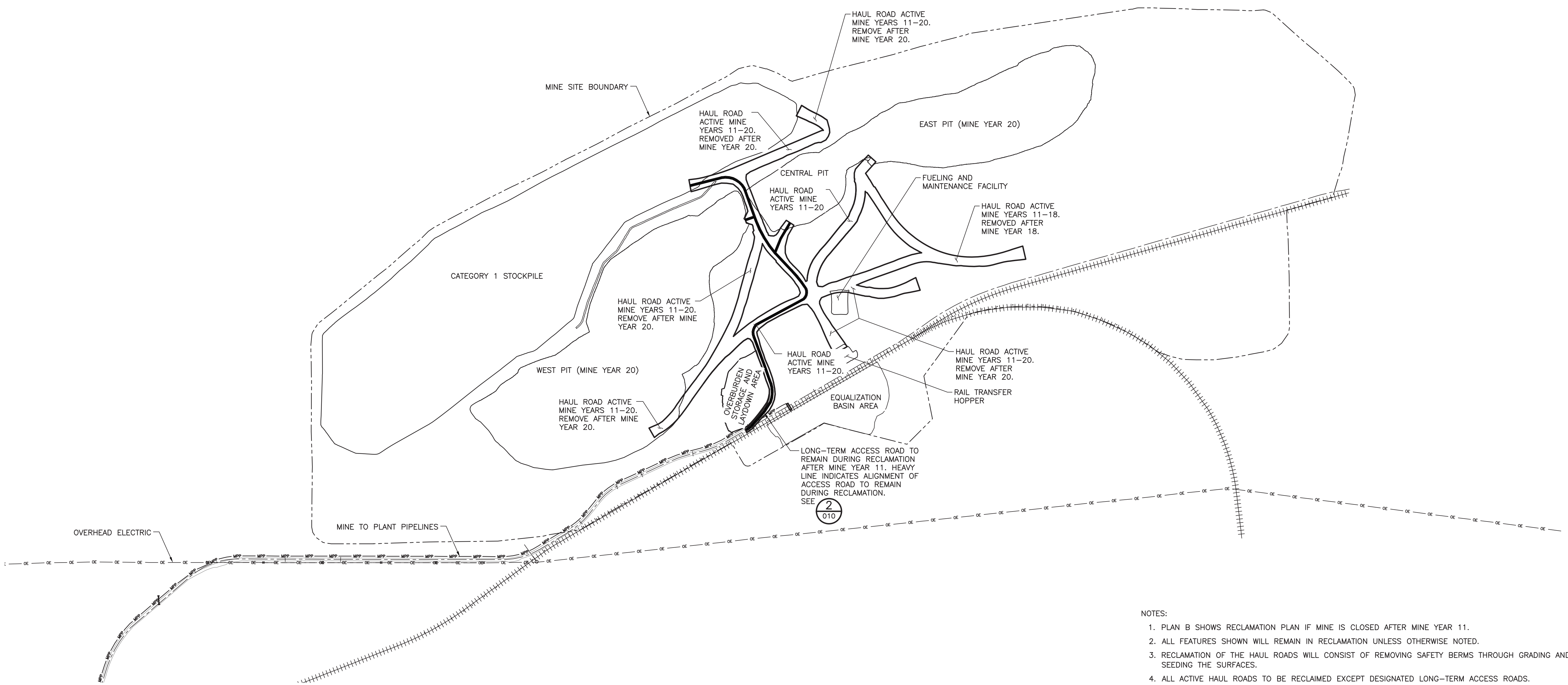
POLYMET MINING
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1–800–632–2277

DWG. NO. EW–010
REV B

CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM–05–EW–010.DWG PLOT SCALE: 1:2 PLOT DATE: 6/9/2017 7:02 AM

INCHES 1 2



NOTES:

1. PLAN B SHOWS RECLAMATION PLAN IF MINE IS CLOSED AFTER MINE YEAR 11.
2. ALL FEATURES SHOWN WILL REMAIN IN RECLAMATION UNLESS OTHERWISE NOTED.
3. RECLAMATION OF THE HAUL ROADS WILL CONSIST OF REMOVING SAFETY BERMS THROUGH GRADING AND SEEDING THE SURFACES.
4. ALL ACTIVE HAUL ROADS TO BE RECLAIMED EXCEPT DESIGNATED LONG–TERM ACCESS ROADS.

1 – PLAN: HAUL ROAD RECLAMATION PLAN B

0 1000 2000
SCALE IN FEET

PLANT DRAWING NUMBER:

MINE SITE AND DUNKA ROAD EARTHWORK
HAUL ROAD RECLAMATION PLAN B
MINE YEARS 11–20

VER NO	DATE	DESCRIPTION
1	5/05/17	ISSUED FOR INCLUSION IN PERMIT APPLICATION
3	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	3	6/7/2017
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

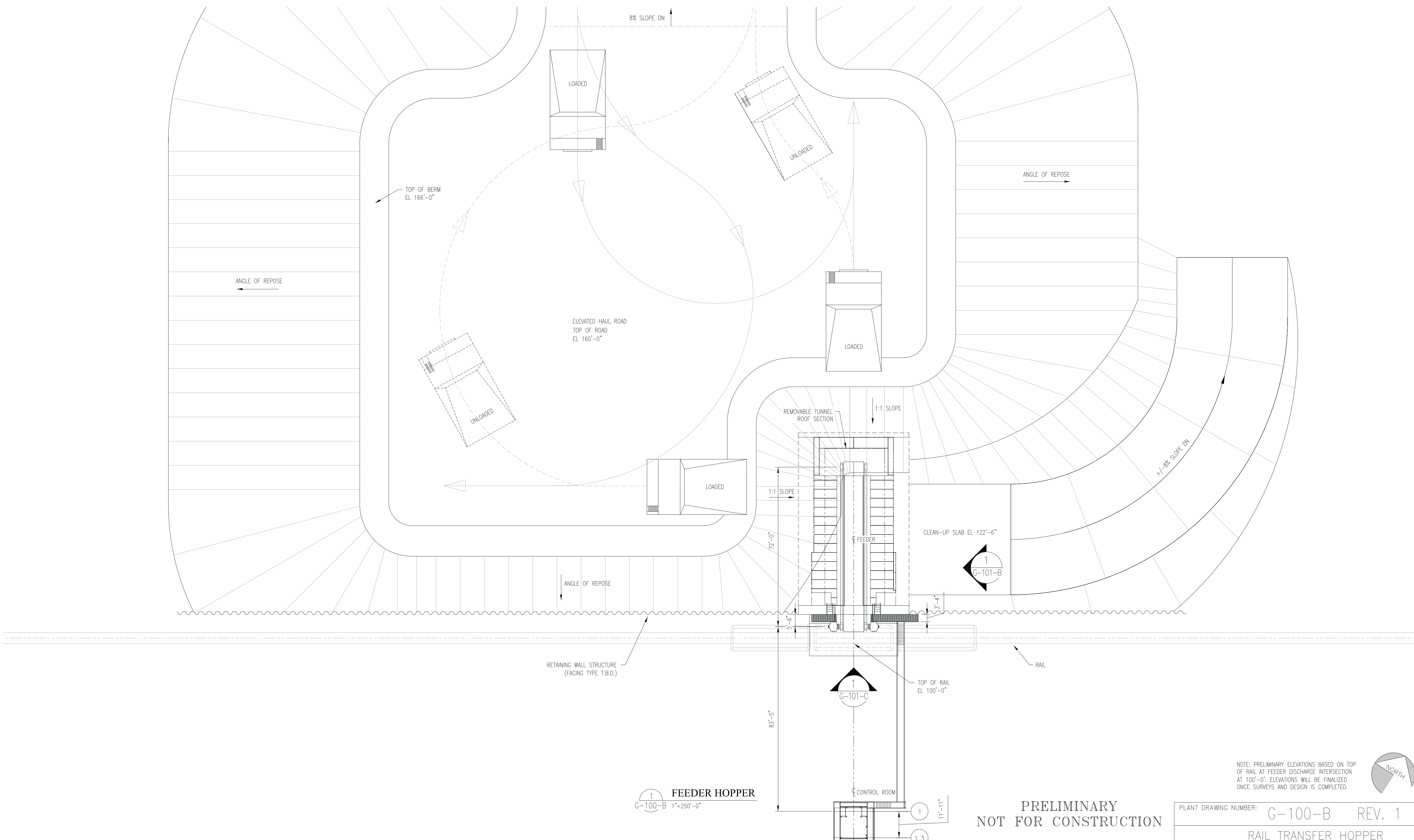
DRAWN: KKB
CHECKED: ATS
BARR PROJECT NO.: 23/69–0C29
SCALE: AS SHOWN

POLYMET MINING
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1–800–632–2277

DWG. NO. EW–011
REV B

CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-05-EW-011.DWG PLOT SCALE: 1:2 PLOT DATE: 6/9/2017 6:50 AM



1 G-100-B FEEDER HOPPER 1"=250'-0"

NOTE: PRELIMINARY ELEVATIONS BASED ON TOP OF RAIL AT FEEDER DISCHARGE INTERSECTION AT 100'-0'. ELEVATIONS WILL BE FINALIZED ONCE SURVEYS AND DESIGN IS COMPLETED.

PRELIMINARY
NOT FOR CONSTRUCTION

REV NO	DATE	REVISIONS	BY	CHKR
1	5/24/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS	JF	RKM
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–

DRAWING STATUS				
ISSUED	REV	DATE	SDE	PEM
PRELIMINARY	1	5/24/17	–	–
APPROVED FOR CONSTRUCTION	–	–	–	–
NOT APPROVED FOR CONSTRUCTION				

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE
PRINTED NAME RYAN.MCKIBBON
DATE 5/24/17 REG. NO. 46303

DRAWN: JF DATE: 5/24/17
CHECKED: RKM DATE: 5/24/17
KOA PROJECT NO.: 151003
SCALE: 1"=250'-0"

PLANT DRAWING NUMBER: G-100-B REV. 1

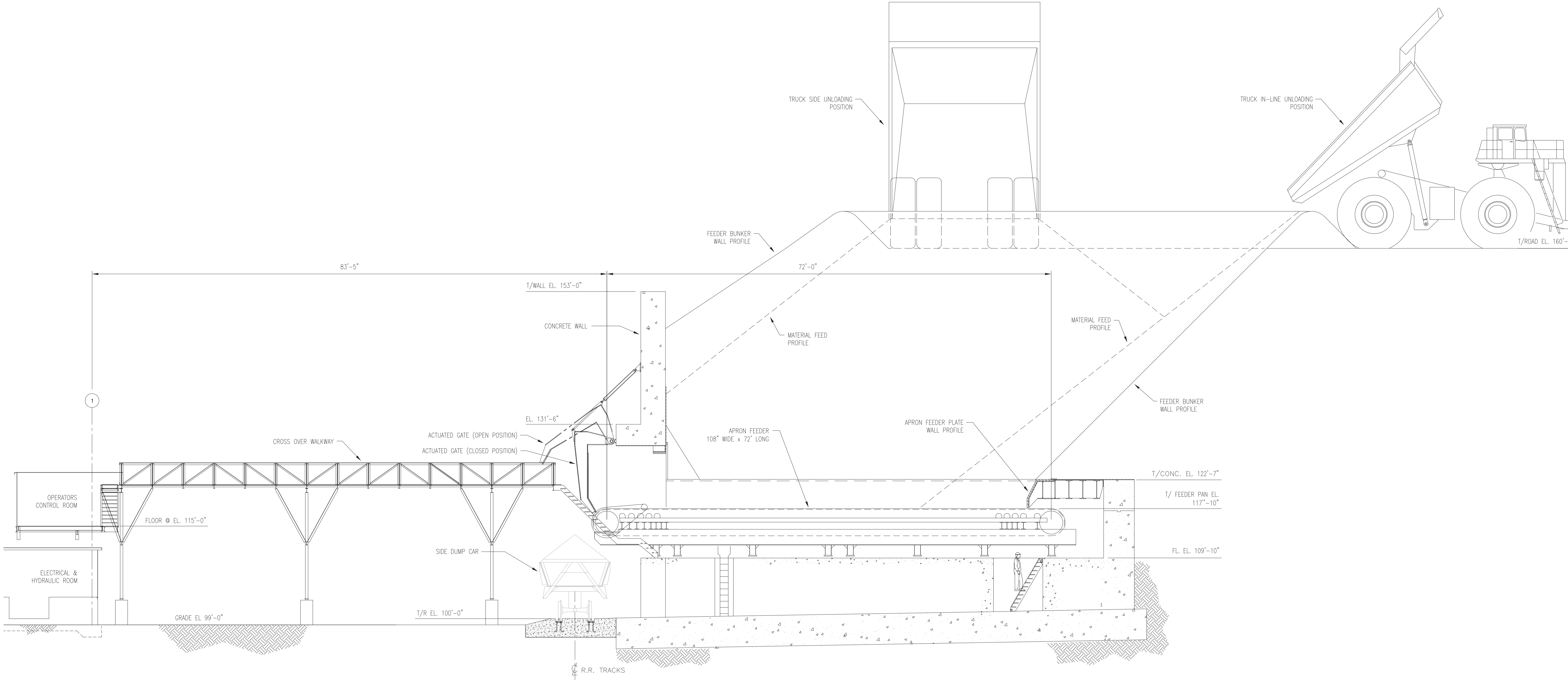
RAIL TRANSFER HOPPER
PLAN VIEW

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

KRECH OJARD & ASSOCIATES, P.A. Engineers & Architects
227 WEST FIRST STREET, SUITE 200
DULUTH, MINNESOTA 55802
Ph: 218.727.3282
Fx: 218.727.1216
www.krechojard.com

INCHES 1 2



1 G-101-B **EAST ELEVATION** 1/8"=1'-0"

NOTE: PRELIMINARY ELEVATIONS BASED ON TOP OF RAIL AT FEEDER DISCHARGE INTERSECTION AT 100'-0'. ELEVATIONS WILL BE FINALIZED ONCE SURVEYS AND DESIGN IS COMPLETED.

PRELIMINARY
NOT FOR CONSTRUCTION

REV NO	DATE	REVISIONS	BY	CHKR
1	5/24/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS	JF	RKM
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–

DRAWING STATUS				
ISSUED	REV	DATE	SDE	PEM
PRELIMINARY	1	5/24/17	–	–
APPROVED FOR CONSTRUCTION	–	–	–	–
NOT APPROVED FOR CONSTRUCTION				

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE
PRINTED NAME RYAN.MCKIBBON
DATE 5/24/17 REG. NO. 46303

DRAWN: JF DATE: 5/24/17
CHECKED: RKM DATE: 5/24/17
KOA PROJECT NO.: 151003
SCALE: 1"=250'-0"

PLANT DRAWING NUMBER: G-101-B REV. 1

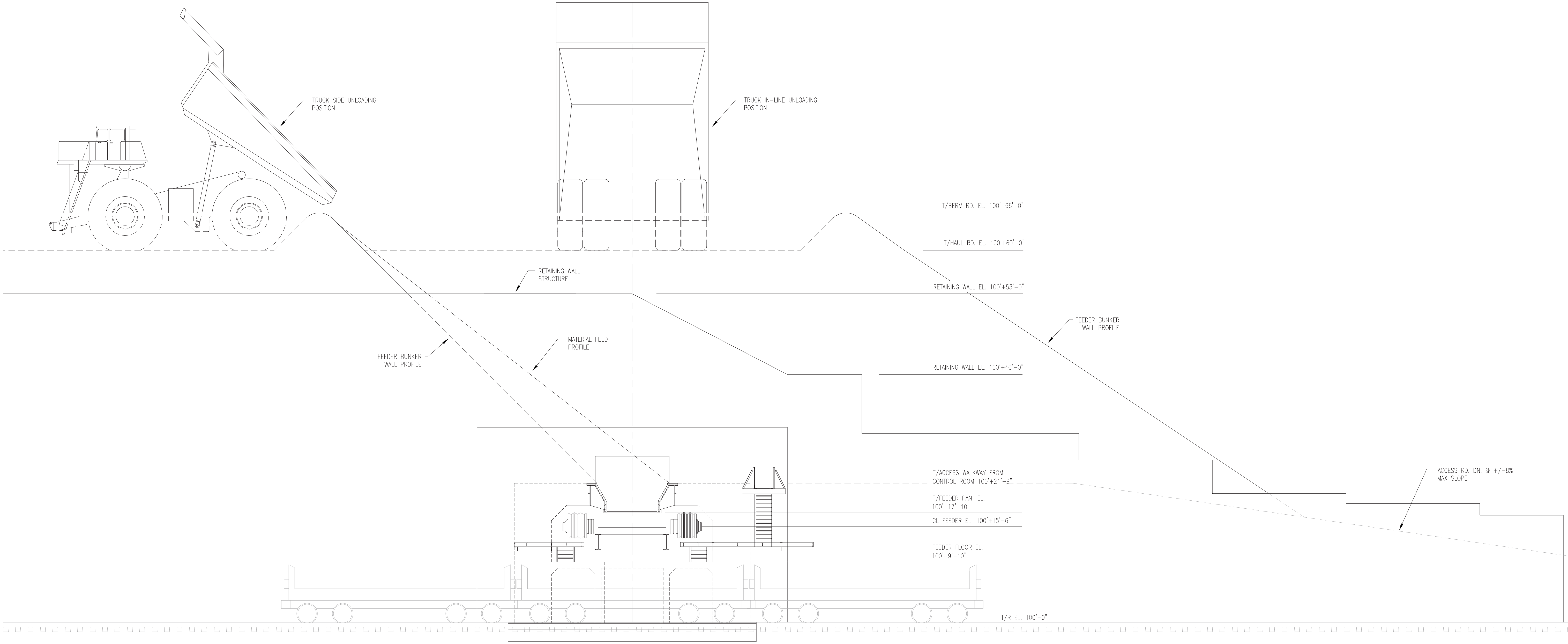
RAIL TRANSFER HOPPER
ELEVATION VIEW

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

KRECH OJARD & ASSOCIATES, P.A.
Engineers & Architects
227 WEST FIRST STREET, SUITE 200
DULUTH, MINNESOTA 55802
Ph: 218.727.3282
Fx: 218.727.1216
www.krechojard.com

INCHES 1 2



1
G-101-C
SOUTH ELEVATION
1/8"=1'-0"

NOTE: PRELIMINARY ELEVATIONS BASED ON TOP OF RAIL AT FEEDER DISCHARGE INTERSECTION AT 100'-0'. ELEVATIONS WILL BE FINALIZED ONCE SURVEYS AND DESIGN IS COMPLETED.

PRELIMINARY
NOT FOR CONSTRUCTION

REV NO	DATE	REVISIONS	BY	CHKR
1	5/24/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS	JF	RKM
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–

DRAWING STATUS				
ISSUED	REV	DATE	SDE	PEM
PRELIMINARY	1	5/24/17	–	–
APPROVED FOR CONSTRUCTION	–	–	–	–
NOT APPROVED FOR CONSTRUCTION				

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE
PRINTED NAME RYAN.MCKIBBON
DATE 5/24/17 REG. NO. 46303

DRAWN: JF DATE: 5/24/17
CHECKED: RKM DATE: 5/24/17
KOA PROJECT NO.: 151003
SCALE: 1"=250'-0"

PLANT DRAWING NUMBER: G-101-C REV. 1

RAIL TRANSFER HOPPER
ELEVATION VIEW

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

KRECH OJARD & ASSOCIATES, P.A.
Engineers & Architects
227 WEST FIRST STREET, SUITE 200
DULUTH, MINNESOTA 55802
Ph: 218.727.3282
Fx: 218.727.1216
www.krechojard.com

INCHES 1 2

Categories 1, 2/3, and 4 Stockpiles and Ore Surge Pile Design
Permit Application Support Drawings

Errata Sheet

Poly Met Mining, Inc. NorthMet Project

Permit Application Support Drawings: Categories 1, 2/3, and 4 Stockpiles and Ore Surge Pile Design

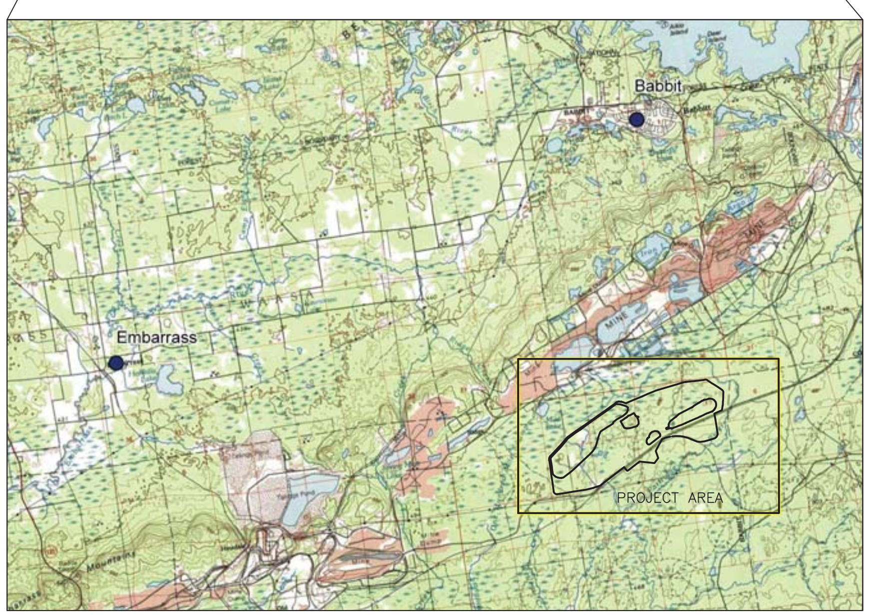
August 2017 (version 3)

Engineering design is currently in progress. The table below lists changes that have been identified to-date and have not yet been incorporated in the attached permit application support drawings within this set. Final design will incorporate these changes along with additional site-specific information (e.g., supplementary geotechnical data); therefore, additional adjustments may be made during final design that will be incorporated into the final design drawing set.

Drawing Sheet(s)	Change
Global change to all sheets, as needed	The terminology "mine drainage" as noted in these drawings will be changed to "mine water".
SKP-002, SKP-003, SKP-004, SKP-005, SKP-006, SKP-007, SKP-008, SKP-009, SKP-010, SKP-011, SKP-012, SKP-014, SKP-015, SKP-016, SKP-017, SKP-018, SKP-026, SKP-027, SKP-028, SKP-029, SKP-030	The "Mine Site Boundary" will be replaced by the "Mining Area Boundary" as shown on figures included in the Permit to Mine Application.

POLY MET MINING, INC. NORTHMET PROJECT
PERMIT APPLICATION SUPPORT DRAWINGS
CATEGORIES 1, 2/3, AND 4 STOCKPILES
AND ORE SURGE PILE DESIGN
HOYT LAKES, MINNESOTA

PROJECT LOCATION MAP



SITE LOCATION

DRAWING LIST		
SHEET NUMBER	REVISION	SHEET TITLE
SKP–001	G	TITLE SHEET AND LOCATION MAP
SKP–002	G	LEGEND, GENERAL NOTES AND SPECIFICATIONS
SKP–003	G	STOCKPILE LAYOUTS – MINE YEAR 1 LIMITS
SKP–004	G	STOCKPILE LAYOUTS – MINE YEAR 2 LIMITS
SKP–005	G	STOCKPILE LAYOUTS – AT PLANNED UTILIZATION LIMITS
SKP–006	G	STOCKPILE LAYOUTS – MINE YEAR 21 LIMITS CLOSURE CONFIGURATION
SKP–007	G	EXISTING SITE CONDITIONS
SKP–008	G	SITE LAYOUT AND LOCATION OF FIELD INVESTIGATIONS
SKP–009	G	DEPTH TO BEDROCK ISOPACH MAP
SKP–010	G	CATEGORY 1 STOCKPILE SUBGRADE EXCAVATION PLAN
SKP–011	G	CATEGORY 1 STOCKPILE MINE YEAR 1 CONTINGENCY CLOSURE CONFIGURATION
SKP–012	G	CATEGORY 1 STOCKPILE FINAL GRADES AND SUB–BASIN DELINEATION
SKP–013	G	CATEGORY 1 STOCKPILE DESIGN SECTIONS
SKP–014	G	CATEGORY 2/3 STOCKPILE SUBGRADE EXCAVATION PLAN
SKP–015	G	CATEGORY 2/3 STOCKPILE FOUNDATION GRADING PLAN – MINE YEAR 1 AND MAXIMUM
SKP–016	G	CATEGORY 2/3 STOCKPILE UNDERDRAIN PIPING PLAN – MINE YEAR 1 AND MAXIMUM
SKP–017	G	CATEGORY 2/3 STOCKPILE OVERLINER DRAINAGE PIPING PLAN – MINE YEAR 1 AND MAXIMUM
SKP–018	G	CATEGORY 2/3 STOCKPILE MAXIMUM CAPACITY CONFIGURATION
SKP–019	G	CATEGORY 2/3 STOCKPILE DESIGN SECTIONS
SKP–020	G	CATEGORY 4 STOCKPILE SUBGRADE EXCAVATION PLAN
SKP–021	G	CATEGORY 4 STOCKPILE FOUNDATION GRADING PLAN – MINE YEAR 1 AND MAXIMUM
SKP–022	G	CATEGORY 4 STOCKPILE UNDERDRAIN PIPING PLAN – MINE YEAR 1 AND MAXIMUM
SKP–023	G	CATEGORY 4 STOCKPILE OVERLINER DRAINAGE PIPING PLAN – MINE YEAR 1 AND MAXIMUM
SKP–024	G	CATEGORY 4 STOCKPILE MAXIMUM CAPACITY CONFIGURATION
SKP–025	G	CATEGORY 4 STOCKPILE DESIGN SECTIONS
SKP–026	G	ORE SURGE PILE SUBGRADE EXCAVATION PLAN
SKP–027	G	ORE SURGE PILE FOUNDATION GRADING PLAN
SKP–028	G	ORE SURGE PILE UNDERDRAIN PIPING PLAN
SKP–029	G	ORE SURGE PILE OVERLINER DRAINAGE PIPING PLAN
SKP–030	G	ORE SURGE PILE TYPICAL CONFIGURATION
SKP–031	G	ORE SURGE PILE DESIGN SECTIONS
SKP–032	G	CATEGORY 1 STOCKPILE RECLAMATION AND OPERATIONS SURFACE WATER – MANAGEMENT DETAILS – SHEET 1 OF 2
SKP–033	G	CATEGORY 1 STOCKPILE RECLAMATION AND OPERATIONS SURFACE WATER – MANAGEMENT DETAILS – SHEET 2 OF 2
SKP–034	G	CATEGORY 1 STOCKPILE PHASED COVER DESIGN
SKP–035	G	CONSTRUCTION DETAILS

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE B. Bronson

PRINTED NAME BRENT R. BRONSON

DATE 8/21/17 LICENSE # 46492

DRAWN: MTM

CHECKED: GG

GOLDER PROJECT NO.: 113–2209

SCALE: AS SHOWN

PLANT DRAWING NUMBER:

TITLE SHEET AND LOCATION MAP

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

Golder Associates

GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980–0540
Fax: (303) 985–2080
www.golder.com

DWG. NO. SKP–001

REV

CADD USER: Jenkins, Crystal FILE: N:\11\113–2209_H SKP FEB2013\1132209H002.DWG PLOT SCALE: 1:1 PLOT DATE: 8/18/2017 10:17 AM

INCHES 1 2

LEGEND

- MAJOR FEATURE
- EXISTING GROUND TOPOGRAPHY (SEE NOTE 2)
- PROPOSED FINISHED GRADE TOPOGRAPHY
- TOE / CREST — SLOPE DIRECTION
- CROSS SECTION IDENTIFIER (1 / 008)
- SHEET WHERE SECTION IS LOCATED
- SLOPE
- HAUL ROADS
- MINE SITE BOUNDARY
- PIT BOUNDARY
- MINE YEAR 1 ORE, WASTE ROCK STOCKPILE LIMITS
- MAXIMUM ORE, WASTE ROCK STOCKPILE LIMITS
- GEOMEMBRANE BARRIER LAYER
- PREPARED SUBGRADE
- SOIL LINER 1
- SOIL LINER 2
- WASTE ROCK OR ORE
- STRUCTURAL FILL
- GRANULAR DRAINAGE MATERIAL 1
- COMMON FILL 1
- DRAIN ROCK
- RIPRAP
- RANDOM FILL
- OVERBURDEN MATERIAL
- VERTICAL PERCOLATION LAYER (USCS – ML)
- LATERAL DRAINAGE LAYER (USCS – SP OR SM)
- GATP-06-7 — GOLDER ASSOC. TEST PIT (2006)
- SB-05-01 — BARR ENGINEERING BOREHOLES (2005)
- RS-11 — BARR ENGINEERING BOREHOLES (2008)
- J003 — AMERICAN ENGINEERING TESTING, INC. BOREHOLES (2010)
- SHALLOW MARSH
- CONIFEROUS SWAMP
- HARDWOOD SWAMP
- SHRUB SWAMP
- CONIFEROUS BOG
- OPEN BOG
- SEDGE MEADOW

TERTIARY COLLECTION PIPING
- 4–INCH

PRIMARY AND SECONDARY COLLECTION PIPING
- 4–INCH
- 6–INCH
- 8–INCH
- 10–INCH
- 12–INCH

LIST OF ABBREVIATIONS

AMSL	ABOVE MEAN SEA LEVEL
CY	CUBIC YARD
DIA.	DIAMETER
EL.	ELEVATION
ET	EVAPOTRANSPIRATION
FT.	FEET
HDPE	HIGH DENSITY POLYETHYLENE
ID	INSIDE DIAMETER
IN.	INCH
LLDPE	LINEAR LOW DENSITY POLYETHYLENE
LCRS	LEAK COLLECTION AND RECOVERY SYSTEM
MAX.	MAXIMUM
MIN.	MINIMUM
N.T.S.	NOT TO SCALE
OD	OUTSIDE DIAMETER
SY	SQUARE YARD
TYP.	TYPICAL
ROMP	ROCK AND OVERBURDEN MANAGEMENT PLAN
USCS	UNIFIED SOIL CLASSIFICATION SYSTEM
CPEP	PERFORATED CORRUGATED POLYETHYLENE

GENERAL NOTES:

1. THIS DRAWING SET REPRESENTS THE DESIGN FOR PERMITTING FOR CATEGORY 1 STOCKPILE, CATEGORY 2/3 STOCKPILE, CATEGORY 4 STOCKPILE AND ORE SURGE PILE FOR THE POLYMET NORTHMET PROJECT IN HOYT LAKES, MINNESOTA, PREPARED IN SUPPORT OF A PERMIT TO MINE. THE DRAWING SET ONLY INCLUDES INFRASTRUCTURE ASSOCIATED WITH THE MOVEMENT OF ROCK (STOCKPILES, PITS, HAUL ROADS, AND RAIL TRANSFER HOPPER) AND NOT OTHER SUPPORT FACILITIES.
2. BASE TOPOGRAPHY PROVIDED BY BARR ENGINEERING IN AUGUST 2011.
3. GOLDER ASSOCIATES INC. (GOLDER) IS RESPONSIBLE FOR STOCKPILE DESIGNS WITH BATTERY LIMITS DEFINED BY THE PERIMETER/LINER BERMS AND THE UNDERDRAIN SUMPS.
4. AT THE BASIC ENGINEERING LEVEL, LIMITED GEOTECHNICAL DATA EXISTS, PARTICULARLY IN LOWLAND AREAS. ADDITIONAL DATA WILL BE OBTAINED FROM THESE AREAS AFTER THE PERMIT TO MINE IS APPROVED. SUBGRADE EXCAVATION PLANS WERE DEVELOPED USING AVAILABLE INFORMATION, AND WILL BE UPDATED FOR FINAL DESIGN BASED ON RESULTS OF PHASE II GEOTECHNICAL INVESTIGATION.
5. EARTHWORK QUANTITIES BASED ON NEAT LINE (I.E., NET CUT/ FILL SHRINKAGE FACTOR = 1.0).
6. PREPARED SUBGRADE, AS DEFINED ON THE DRAWINGS, INCLUDES CLEARING, GRUBBING, TOPSOIL REMOVAL, REMOVAL OF GEOTECHNICALLY–UNSUITABLE MATERIALS, MOISTURE CONDITIONING, AND SUBGRADE COMPACTION AS DEFINED IN THE SPECIFICATIONS.
7. FOUNDATION PREPARATION ASSUMES THE FOLLOWING GENERAL CONSTRUCTION SEQUENCE: (I) EXCAVATE TO BEDROCK WITHIN LOWLAND AREAS ASSUMING A MAXIMUM DEPTH OF OVER–EXCAVATION OF 20 FEET, OR UNTIL REACHING GEOTECHNICALLY–SUITABLE FOUNDATION SOILS AS DETERMINED BY THE PHASE II GEOTECHNICAL INVESTIGATION. STOCKPILE ORGANIC SOILS AND MINERAL OVERBURDEN SEPARATELY FOR FUTURE APPROVED USE; (II) PLACE STRUCTURAL FILL AS REQUIRED TO MEET THE FOUNDATION GRADE REQUIREMENTS WITH GRANULAR SOILS, E.G., DULUTH COMPLEX CONSTRUCTION ROCK, BIWABIK IRON FORMATION CONSTRUCTION ROCK, AND UNSATURATED MINERAL OVERBURDEN; (III) ESTABLISH FOUNDATION DRAINAGE AS REQUIRED TO PREVENT EXCESS PORE PRESSURES DURING OPERATION; AND (IV) CONSTRUCT LINER SYSTEM DEPENDENT UPON THE REACTIVITY CATEGORY OF THE STOCKPILE MATERIAL.
8. AREAS WITH UNSUITABLE SOILS (LOWLAND AREAS) ARE ASSUMED TO COINCIDE WITH THE PREVIOUSLY IDENTIFIED WETLAND AREAS. HORIZONTAL AND VERTICAL EXTENTS OF LOWLAND AREAS ARE EXPECTED TO BE REVISED BASED ON RESULTS OF PHASE II GEOTECHNICAL INVESTIGATION.
9. POST–CONSOLIDATION STOCKPILE SETTLEMENTS WERE ESTIMATED BASED ON LIMITED INFORMATION ON THE CONSOLIDATION PROPERTIES OF SUBGRADE MATERIALS. HENCE, FOUNDATION EXCAVATION AND GRADING PLANS ARE ANTICIPATED TO UNDERGO MINOR MODIFICATIONS BASED ON THE RESULTS OF THE PHASE II GEOTECHNICAL INVESTIGATION TO ENSURE SUFFICIENT DRAINAGE.
10. CATEGORY 1 WASTE ROCK STOCKPILE WILL BE RECLAIMED BY PLACEMENT OF A GEOMEMBRANE COVER AT CLOSURE. PRIOR TO CLOSURE, WASTE ROCK CATEGORY 2, 3 AND 4 WILL BE USED FOR PIT BACKFILL.
11. LIMITS OF DISTURBANCE (I.E., CLEARING LIMITS) ASSUMED TO BE 40 FEET FROM THE FACILITY LIMITS.
12. INTERIM STOCKPILE FILL SLOPES SHOWN WITH WASTE ROCK SLOPES AT ANGLE OF REPOSE. FINAL/CLOSURE STOCKPILE FILL SLOPES SHOWN WITH WASTE ROCK SLOPES REGRADED TO FINAL SLOPE ANGLES.

SPECIFICATIONS:

1. FOR EARTHWORKS COMPONENTS OF THE STOCKPILE DESIGN, REFER TO SECTION 2300 OF THE PROJECT SPECIFICATIONS.
2. FOR GEOSYNTHETIC AND PIPING COMPONENTS OF THE STOCKPILE DESIGN, REFER TO SECTION 2272 FOR GEOTEXTILE, 2273 FOR POLYETHYLENE GEOMEMBRANE LINERS, AND SECTION 2610 FOR PIPING.
3. QUALITY ASSURANCE REQUIREMENTS FOR STOCKPILE CONSTRUCTION ARE DEFINED IN THE CONSTRUCTION QUALITY ASSURANCE PLAN.
4. SPECIFICATION SECTION NUMBERING IS PRELIMINARY.

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE

PRINTED NAME BRENT R. BRONSON

DATE 8/21/17 LICENSE # 46492

DRAWN: MTM

CHECKED:

GOLDER PROJECT NO.: 113-2209

SCALE: AS SHOWN

PLANT DRAWING NUMBER:

LEGEND, GENERAL NOTES AND SPECIFICATIONS

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

Golder Associates
GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980-0540
Fax: (303) 985-2080
www.golder.com

DWG. NO. SKP–002 REV

INCHES 1 2

0 800 1600
SCALE IN FEET

LEGEND

- EXISTING GROUND TOPOGRAPHY
- PROPOSED STOCKPILE LAYOUTS
- HAUL ROADS
- MINE SITE BOUNDARY
- MINE YEAR 1 PIT BOUNDARY (SEE NOTE 1)
- MINE YEAR 1 ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- MAXIMUM ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- CROSS SECTION IDENTIFIER
- SHEET WHERE SECTION IS LOCATED

NOTES

1. OPEN PIT AND HAUL ROAD LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.
4. CATEGORY 2/3 AND CATEGORY 4 STOCKPILES SHOWN BASED ON WASTE ROCK SCHEDULE ONLY, I.E. WITHOUT OVERBURDEN. SEE DRAWINGS 018 AND 024 SHOWING MAXIMUM CAPACITY LAYOUTS FOR THESE STOCKPILES.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

PLANT DRAWING NUMBER:

STOCKPILE LAYOUTS – MINE YEAR 1 LIMITS

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE

PRINTED NAME BRENT R. BRONSON

DATE 8/21/17 LICENSE # 46492

DRAWN: MTM

CHECKED:

GOLDER PROJECT NO.: 113-2209

SCALE: AS SHOWN

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

Golder Associates

GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980-0540
Fax: (303) 985-2080
www.golder.com

DWG. NO. SKP-003

REV

CADD USER: Jenkins, Crystal FILE: N:\11\113-2209\...H SKP FEB2013\1132209H001.DWG PLOT SCALE: 1:1 PLOT DATE: 8/18/2017 10:20 AM

INCHES 1 2

LEGEND

- EXISTING GROUND TOPOGRAPHY
- PROPOSED GRADING TOPOGRAPHY
- HAUL ROADS
- MINE SITE BOUNDARY
- PIT BOUNDARIES AT MINE YEAR 2 (SEE NOTE 1)
- MINE YEAR 1 AND 2 ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- MAXIMUM ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- A / 019: CROSS SECTION IDENTIFIER; SHEET WHERE SECTION IS LOCATED

NOTES

1. OPEN PIT AND HAUL ROAD LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.
4. CATEGORY 2/3 AND CATEGORY 4 STOCKPILES SHOWN BASED ON WASTE ROCK SCHEDULE ONLY, I.E. WITHOUT OVERBURDEN. SEE DRAWINGS 018 AND 024 SHOWING MAXIMUM CAPACITY LAYOUTS FOR THESE STOCKPILES.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

PLANT DRAWING NUMBER:

STOCKPILE LAYOUTS – MINE YEAR 2 LIMITS

0 800 1600
SCALE IN FEET

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE
PRINTED NAME BRENT R. BRONSON
DATE 8/21/17 LICENSE # 46492

DRAWN: MTM
CHECKED:
GOLDER PROJECT NO.: 113-2209
SCALE: AS SHOWN

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

Golder Associates

GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980-0540
Fax: (303) 985-2080
www.golder.com

DWG. NO. SKP-004
REV

INCHES 1 2

CADD USER: Jenkins, Crystal FILE: N:\11\113-2209_H SKP FEB2013\1132209H005.DWG PLOT SCALE: 1:1 PLOT DATE: 8/18/2017 10:22 AM

LEGEND

1590 1580	EXISTING GROUND TOPOGRAPHY
1590 1600	PROPOSED LAYOUTS
	HAUL ROADS
	MINE SITE BOUNDARY
	PIT BOUNDARIES AT MINE YEAR 11 (SEE NOTE 1)
	MINE YEAR 1 ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
	MAXIMUM ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
A 025	CROSS SECTION IDENTIFIER
	SHEET WHERE SECTION IS LOCATED

NOTES

1. OPEN PIT AND HAUL ROAD LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.
4. CATEGORY 2/3 AND CATEGORY 4 STOCKPILES SHOWN BASED ON WASTE ROCK SCHEDULE ONLY, I.E. WITHOUT OVERBURDEN. SEE DRAWINGS 018 AND 024 SHOWING MAXIMUM CAPACITY LAYOUTS FOR THESE STOCKPILES.
5. PLANNED UTILIZATION LIMITS FOR CATEGORY 1 STOCKPILE REACHED IN MINE YEAR 13, PLANNED UTILIZATION LIMITS FOR CATEGORY 2/3 AND CATEGORY 4 STOCKPILES REACHED IN MINE YEAR 11.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

PLANT DRAWING NUMBER:

STOCKPILE LAYOUTS – AT PLANNED UTILIZATION LIMITS

N

0 800 1600
SCALE IN FEET

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS

ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE

PRINTED NAME BRENT R. BRONSON

DATE 8/21/17 LICENSE # 46492

DRAWN: MTM

CHECKED:

GOLDER PROJECT NO.: 113-2209

SCALE: AS SHOWN

POLYMET MINING

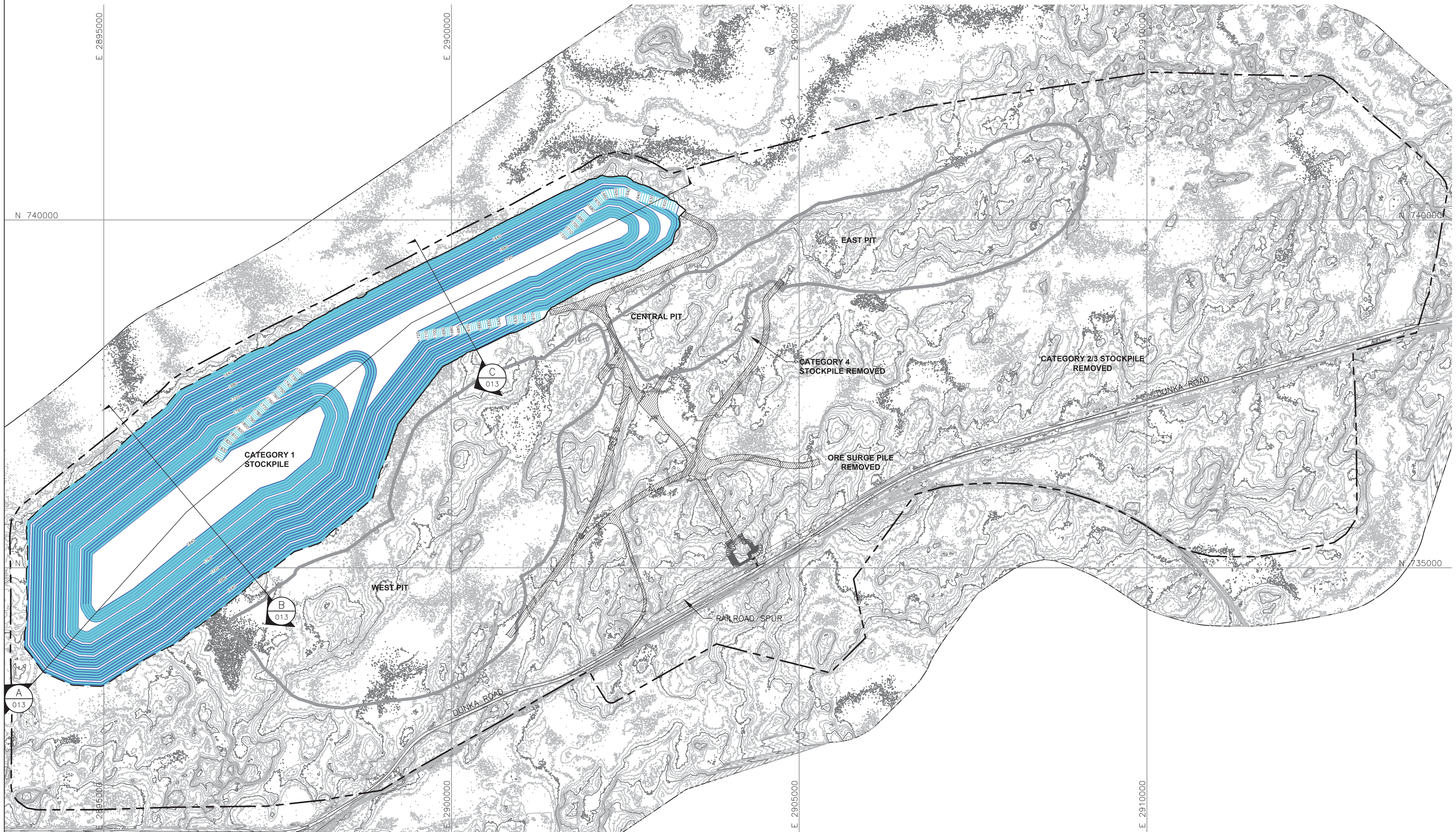
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980-0540
Fax: (303) 985-2080
www.golder.com

DWG. NO. SKP-005

REV

INCHES 1 2



LEGEND

- EXISTING GROUND TOPOGRAPHY
- PROPOSED LAYOUT CONTOURS
- HAUL ROADS
- MINE SITE BOUNDARY
- ULTIMATE PIT BOUNDARIES (SEE NOTE 1)
- MINE YEAR 1 ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- MAXIMUM ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- A / 013 — CROSS SECTION IDENTIFIER; SHEET WHERE SECTION IS LOCATED

NOTES

1. OPEN PIT AND HAUL ROAD LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

N

0 800 1600
SCALE IN FEET

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE [signature]
PRINTED NAME BRENT R. BRONSON
DATE 8/21/17 LICENSE # 46492

DRAWN: MTM
CHECKED: [initials]
GOLDER PROJECT NO.: 113-2209
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

STOCKPILE LAYOUTS
MINE YEAR 21 LIMITS
CLOSURE CONFIGURATION

POLYMET MINING

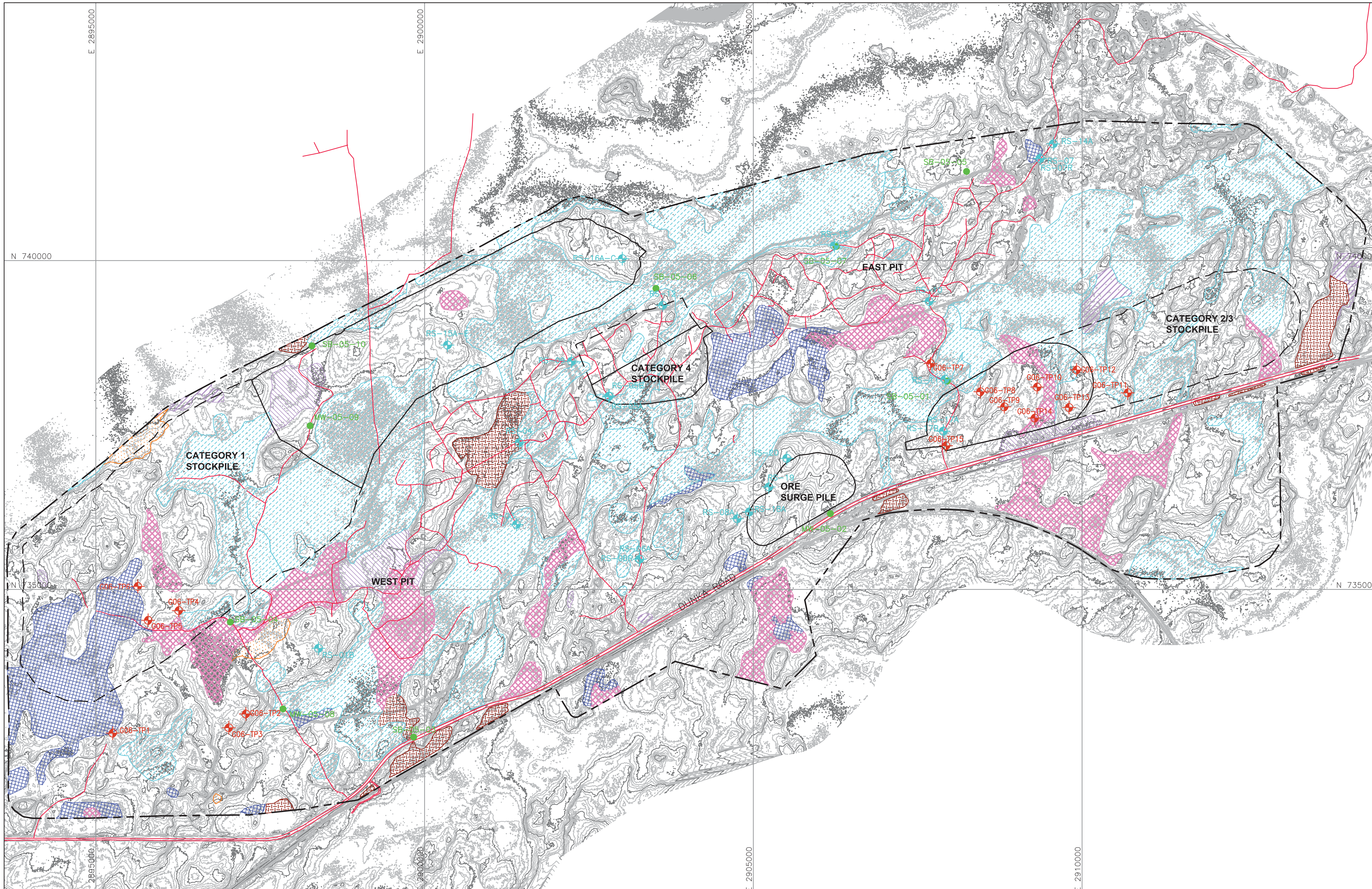
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

Golder Associates

GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980-0540
Fax: (303) 985-2080
www.golder.com

DWG. NO. SKP-006 REV

INCHES 1 2



LEGEND

EXISTING GROUND TOPOGRAPHY (SEE REFERENCE 1)

MINE SITE BOUNDARY

G06-TP11 GOLDER ASSOC. TEST PIT (2006)

SB-05-01 BARR ENGINEERING BOREHOLES (2005)

RS-11 BARR ENGINEERING BOREHOLES (2008)

SHALLOW MARSH

SHRUB SWAMP

CONIFEROUS SWAMP

HARDWOOD SWAMP

SEDGE MEADOW

CONIFEROUS BOG

OPEN BOG

EXISTING TRAIL OR ROAD

MINE YEAR 11 PIT BOUNDARIES (SEE NOTE 2)

MINE YEAR 1 ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 3)

MAXIMUM ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 3)

NOTES

1. WETLAND DELINEATION CHARACTERIZATION PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. OPEN PIT LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
3. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
4. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

CADD USER: Jenkins, Crystal FILE: N:\1\113-2209_H SKP FEB2013\1132209H022.DWG PLOT SCALE: 1:1 PLOT DATE: 8/18/2017 10:28 AM

0 800 1600
SCALE IN FEET

INCHES 1 2

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE

PRINTED NAME BRENT R. BRONSON

DATE 8/21/17 LICENSE # 46492

DRAWN: MTM

CHECKED:

GOLDER PROJECT NO.: 113-2209

SCALE: AS SHOWN

PLANT DRAWING NUMBER:

EXISTING SITE CONDITIONS

POLYMET MINING

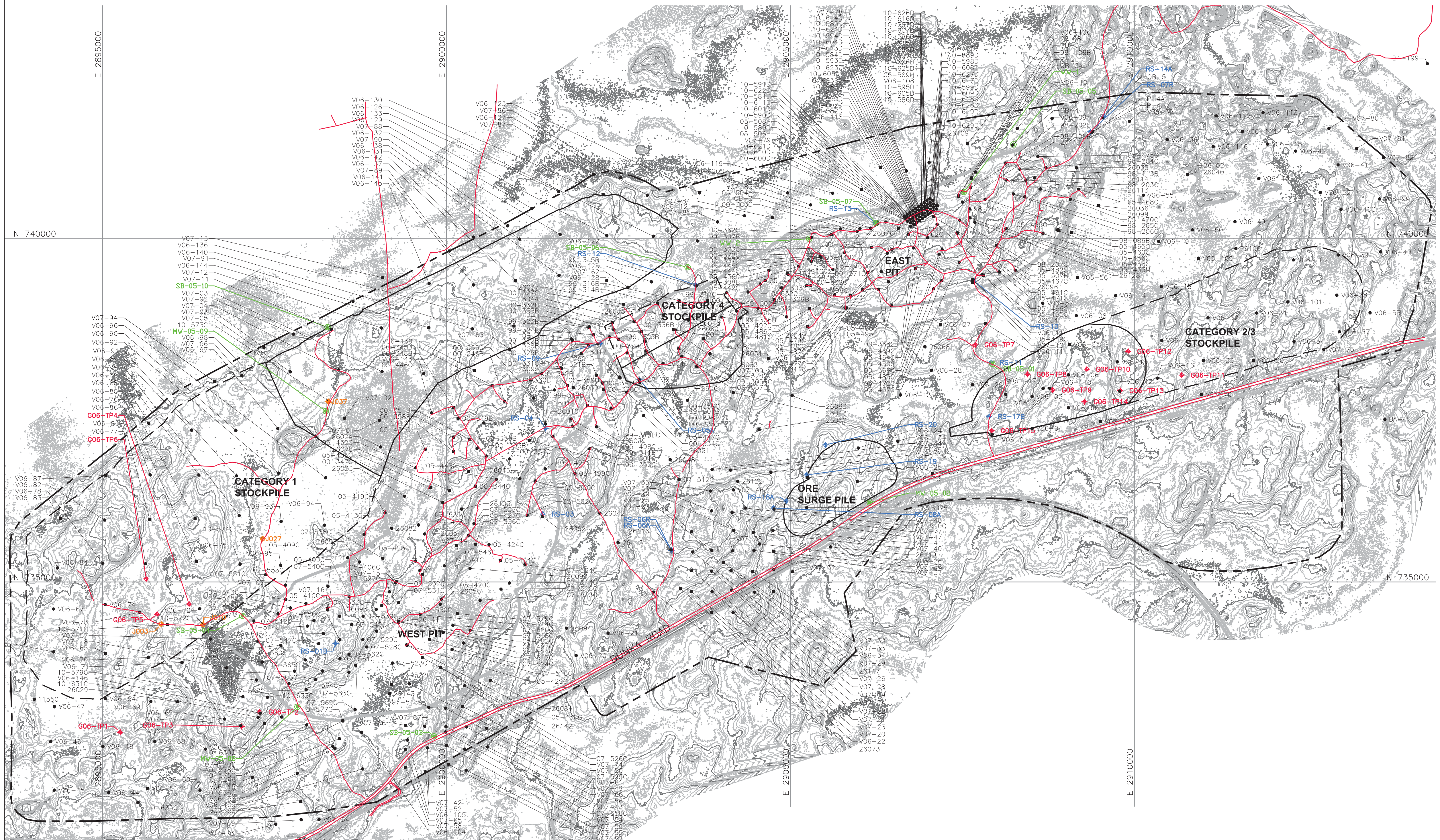
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

Golder Associates

GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980-0540
Fax: (303) 985-2080
www.golder.com

DWG. NO. SKP-007

REV



LEGEND

- EXISTING GROUND TOPOGRAPHY
- MINE SITE BOUNDARY
- MINE YEAR 11 PIT BOUNDARIES (SEE NOTE 1)
- MINE YEAR 1 ORE, AND WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- MAXIMUM ORE, AND WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- G06-TP11 — GOLDER ASSOC. TEST PIT (2006)
- SB-05-01 — BARR ENGINEERING BOREHOLES (2005)
- RS-07R — BARR ENGINEERING BOREHOLES (2008)
- 05-444PM, 06-58 — BORING OR GEOPHYSICAL SURVEY LOCATION
- J003 — AMERICAN ENGINEERING TESTING, INC. BOREHOLES (2010)

NOTES

1. OPEN PIT LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.
4. SEE GEOTECHNICAL DATA PACKAGE VOLUME 3 FOR DETAILS ON TEST PITS, BOREHOLES AND GEOPHYSICAL SURVEYS.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

PLANT DRAWING NUMBER:

SITE LAYOUT AND LOCATION OF FIELD INVESTIGATIONS

0 800 1600
SCALE IN FEET

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE

PRINTED NAME BRENT R. BRONSON

DATE 8/21/17 LICENSE # 46492

DRAWN: MTM

CHECKED:

GOLDER PROJECT NO.: 113-2209

SCALE: AS SHOWN

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

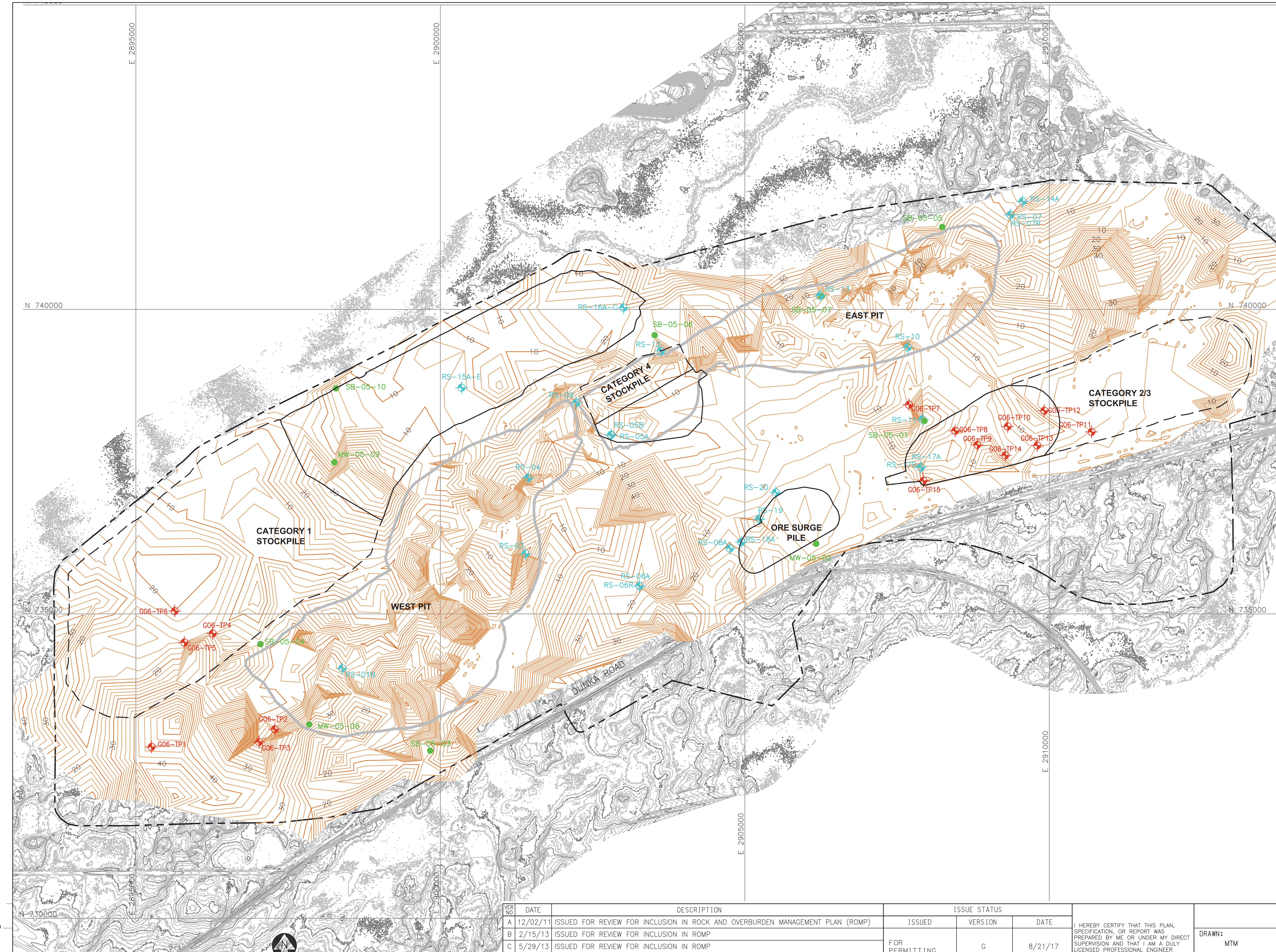
Golder Associates
GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980-0540
Fax: (303) 985-2080
www.golder.com

DWG. NO. SKP-008

REV

CADD USER: Jenkins, Crystal FILE: N:\1\113-2209_H SKP FEB2013\1132209H023.DWG PLOT SCALE: 1:1 PLOT DATE: 8/18/2017 10:30 AM

INCHES 1 2



LEGEND

- EXISTING GROUND TOPOGRAPHY
- MINE SITE BOUNDARY
- ESTIMATED DEPTH TO BEDROCK CONTOURS
- MINE YEAR 11 PIT BOUNDARIES (SEE NOTE 1)
- MINE YEAR 1 ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- MAXIMUM ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- G06-TP11 GOLDER ASSOC. TEST PIT (2006)
- SB-05-01 BARR ENGINEERING BOREHOLES (2005)
- RS-11 BARR ENGINEERING BOREHOLES (2008)

NOTES

1. OPEN PIT BOUNDARIES PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

PLANT DRAWING NUMBER:

DEPTH TO BEDROCK ISOPACH MAP

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE [signature]
PRINTED NAME BRENT R. BRONSON
DATE 8/21/17 LICENSE # 46492

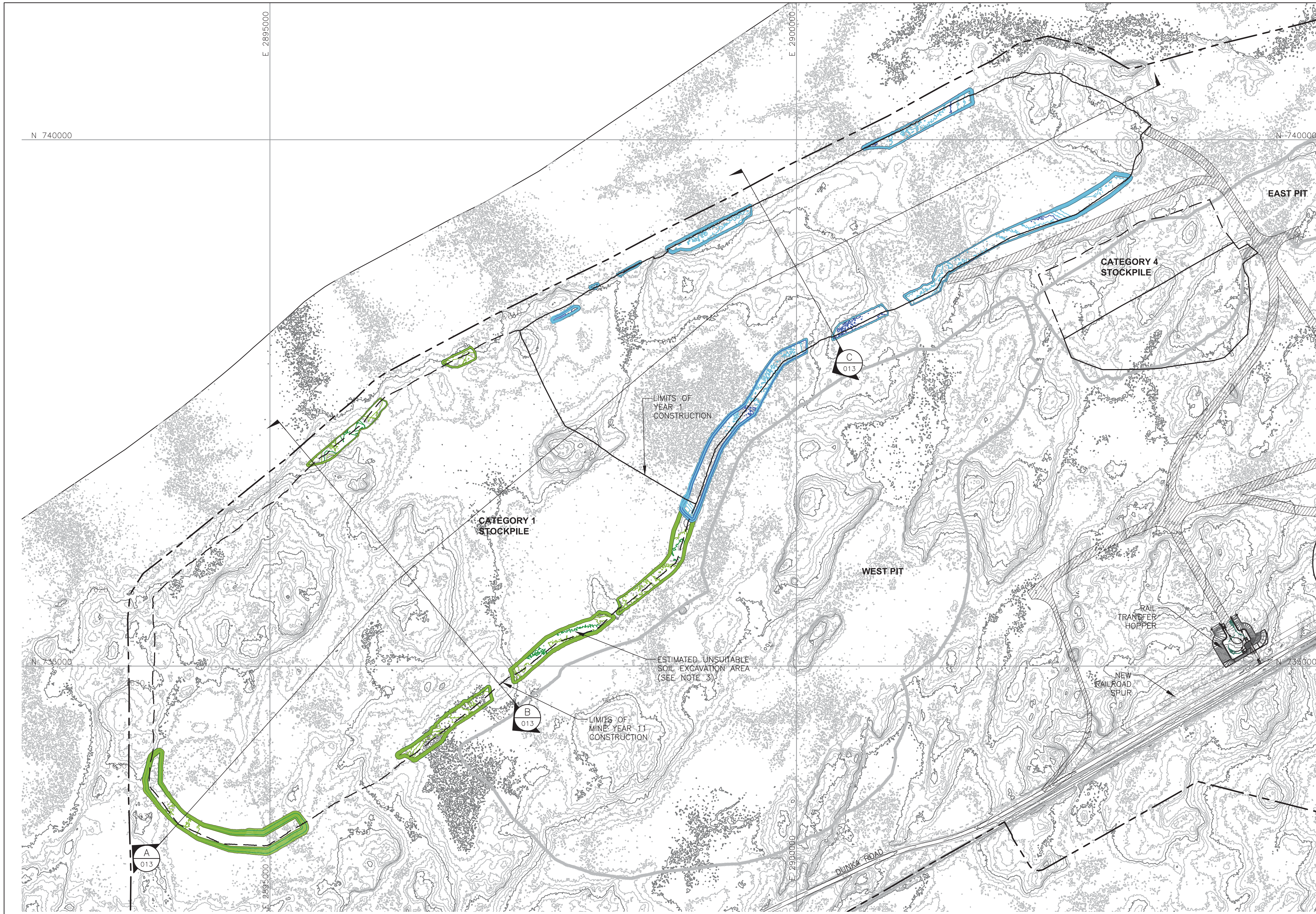
DRAWN: MTM
CHECKED: [initials]
GOLDER PROJECT NO.: 113-2209
SCALE: AS SHOWN

POLYMET MINING
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

Golder Associates
GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980-0540
Fax: (303) 985-2080
www.golder.com

DWG. NO. SKP-009
REV

INCHES 1 2



LEGEND

- EXISTING GROUND TOPOGRAPHY (SEE REFERENCE 1)
- PROPOSED MINE YEAR 1 EXCAVATION TOPOGRAPHY
- MINE YEAR 11 AND ULTIMATE EXCAVATION TOPOGRAPHY
- MINE SITE BOUNDARY
- MINE YEAR 11 PIT BOUNDARIES (SEE NOTE 1)
- MINE YEAR 1 WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- MAXIMUM WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- HAUL ROADS
- CROSS SECTION IDENTIFIER
- SHEET WHERE SECTION IS LOCATED

NOTES

1. OPEN PIT AND HAUL ROAD LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. UNSUITABLE SOILS TO BE EXCAVATED WITHIN FIRST 100 FEET FROM THE ULTIMATE STOCKPILE BOUNDARIES. GEOTECHNICAL PROPERTIES OF THE FOUNDATION SOILS WILL BE CONFIRMED PRIOR TO FINAL DESIGN.
4. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

PLANT DRAWING NUMBER:

CATEGORY 1 STOCKPILE
SUBGRADE EXCAVATION PLAN

N

0 500 1000
SCALE IN FEET

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE

PRINTED NAME BRENT R. BRONSON

DATE 8/21/17 LICENSE # 46492

DRAWN: MTM

CHECKED:

GOLDER PROJECT NO.: 113-2209

SCALE: AS SHOWN

POLYMET MINING

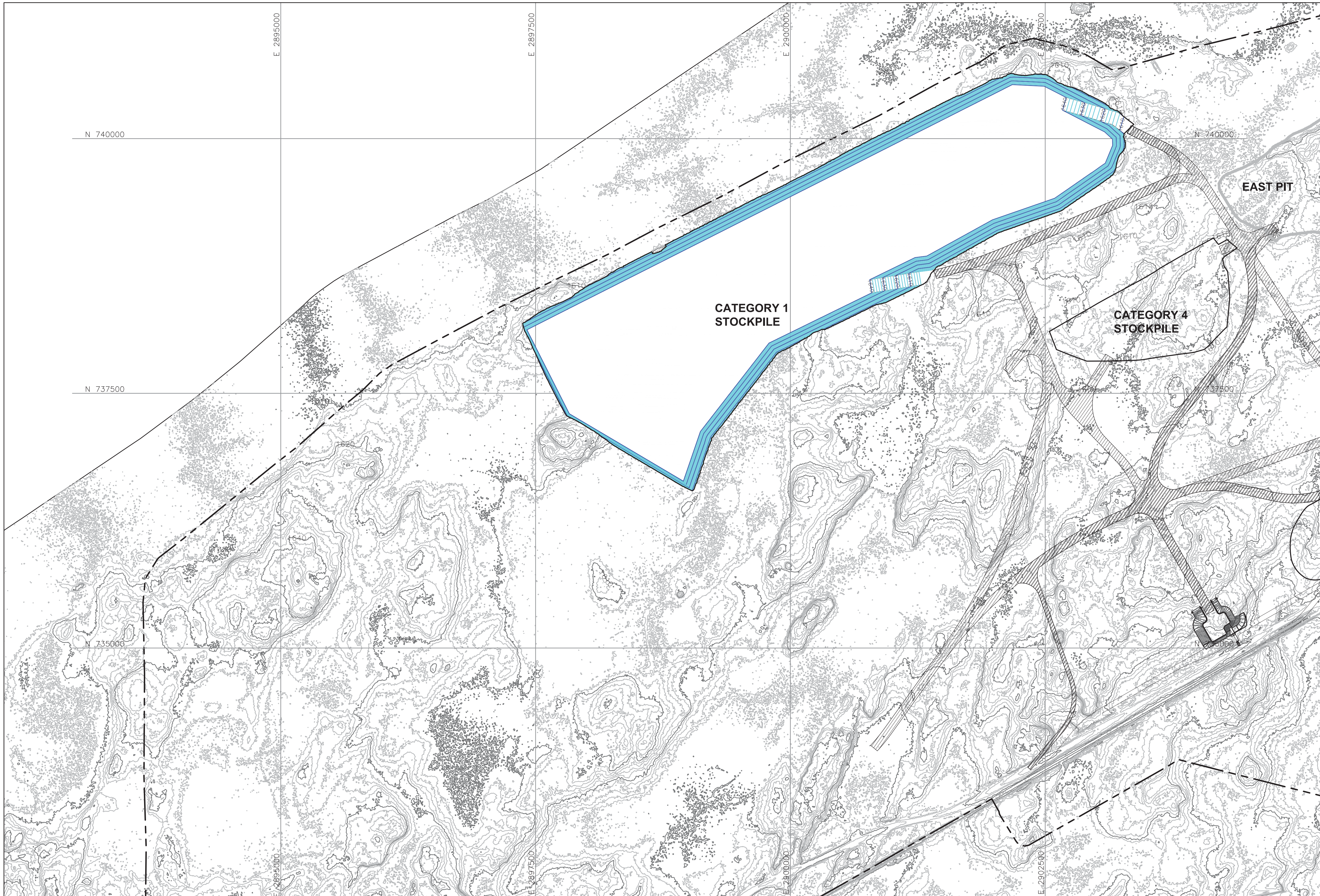
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

Golder Associates
GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980-0540
Fax: (303) 985-2080
www.golder.com

DWG. NO. SKP-010

REV

INCHES 1 2



LEGEND

- EXISTING GROUND TOPOGRAPHY
- PROPOSED GRADING TOPOGRAPHY
- HAUL ROADS
- MINE SITE BOUNDARY
- PIT BOUNDARIES AT MINE YEAR 2 (SEE NOTE 1)
- MINE YEAR 1 AND 2 ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)

NOTES

1. OPEN PIT AND HAUL ROAD LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.
4. IF CLOSURE OCCURS AFTER 1 YEAR OF MINING, STOCKPILE DRAINAGE WILL BE AS SHOWN ON DRAWING 012 FOR THIS PORTION OF THE STOCKPILE.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

0 500 1000
SCALE IN FEET

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS

ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE
PRINTED NAME BRENT R. BRONSON
DATE 8/21/17 LICENSE # 46492

DRAWN: MTM
CHECKED:
GOLDER PROJECT NO.: 113-2209
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

CATEGORY 1 STOCKPILE MINE YEAR 1 CONTINGENCY CLOSURE CONFIGURATION

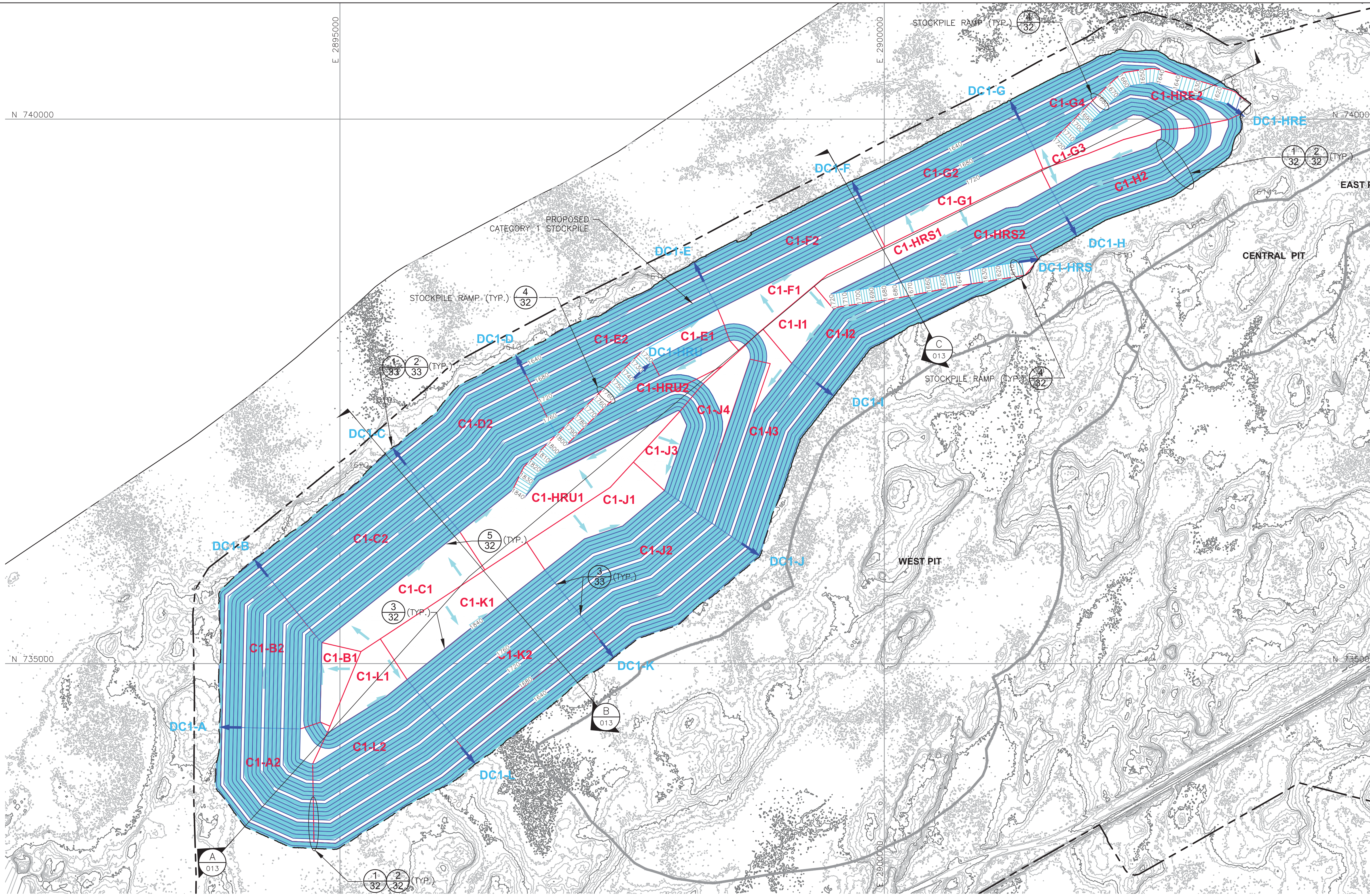
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

POLYMET MINING

GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980-0540
Fax: (303) 985-2080
www.golder.com

DWG. NO. SKP-011 REV

INCHES 1 2



LEGEND

- EXISTING GROUND TOPOGRAPHY
- GRADING TOPOGRAPHY AT MAXIMUM STOCKPILE CAPACITY
- HAUL ROADS
- MINE SITE BOUNDARY
- PIT BOUNDARIES AT MINE YEAR 2 (SEE NOTE 1)
- MINE YEAR 1 AND 2 ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- MAXIMUM WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- DOWNCHUTE/DRAINAGE DIRECTION
- WATERSHED DIVIDES
- C1-H1 WATERSHED ID
- DC1-H DOWNCHUTE ID
- GENERAL DRAINAGE DIRECTION
- CROSS SECTION IDENTIFIER
- SHEET WHERE SECTION IS LOCATED

NOTES

1. OPEN PIT AND HAUL ROAD LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. SEE GENERAL NOTES AND LEGEND ON DRAWING 002 AND NOTES ON DRAWING 013.
4. FINAL GRADES SHOWN ARE WITH STOCKPILE AT MAXIMUM CAPACITY. SEE CROSS-SECTIONS AND NOTES ON DRAWING 013.
5. SEE DRAWINGS 003 THROUGH 005 FOR INTERIM STOCKPILE FILL CONTOURS.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

PLANT DRAWING NUMBER:

CATEGORY 1 STOCKPILE
FINAL GRADES AND SUB-BASIN DELINEATION

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE

PRINTED NAME BRENT R. BRONSON

DATE 8/21/17 LICENSE # 46492

DRAWN: MTM

CHECKED:

GOLDER PROJECT NO.: 113-2209

SCALE: AS SHOWN

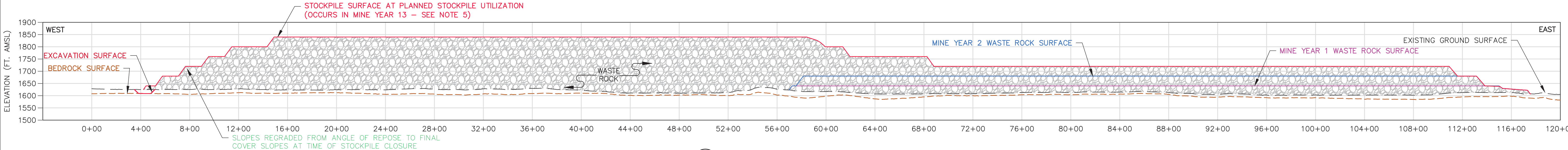
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980-0540
Fax: (303) 985-2080
www.golder.com

DWG. NO. SKP-012

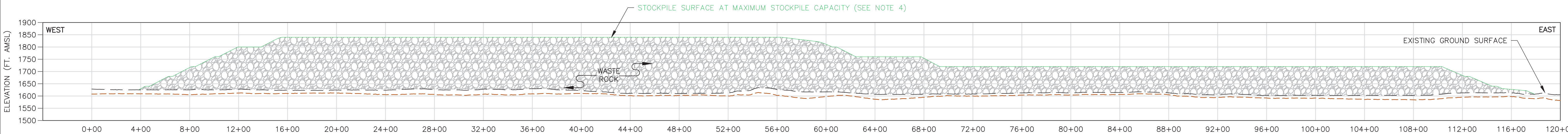
REV

INCHES 1 2



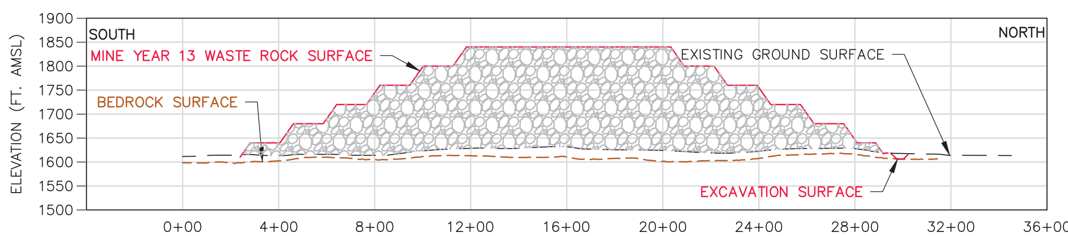
A 013 INTERIM CONFIGURATION SECTION

0 400 800
HORIZONTAL SCALE IN FEET
2X VERTICAL EXAGGERATION



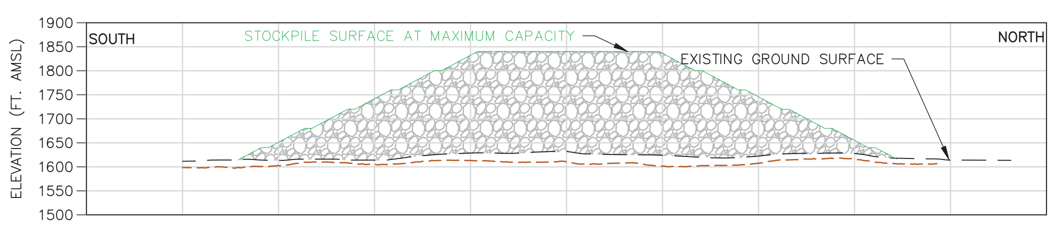
A 013 CLOSURE CONFIGURATION SECTION

0 400 800
HORIZONTAL SCALE IN FEET
2X VERTICAL EXAGGERATION



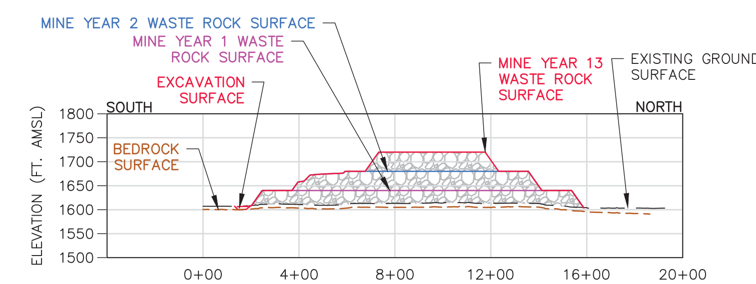
B 013 INTERIM CONFIGURATION SECTION

0 400 800
HORIZONTAL SCALE IN FEET
2X VERTICAL EXAGGERATION



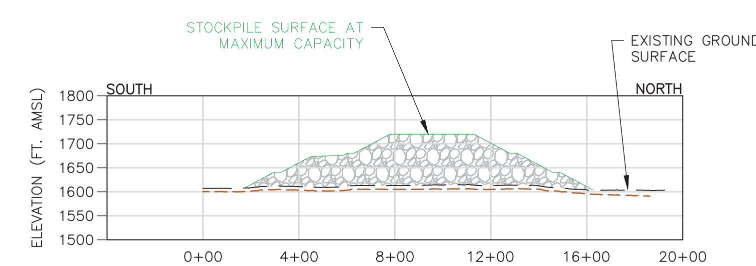
B 013 CLOSURE CONFIGURATION SECTION

0 400 800
HORIZONTAL SCALE IN FEET
2X VERTICAL EXAGGERATION



C 013 INTERIM CONFIGURATION SECTION

0 400 800
HORIZONTAL SCALE IN FEET
2X VERTICAL EXAGGERATION



C 013 CLOSURE CONFIGURATION SECTION

0 400 800
HORIZONTAL SCALE IN FEET
2X VERTICAL EXAGGERATION

NOTES

1. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.
2. UNSUITABLE SOILS TO BE EXCAVATED WITHIN FIRST 100 FEET FROM THE ULTIMATE STOCKPILE BOUNDARIES. GEOTECHNICAL PROPERTIES OF THE FOUNDATION SOILS WILL BE CONFIRMED PRIOR TO FINAL DESIGN.
3. SEE CROSS SECTION LOCATIONS ON DRAWINGS 3, 4, 5, 6, 10, AND 12.
4. MAXIMUM STOCKPILE CAPACITY – THE TOTAL CAPACITY OF THE WASTE ROCK STOCKPILE IF FILLED TO THE MAXIMUM ELEVATIONS NOTED.
5. PLANNED STOCKPILE UTILIZATION – THE PORTION OF THE TOTAL WASTE ROCK STOCKPILE CAPACITY PLANNED TO BE UTILIZED.

LEGEND

MINE YEAR 1 LIMITS
MINE YEAR 2 LIMITS
MINE YEAR 13 LIMITS
MINE YEAR 21, ULTIMATE LIMITS
EXISTING GROUND SURFACE
BEDROCK SURFACE
EXCAVATION SURFACE

PLANT DRAWING NUMBER:

DESIGN SECTIONS

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE
PRINTED NAME BRENT R. BRONSON
DATE 8/21/17 LICENSE # 46492

DRAWN: MTM
CHECKED:
GOLDER PROJECT NO.: 113-2209
SCALE: AS SHOWN

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

Golder Associates
GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980-0540
Fax: (303) 985-2080
www.golder.com

DWG. NO. SKP-013 REV A

INCHES 1 2

LEGEND

EXISTING GROUND TOPOGRAPHY (SEE REFERENCE 1)

PROPOSED MINE YEAR 1 EXCAVATION TOPOGRAPHY

PROPOSED MAXIMUM FOOTPRINT EXCAVATION TOPOGRAPHY

MINE SITE BOUNDARY

MINE YEAR 11 PIT BOUNDARIES (SEE NOTE 1)

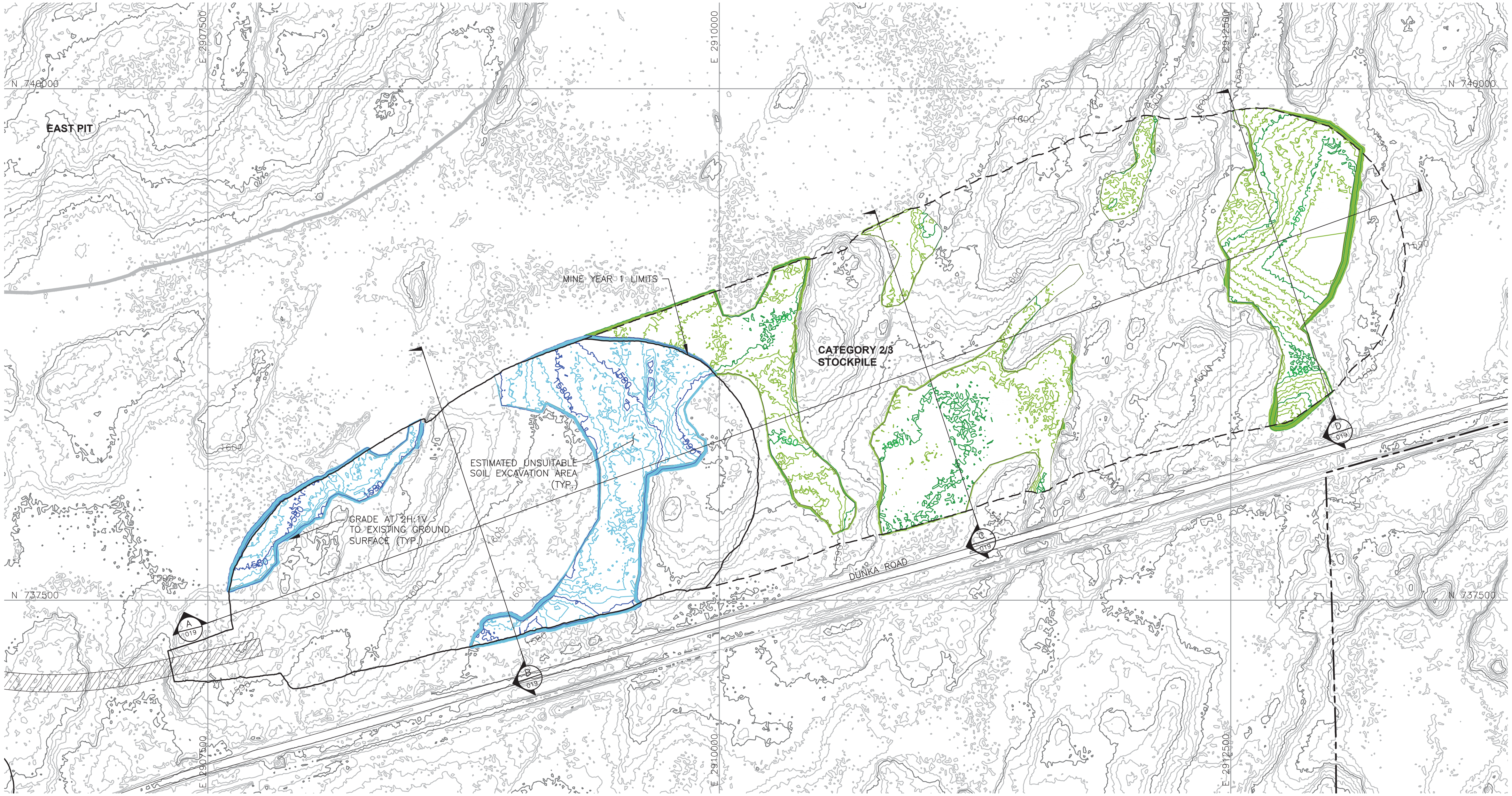
MINE YEAR 1 WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)

MAXIMUM WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)

HAUL ROADS

CROSS SECTION IDENTIFIER

SHEET WHERE SECTION IS LOCATED



0 300 600
SCALE IN FEET

NOTES

1. OPEN PIT AND HAUL ROAD LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

PLANT DRAWING NUMBER:

CATEGORY 2/3 STOCKPILE
SUBGRADE EXCAVATION PLAN

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE
PRINTED NAME BRENT R. BRONSON
DATE 8/21/17 LICENSE # 46492

DRAWN: MTM
CHECKED:
GOLDER PROJECT NO.: 113-2209
SCALE: AS SHOWN

POLYMET MINING

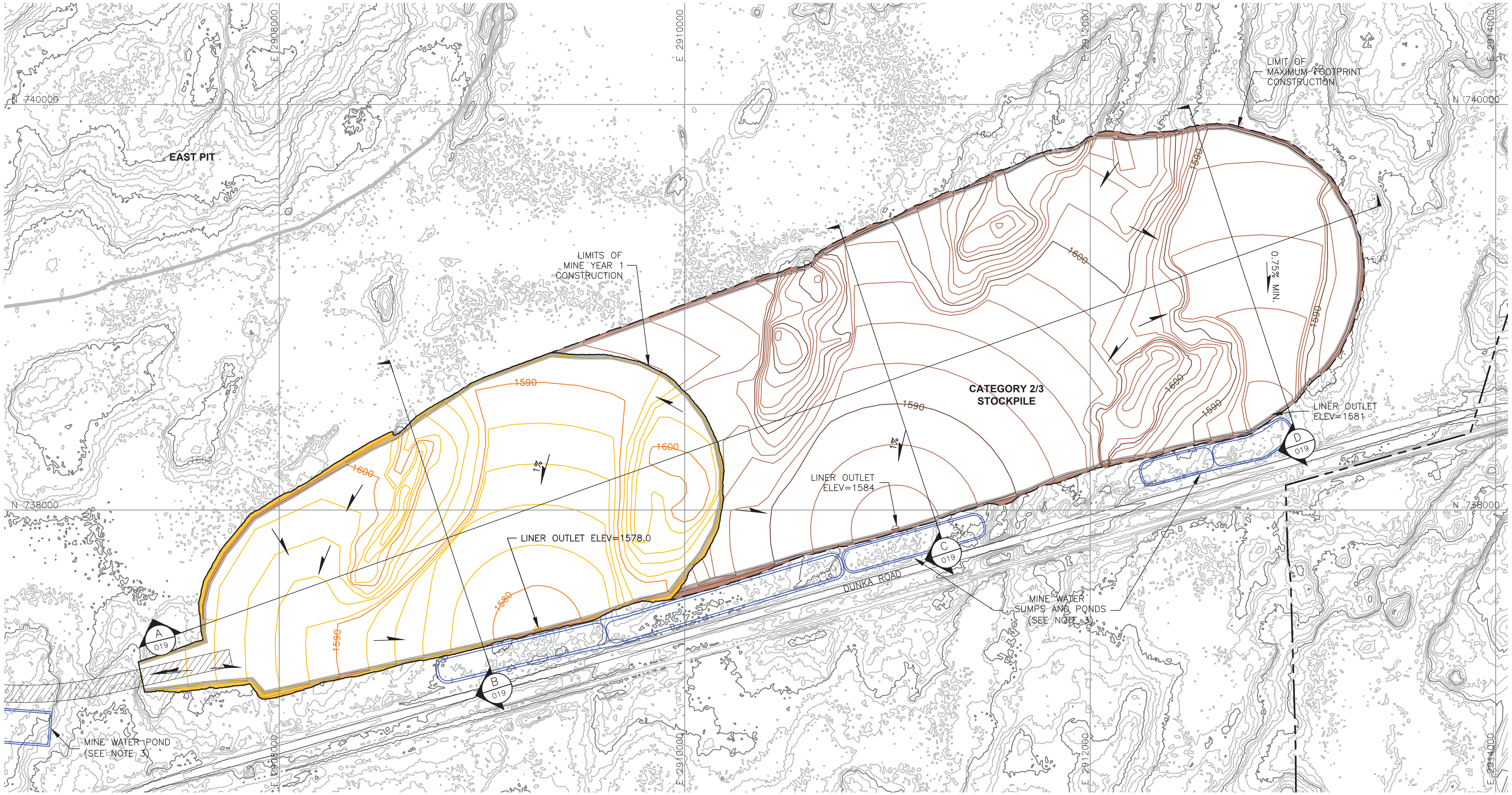
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

Golder Associates

GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980-0540
Fax: (303) 985-2080
www.golder.com

DWG. NO. SKP-014
REV

INCHES 1 2



LEGEND

- EXISTING GROUND TOPOGRAPHY (SEE REFERENCE 1)
- PROPOSED MINE YEAR 1 GRADING TOPOGRAPHY
- PROPOSED MAXIMUM FOOTPRINT GRADING TOPOGRAPHY
- MINE SITE BOUNDARY
- CROSS SECTION IDENTIFIER
- SHEET WHERE SECTION IS LOCATED
- SLOPE
- MINE YEAR 11 PIT BOUNDARIES (SEE NOTE 1)
- MINE YEAR 1 WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- MAXIMUM WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- HAUL ROADS
- MINE WATER SUMP/POND (SEE NOTE 3)

NOTES

1. OPEN PIT AND HAUL ROAD LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. SEE MECHANICAL INFRASTRUCTURE PERMIT SUPPORT DRAWINGS.
4. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

PLANT DRAWING NUMBER:

CATEGORY 2/3 STOCKPILE
FOUNDATION GRADING PLAN
MINE YEAR 1 AND MAXIMUM

0 300 600
SCALE IN FEET

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE

PRINTED NAME BRENT R. BRONSON

DATE 8/21/17 LICENSE # 46492

DRAWN: MTM

CHECKED:

GOLDER PROJECT NO.: 113-2209

SCALE: AS SHOWN

POLYMET MINING

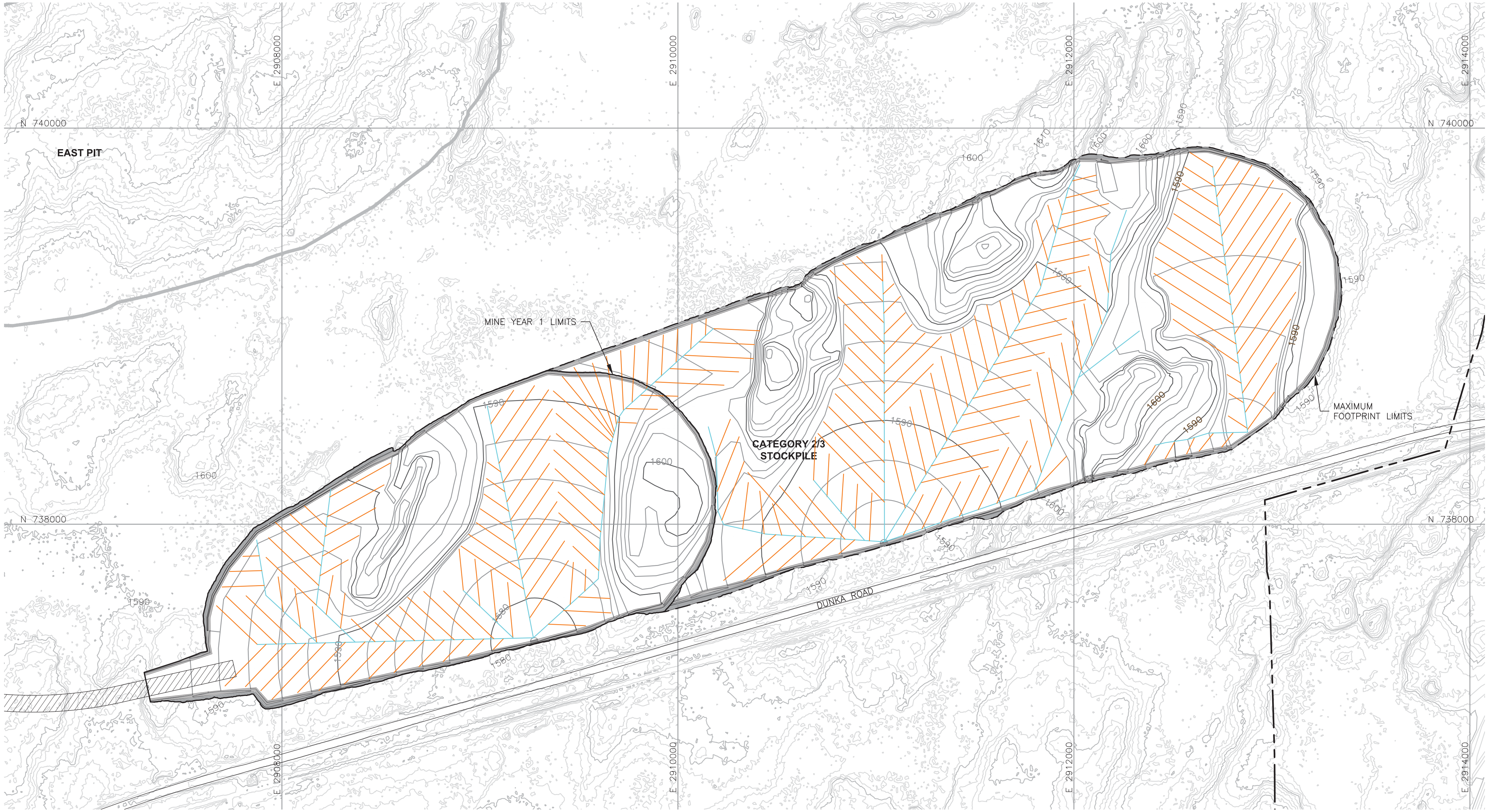
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

Golder Associates
GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980-0540
Fax: (303) 985-2080
www.golder.com

DWG. NO. SKP-015

REV

INCHES 1 2



LEGEND

EXISTING GROUND TOPOGRAPHY

PROPOSED GRADING TOPOGRAPHY

MINE SITE BOUNDARY

MINE YEAR 11 PIT BOUNDARIES (SEE NOTE 1)

MINE YEAR 1 WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)

MAXIMUM WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)

HAUL ROADS

TERTIARY COLLECTION PIPING (SEE NOTE 3)
4-INCH

SECONDARY COLLECTION PIPING (SEE NOTE 3)
6-INCH

NOTES

1. OPEN PIT AND HAUL ROAD LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. ACTUAL NUMBER AND LOCATION OF UNDERDRAIN PIPES AND SUMPS WILL NEED TO BE DETERMINED DURING CONSTRUCTION BASED ON ENCOUNTERED FIELD CONDITIONS. SEE DETAIL 5 ON DRAWING 035 FOR UNDERDRAIN.
4. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

0 300 600
SCALE IN FEET

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE B Bronson
PRINTED NAME BRENT R. BRONSON
DATE 8/21/17 LICENSE # 46492

DRAWN: MTM
CHECKED: GG
GOLDER PROJECT NO.: 113-2209
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

CATEGORY 2/3 STOCKPILE
UNDERDRAIN PIPING PLAN
MINE YEAR 1 AND MAXIMUM

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

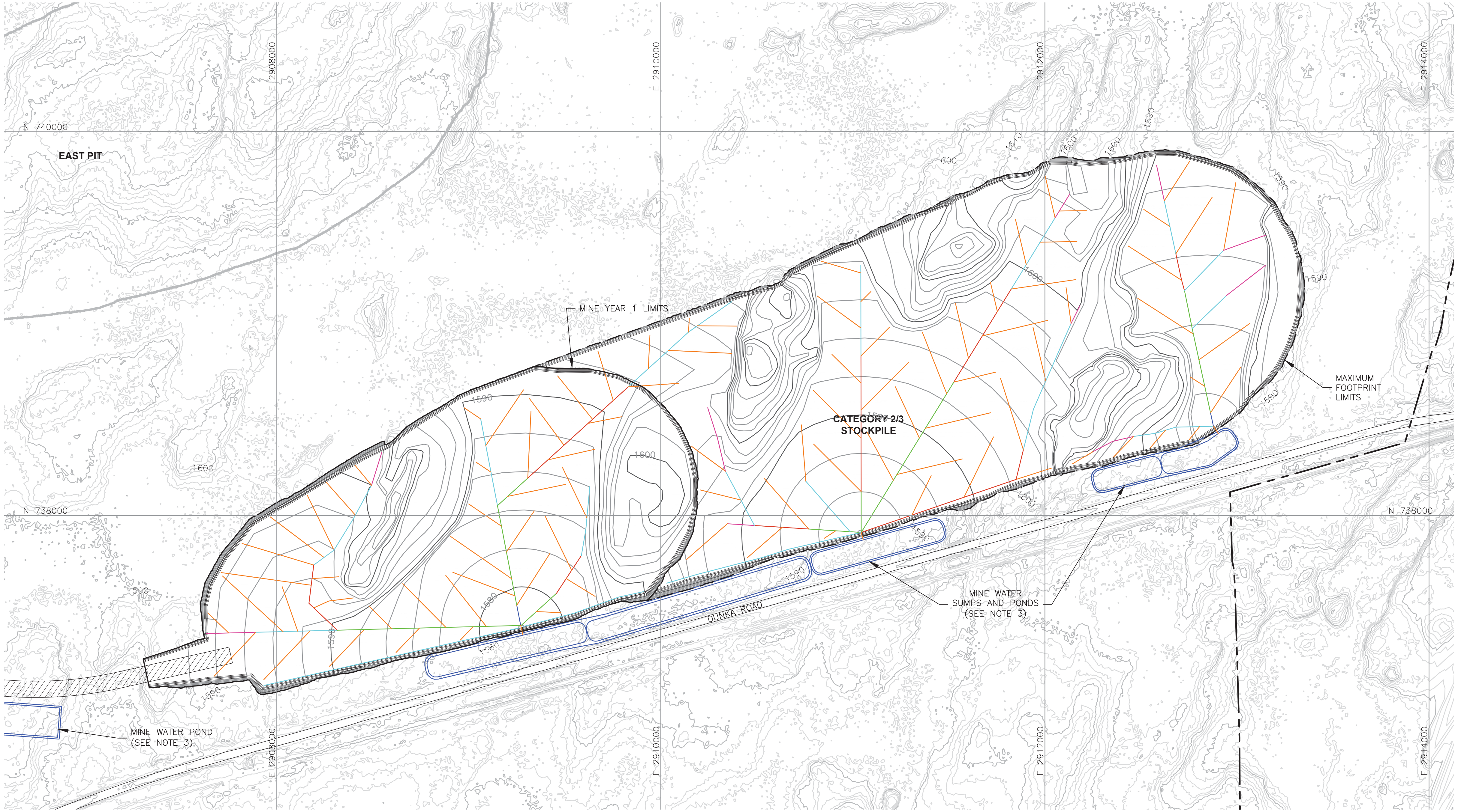
Golder Associates

GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980-0540
Fax: (303) 985-2080
www.golder.com

DWG. NO. SKP-016
REV

CADD USER: Jenkins, Crystal FILE: N:\11\113-2209_H SKP FEB2013\1132209H008.DWG PLOT SCALE: 1:1 PLOT DATE: 8/18/2017 10:49 AM

INCHES 1 2



LEGEND

EXISTING GROUND TOPOGRAPHY

PROPOSED GRADING TOPOGRAPHY

MINE SITE BOUNDARY

MINE YEAR 11 PIT BOUNDARIES (SEE NOTE 1)

MINE YEAR 1 ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)

MAXIMUM ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)

HAUL ROADS

MINE WATER SUMP/POND (SEE NOTE 3)

TERTIARY COLLECTION PIPING
- 4-INCH

PRIMARY AND SECONDARY COLLECTION PIPING
- 4-INCH
- 6-INCH
- 8-INCH
- 10-INCH
- 12-INCH

NOTES

1. OPEN PIT AND HAUL ROAD LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. SEE MECHANICAL INFRASTRUCTURE PERMIT SUPPORT DRAWINGS.
4. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

0 200 400
SCALE IN FEET

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE
PRINTED NAME BRENT R. BRONSON
DATE 8/21/17 LICENSE # 46492

DRAWN: MTM
CHECKED:
GOLDER PROJECT NO.: 113-2209
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

CATEGORY 2/3 STOCKPILE
OVERLINER DRAINAGE PIPING PLAN
MINE YEAR 1 AND MAXIMUM

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

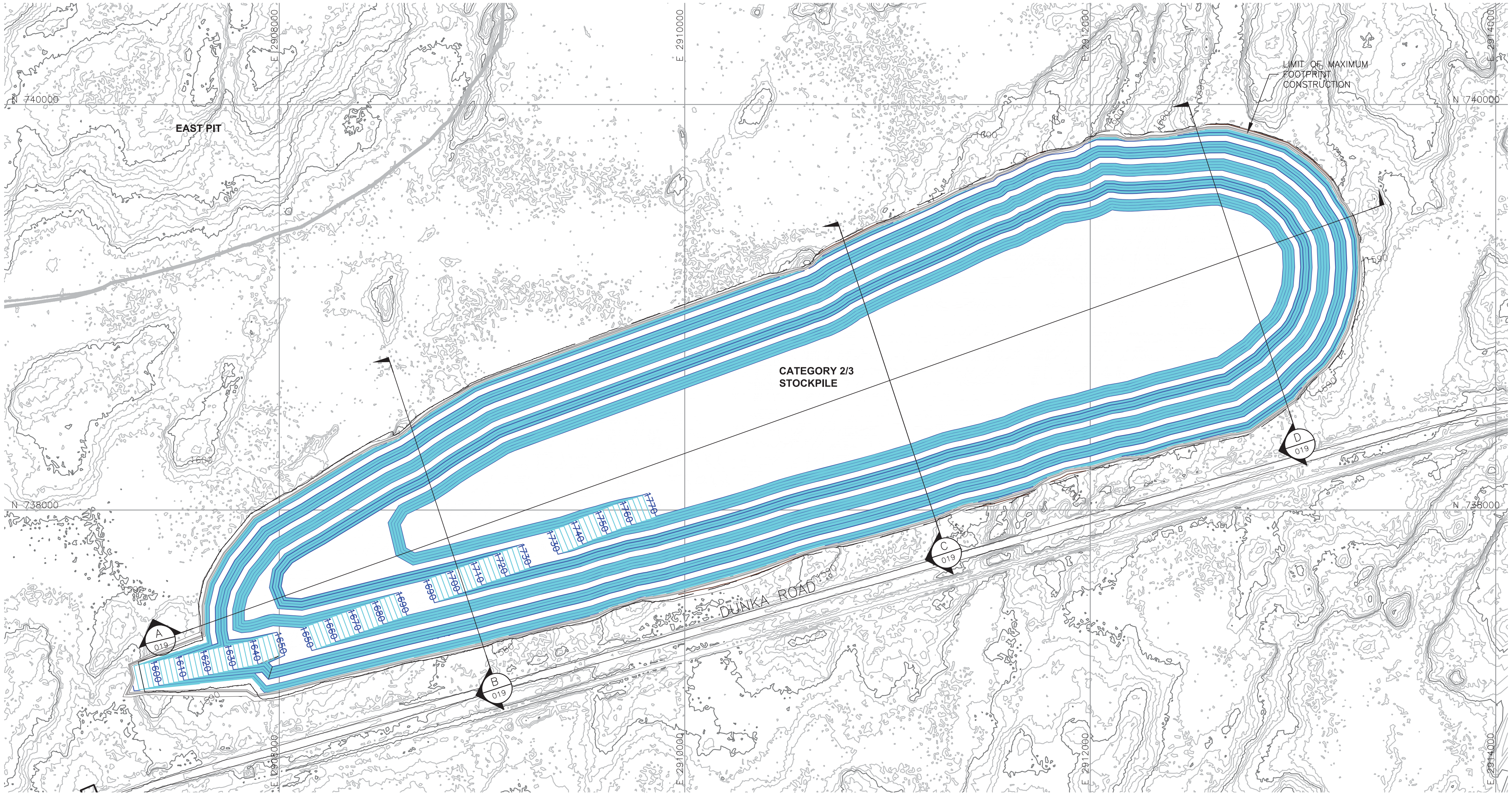
Golder Associates

GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980-0540
Fax: (303) 985-2080
www.golder.com

DWG. NO. SKP-017
REV

CADD USER: Jenkins, Crystal FILE: N:\11\113-2209_H SKP FEB2013\113220910.DWG PLOT SCALE: 1:1 PLOT DATE: 8/18/2017 10:51 AM

INCHES 1 2



LEGEND

- EXISTING GROUND TOPOGRAPHY (SEE REFERENCE 1)
- GRADING TOPOGRAPHY AT MAXIMUM STOCKPILE CAPACITY
- MINE SITE BOUNDARY
- CROSS SECTION IDENTIFIER
- SHEET WHERE SECTION IS LOCATED
- MINE YEAR 1 WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- MAXIMUM ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- PROPOSED HAUL ROAD
- MINE YEAR 11 PIT BOUNDARIES (SEE NOTE 1)

NOTES

1. OPEN PIT AND HAUL ROAD LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. SEE GENERAL NOTES AND LEGEND ON DRAWING 002 AND NOTES ON DRAWING 019.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

0 300 600
SCALE IN FEET

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE
PRINTED NAME BRENT R. BRONSON
DATE 8/21/17 LICENSE # 46492

DRAWN: MTM
CHECKED:
GOLDER PROJECT NO.: 113-2209
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

CATEGORY 2/3 STOCKPILE MAXIMUM CAPACITY CONFIGURATION

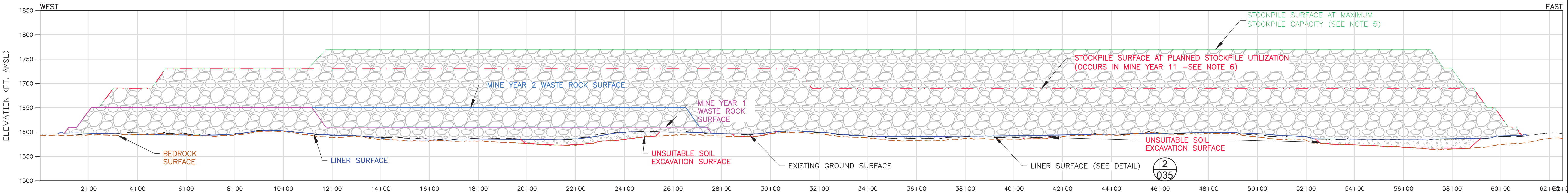
POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

Golder Associates
GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980-0540
Fax: (303) 985-2080
www.golder.com

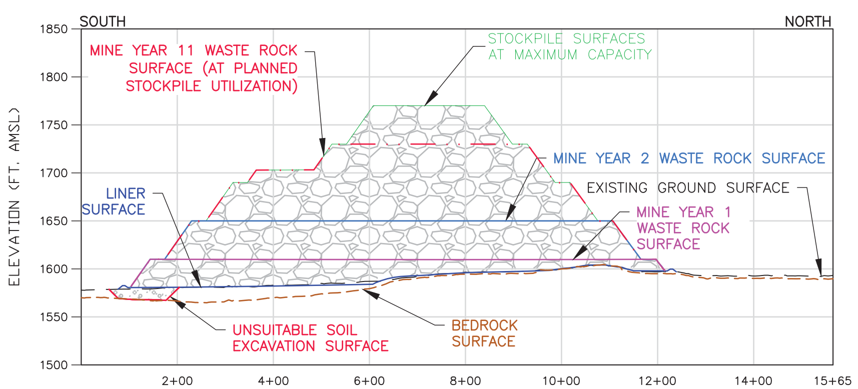
DWG. NO. SKP-018
REV

INCHES 1 2



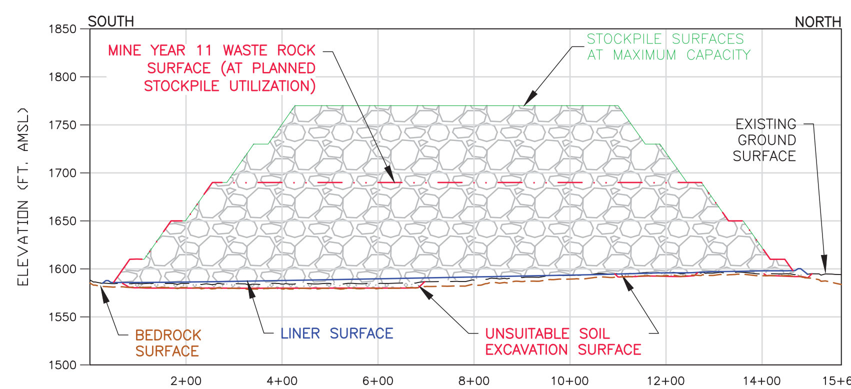
A SECTION 019

0 200 400
HORIZONTAL SCALE IN FEET
2X VERTICAL EXAGGERATION



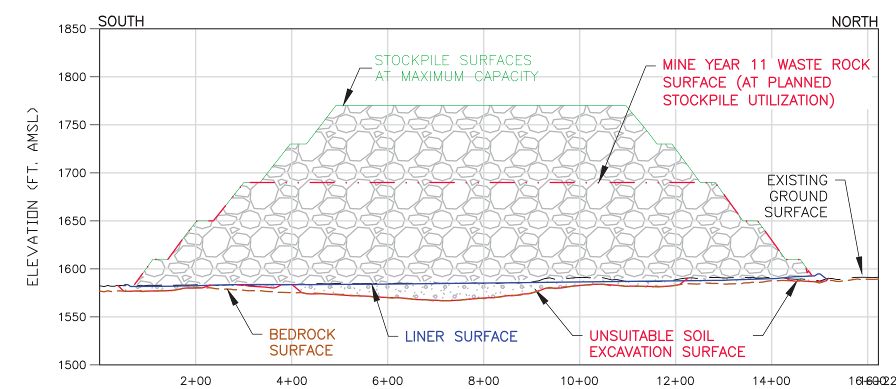
B SECTION 019

0 200 400
HORIZONTAL SCALE IN FEET
2X VERTICAL EXAGGERATION



C SECTION 019

0 200 400
HORIZONTAL SCALE IN FEET
2X VERTICAL EXAGGERATION



D SECTION 019

0 200 400
HORIZONTAL SCALE IN FEET
2X VERTICAL EXAGGERATION

NOTES

1. STOCKPILE INTERBENCH SLOPES AT ANGLE OF REPOSE.
2. THIS DESIGN CONSERVATIVELY ASSUMES THAT ALL LOWLAND/WETLAND SOILS ARE GEOTECHNICALLY UNSUITABLE AND WILL REQUIRE EXCAVATION AND REPLACEMENT WITH STRUCTURAL FILL TO THE DESIGN FOUNDATION BASE GRADE. GEOTECHNICAL PROPERTIES OF THE FOUNDATION SOILS WILL BE CONFIRMED PRIOR TO FINAL DESIGN.
3. MAXIMUM DEPTH OF UNSUITABLE MATERIAL SUBGRADE EXCAVATION LIMITED TO 20 FEET FOR THIS DESIGN. THE ACTUAL DEPTH OF UNSUITABLE SOIL EXCAVATION WILL BE CONFIRMED BY PHASE II GEOTECHNICAL INVESTIGATION.
4. SEE CROSS SECTION LOCATIONS ON DRAWINGS 3, 4, 5, 14, 15 AND 18.
5. MAXIMUM STOCKPILE CAPACITY – THE TOTAL CAPACITY OF THE WASTE ROCK STOCKPILE IF FILLED TO THE MAXIMUM ELEVATIONS NOTED.
6. PLANNED STOCKPILE UTILIZATION – THE PORTION OF THE TOTAL WASTE ROCK STOCKPILE CAPACITY PLANNED TO BE UTILIZED.

LEGEND

MINE YEAR 1 LIMITS
MINE YEAR 2 LIMITS
MINE YEAR 11 LIMITS
MAXIMUM CAPACITY
LINER SURFACE
EXISTING GROUND SURFACE
UNSUITABLE SOIL EXCAVATION SURFACE
BEDROCK SURFACE

PLANT DRAWING NUMBER:

CATEGORY 2/3 STOCKPILE
DESIGN SECTIONS

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE
PRINTED NAME BRENT R. BRONSON
DATE 8/21/17 LICENSE # 46492

DRAWN: MTM
CHECKED:
GOLDER PROJECT NO.: 113-2209
SCALE: AS SHOWN

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

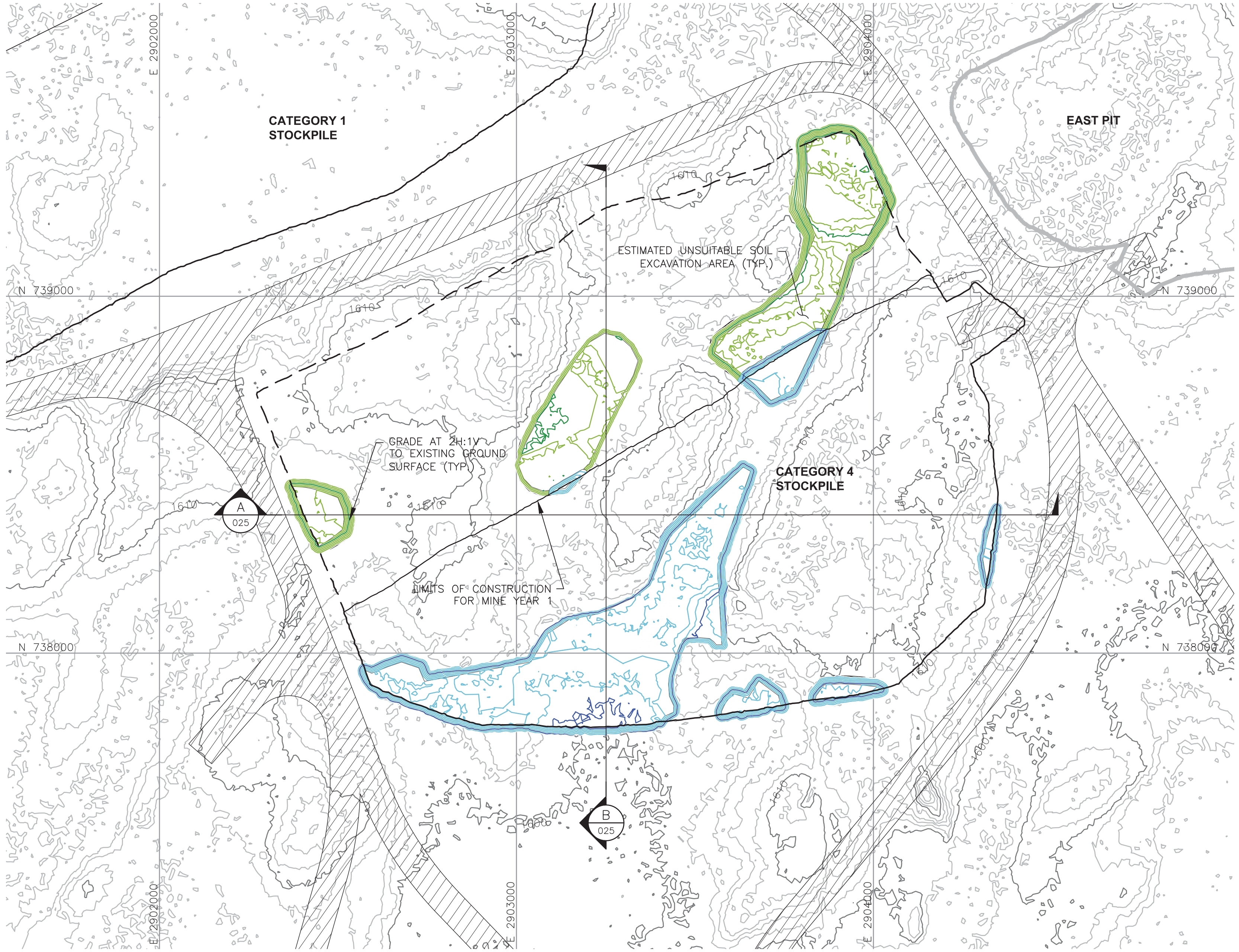
Golder Associates

GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980-0540
Fax: (303) 985-2080
www.golder.com

DWG. NO. SKP-019
REV

CADD USER: Jenkins, Crystal FILE: N:\11\113-2209_H SKP FEB2013\1132209H011.DWG PLOT SCALE: 1:1 PLOT DATE: 8/18/2017 10:56 AM

INCHES 1 2



LEGEND

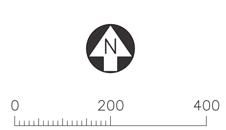
- EXISTING GROUND TOPOGRAPHY (SEE REFERENCE 1)
- PROPOSED MINE YEAR 1 EXCAVATION TOPOGRAPHY
- PROPOSED MAXIMUM FOOTPRINT EXCAVATION TOPOGRAPHY
- MINE SITE BOUNDARY
- MINE YEAR 1 WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- MAXIMUM WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- HAUL ROADS
- MINE YEAR 2 PIT BOUNDARIES (SEE NOTE 1)
- CROSS SECTION IDENTIFIER
- SHEET WHERE SECTION IS LOCATED

NOTES

1. OPEN PIT AND HAUL ROAD LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).



VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE

PRINTED NAME BRENT R. BRONSON

DATE 8/21/17 LICENSE # 46492

DRAWN: MTM

CHECKED:

GOLDER PROJECT NO.: 113-2209

SCALE: AS SHOWN

PLANT DRAWING NUMBER:

CATEGORY 4 STOCKPILE SUBGRADE EXCAVATION PLAN

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

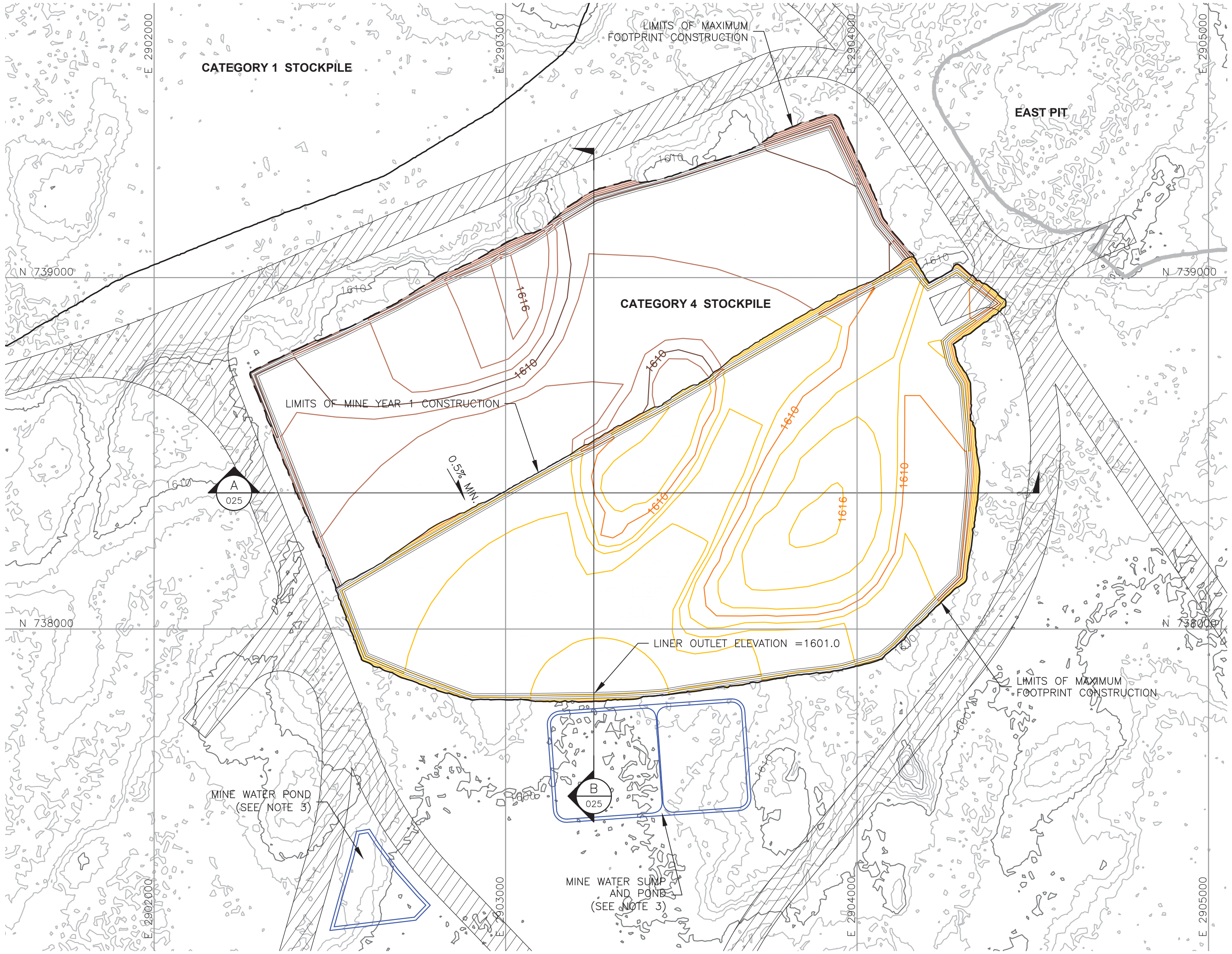
Golder Associates
GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980-0540
Fax: (303) 985-2080
www.golder.com

DWG. NO. SKP-020

REV

INCHES 1 2

CADD USER: Jenkins, Crystal FILE: N:\11\113-2209_H SKP FEB2013\1132209H012.DWG PLOT SCALE: 1:1 PLOT DATE: 8/18/2017 10:58 AM



N

0 200 400
SCALE IN FEET

INCHES 1 2

LEGEND

- EXISTING GROUND TOPOGRAPHY (SEE REFERENCE 1)
- PROPOSED MINE YEAR 1 GRADING TOPOGRAPHY
- PROPOSED MAXIMUM FOOTPRINT GRADING TOPOGRAPHY
- MINE SITE BOUNDARY
- A / 025 CROSS SECTION IDENTIFIER
- SHEET WHERE SECTION IS LOCATED
- SLOPE
- MINE YEAR 1 WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- MAXIMUM WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- HAUL ROAD
- MINE YEAR 2 PIT BOUNDARIES (SEE NOTE 1)
- MINE WATER SUMP/POND (SEE NOTE 3)

NOTES

1. OPEN PIT AND HAUL ROAD LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. SEE MECHANICAL INFRASTRUCTURE PERMIT SUPPORT DRAWINGS.
4. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE

PRINTED NAME BRENT R. BRONSON

DATE 8/21/17 LICENSE # 46492

DRAWN: MTM

CHECKED:

GOLDER PROJECT NO.: 113-2209

SCALE: AS SHOWN

PLANT DRAWING NUMBER:

CATEGORY 4 STOCKPILE
FOUNDATION GRADING PLAN
MINE YEAR 1 AND MAXIMUM

POLYMET MINING

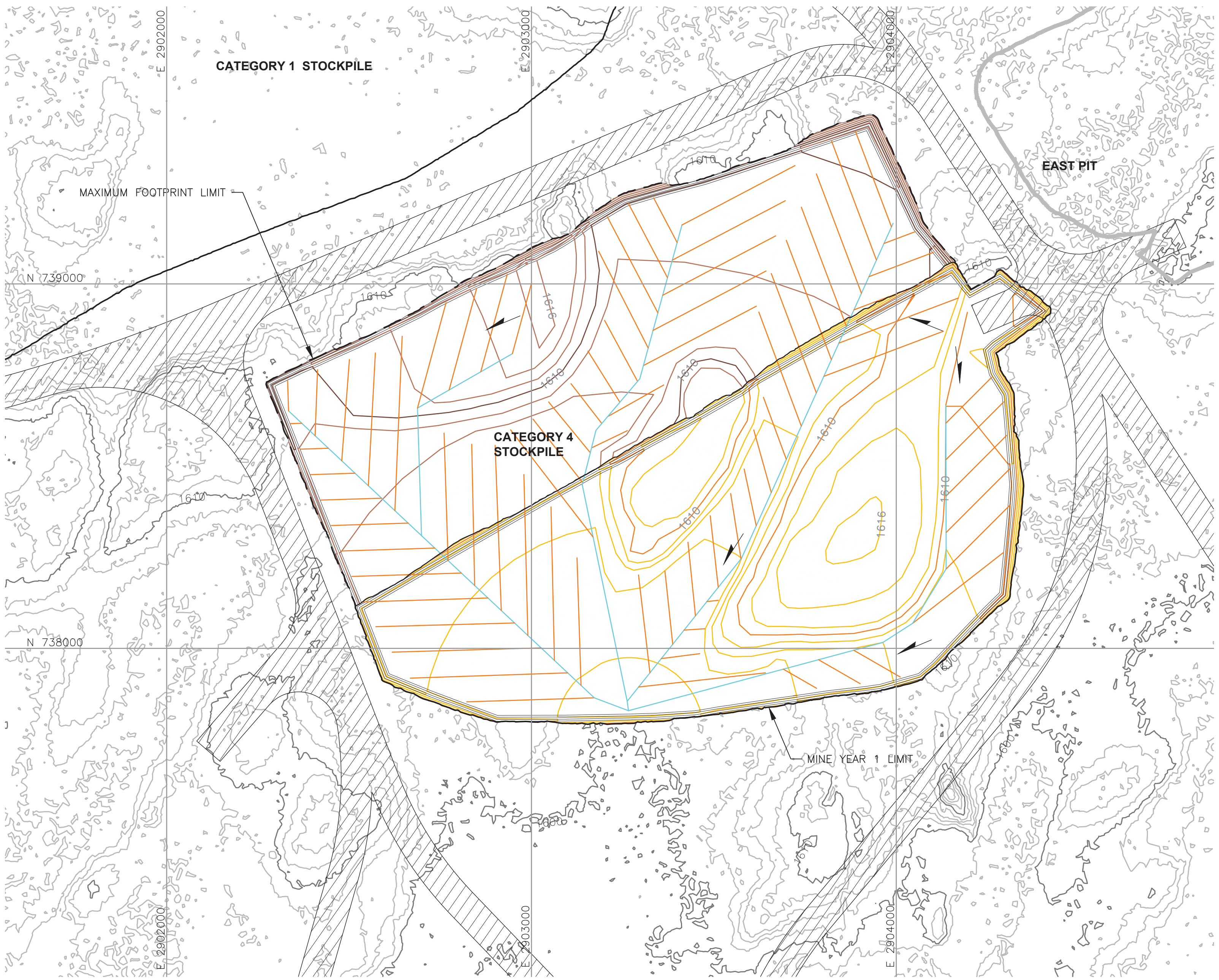
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

Golder Associates

GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980-0540
Fax: (303) 985-2080
www.golder.com

DWG. NO. SKP-021

REV



LEGEND

- EXISTING GROUND TOPOGRAPHY
- PROPOSED MINE YEAR 1 GRADING TOPOGRAPHY
- PROPOSED MAXIMUM FOOTPRINT GRADING TOPOGRAPHY
- MINE SITE BOUNDARY
- MINE YEAR 2 PIT BOUNDARIES (SEE NOTE 1)
- SLOPE
- MINE YEAR 1 WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- MAXIMUM WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- HAUL ROADS

TERTIARY COLLECTION PIPING (SEE NOTE 3)
4-INCH

SECONDARY COLLECTION PIPING (SEE NOTE 3)
6-INCH

NOTES

1. OPEN PIT AND HAUL ROAD LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. ACTUAL NUMBER AND LOCATION OF UNDERDRAIN PIPES AND SUMPS WILL NEED TO BE DETERMINED DURING CONSTRUCTION BASED ON ENCOUNTERED FIELD CONDITIONS. SEE DETAIL 5 ON DRAWING 035 FOR UNDERDRAIN.
4. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

PLANT DRAWING NUMBER:

CATEGORY 4 STOCKPILE
UNDERDRAIN PIPING PLAN
MINE YEAR 1 AND MAXIMUM

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE
PRINTED NAME BRENT R. BRONSON
DATE 8/21/17 LICENSE # 46492

DRAWN: MTM
CHECKED:
GOLDER PROJECT NO.: 113-2209
SCALE: AS SHOWN

POLYMET MINING

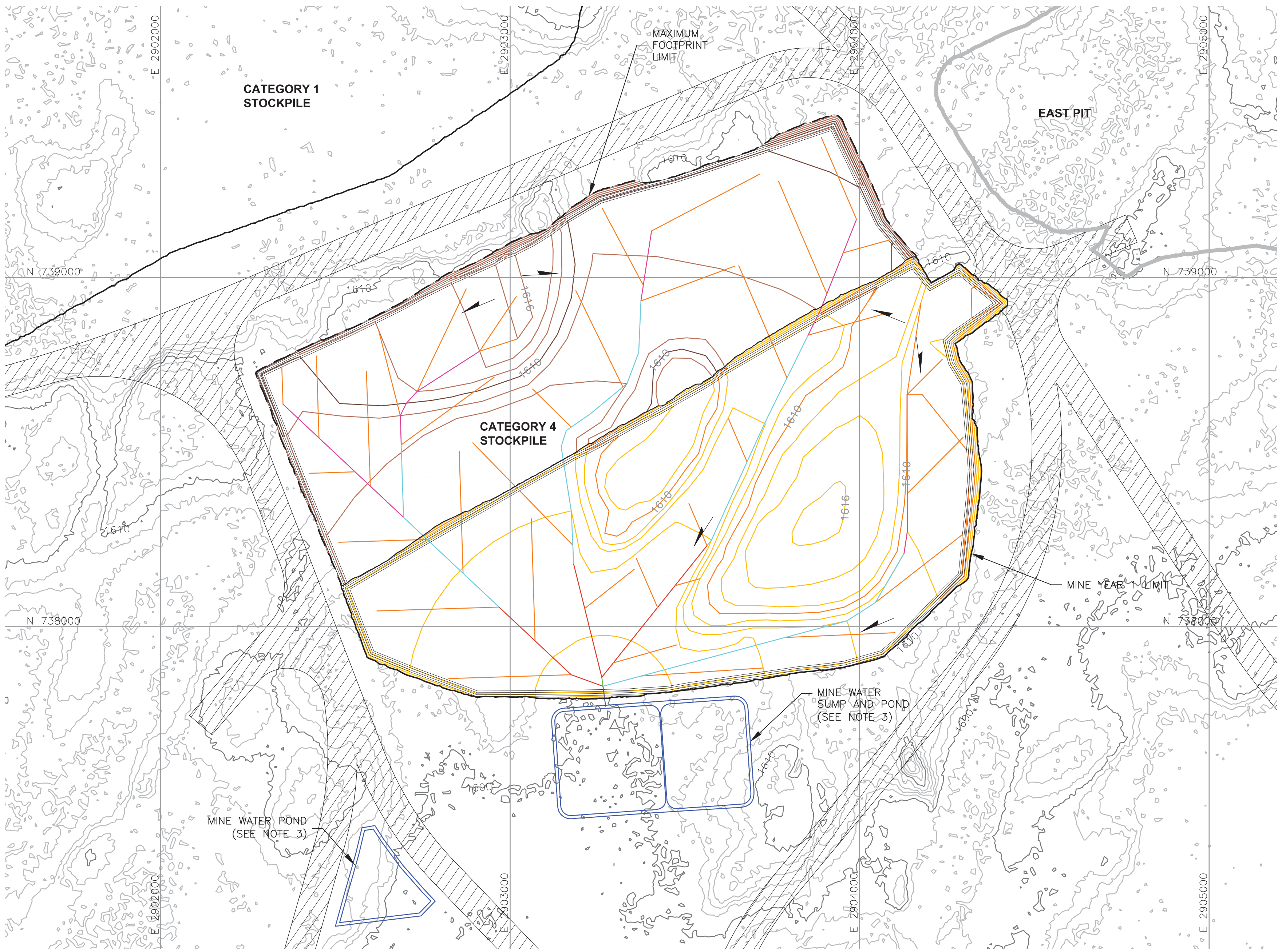
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

Golder Associates
GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980-0540
Fax: (303) 985-2080
www.golder.com

DWG. NO. SKP-022
REV

INCHES 1 2

CADD USER: Jenkins, Crystal FILE: N:\11\113-2209_H SKP FEB2013\1132209H015.DWG PLOT SCALE: 1:1 PLOT DATE: 8/18/2017 4:40 PM



0 200 400
SCALE IN FEET

LEGEND

- EXISTING GROUND TOPOGRAPHY
- PROPOSED MINE YEAR 1 GRADING TOPOGRAPHY
- PROPOSED MAXIMUM FOOTPRINT GRADING TOPOGRAPHY
- MINE SITE BOUNDARY
- MINE YEAR 2 PIT BOUNDARIES (SEE NOTE 1)
- SLOPE
- MINE YEAR 1 WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- MAXIMUM WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- HAUL ROADS
- MINE WATER SUMP/POND (SEE NOTE 3)

MINE YEAR 1 – TERTIARY COLLECTION PIPING
- 4–INCH

MINE YEAR 1 – PRIMARY AND SECONDARY COLLECTION PIPING
- 4–INCH
- 6–INCH
- 8–INCH
- 10–INCH
- 12–INCH

NOTES

1. OPEN PIT AND HAUL ROAD LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. SEE MECHANICAL INFRASTRUCTURE PERMIT SUPPORT DRAWINGS.
4. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

PLANT DRAWING NUMBER:

CATEGORY 4 STOCKPILE
OVERLINER DRAINAGE PIPING PLAN
MINE YEAR 1 AND MAXIMUM

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE

PRINTED NAME BRENT R. BRONSON

DATE 8/21/17 LICENSE # 46492

DRAWN: MTM

CHECKED:

GOLDER PROJECT NO.: 113-2209

SCALE: AS SHOWN

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

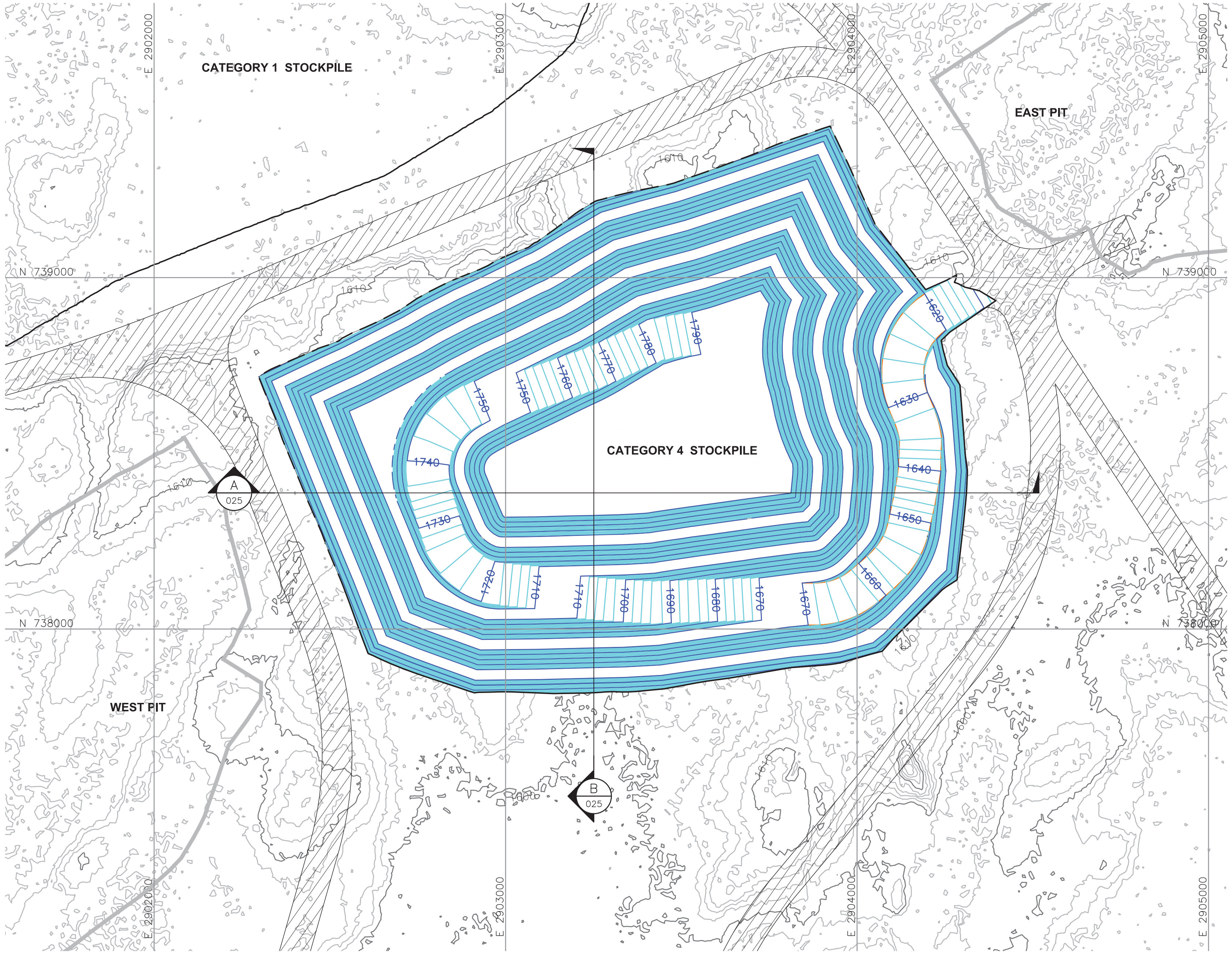
Golder Associates

GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980-0540
Fax: (303) 985-2080
www.golder.com

DWG. NO. SKP–023

REV

INCHES 1 2



LEGEND

EXISTING GROUND TOPOGRAPHY (SEE REFERENCE 1)

GRADING TOPOGRAPHY AT MAXIMUM STOCKPILE CAPACITY

MINE SITE BOUNDARY

CROSS SECTION IDENTIFIER

SHEET WHERE SECTION IS LOCATED

MINE YEAR 1 WASTE ROCK STOCKPILE LIMIT (SEE NOTE 1)

MAXIMUM WASTE ROCK STOCKPILE LIMIT

PROPOSED HAUL ROAD

MINE YEAR 11 PIT BOUNDARIES (SEE NOTE 1)

NOTES

1. OPEN PIT AND HAUL ROAD LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. SEE GENERAL NOTES AND LEGEND ON DRAWING 002 AND NOTES ON DRAWING 025.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

N

0 200 400
SCALE IN FEET

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE

PRINTED NAME BRENT R. BRONSON

DATE 8/21/17 LICENSE # 46492

DRAWN: MTM

CHECKED:

GOLDER PROJECT NO.: 113-2209

SCALE: AS SHOWN

PLANT DRAWING NUMBER:

CATEGORY 4 STOCKPILE
MAXIMUM CAPACITY CONFIGURATION

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

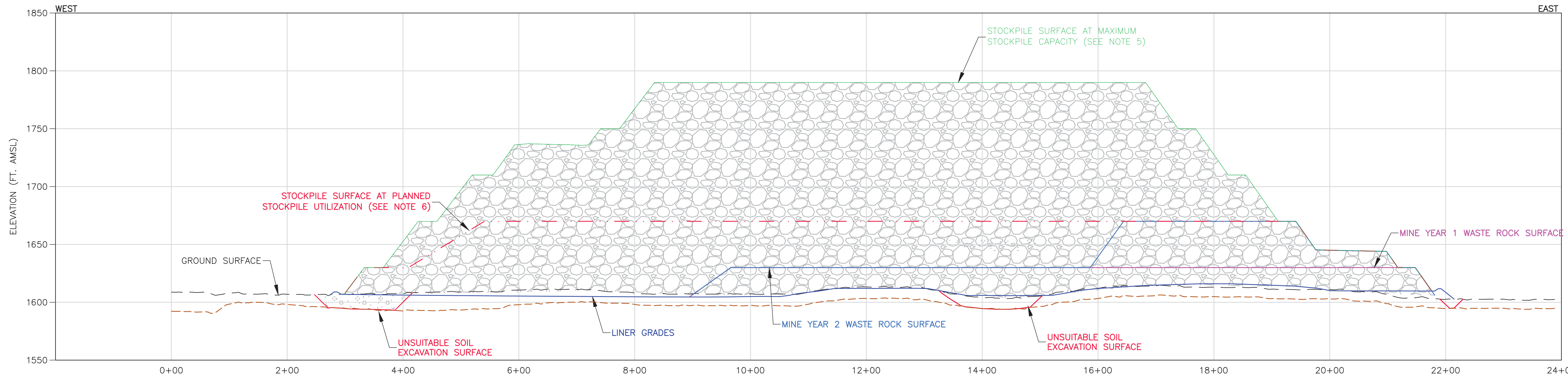
Golder Associates
GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980-0540
Fax: (303) 985-2080
www.golder.com

DWG. NO. SKP-024

REV

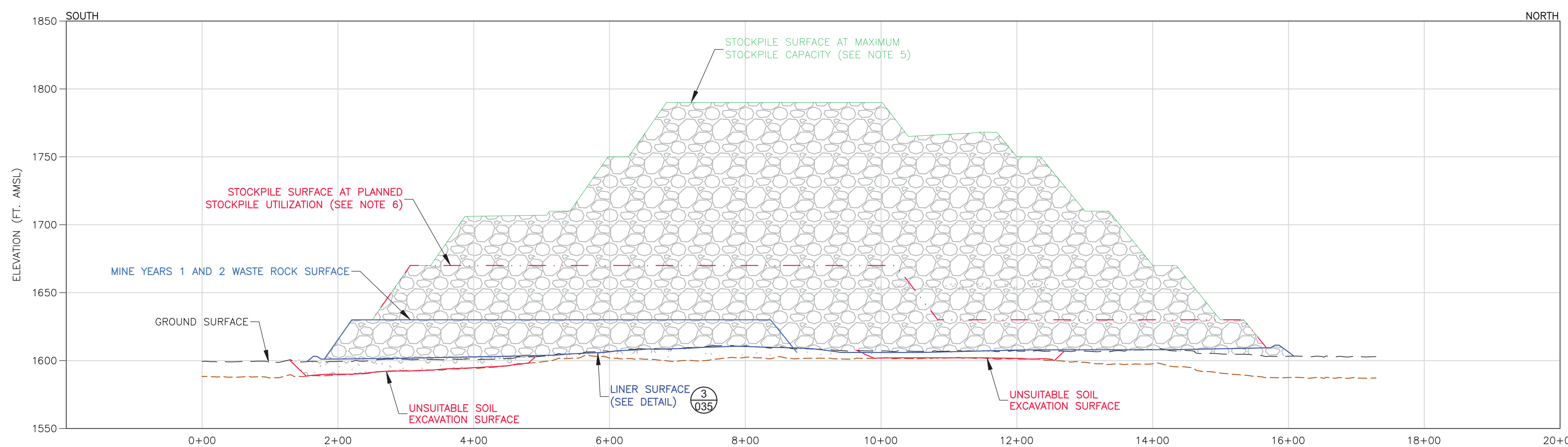
CADD USER: Jenkins, Crystal FILE: N:\11\113-2209_H SKP FEB2013\113220H006.DWG PLOT SCALE: 1:1 PLOT DATE: 8/18/2017 11:08 AM

INCHES 1 2



A 025 SECTION

0 100 200
HORIZONTAL SCALE IN FEET
2X VERTICAL EXAGGERATION



B 025 SECTION

0 100 200
HORIZONTAL SCALE IN FEET
2X VERTICAL EXAGGERATION

LEGEND

- MINE YEAR 1 LIMITS
- MINE YEAR 2 LIMITS
- MINE YEAR 11 LIMITS
- MAXIMUM CAPACITY
- LINER SURFACE
- EXISTING GROUND SURFACE
- UNSUITABLE SOIL EXCAVATION SURFACE
- BEDROCK SURFACE

NOTES

1. STOCKPILE INTERBENCH SLOPES AT ANGLE OF REPOSE.
2. THIS DESIGN CONSERVATIVELY ASSUMES THAT ALL LOWLAND/WETLAND SOILS ARE GEOTECHNICALLY UNSUITABLE AND WILL REQUIRE EXCAVATION AND REPLACEMENT WITH STRUCTURAL FILL TO THE DESIGN FOUNDATION BASE GRADE. GEOTECHNICAL PROPERTIES OF THE FOUNDATION SOILS WILL BE CONFIRMED PRIOR TO FINAL DESIGN.
3. MAXIMUM DEPTH OF UNSUITABLE MATERIAL SUBGRADE EXCAVATION LIMITED TO 20 FEET FOR THIS DESIGN. THE ACTUAL DEPTH OF UNSUITABLE SOIL EXCAVATION WILL BE CONFIRMED BY PHASE II GEOTECHNICAL INVESTIGATION.
4. SEE CROSS SECTION LOCATIONS ON DRAWINGS 3, 4, 5, 20, 21 AND 24.
5. MAXIMUM STOCKPILE CAPACITY – THE TOTAL CAPACITY OF THE WASTE ROCK STOCKPILE IF FILLED TO THE MAXIMUM ELEVATIONS NOTED.
6. PLANNED STOCKPILE UTILIZATION – THE PORTION OF THE TOTAL WASTE ROCK STOCKPILE CAPACITY PLANNED TO BE UTILIZED.

PLANT DRAWING NUMBER:

CATEGORY 4 STOCKPILE DESIGN SECTIONS

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE
PRINTED NAME BRENT R. BRONSON
DATE 8/21/17 LICENSE # 46492

DRAWN: MTM
CHECKED:
GOLDER PROJECT NO.: 113-2209
SCALE: AS SHOWN

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

Golder Associates

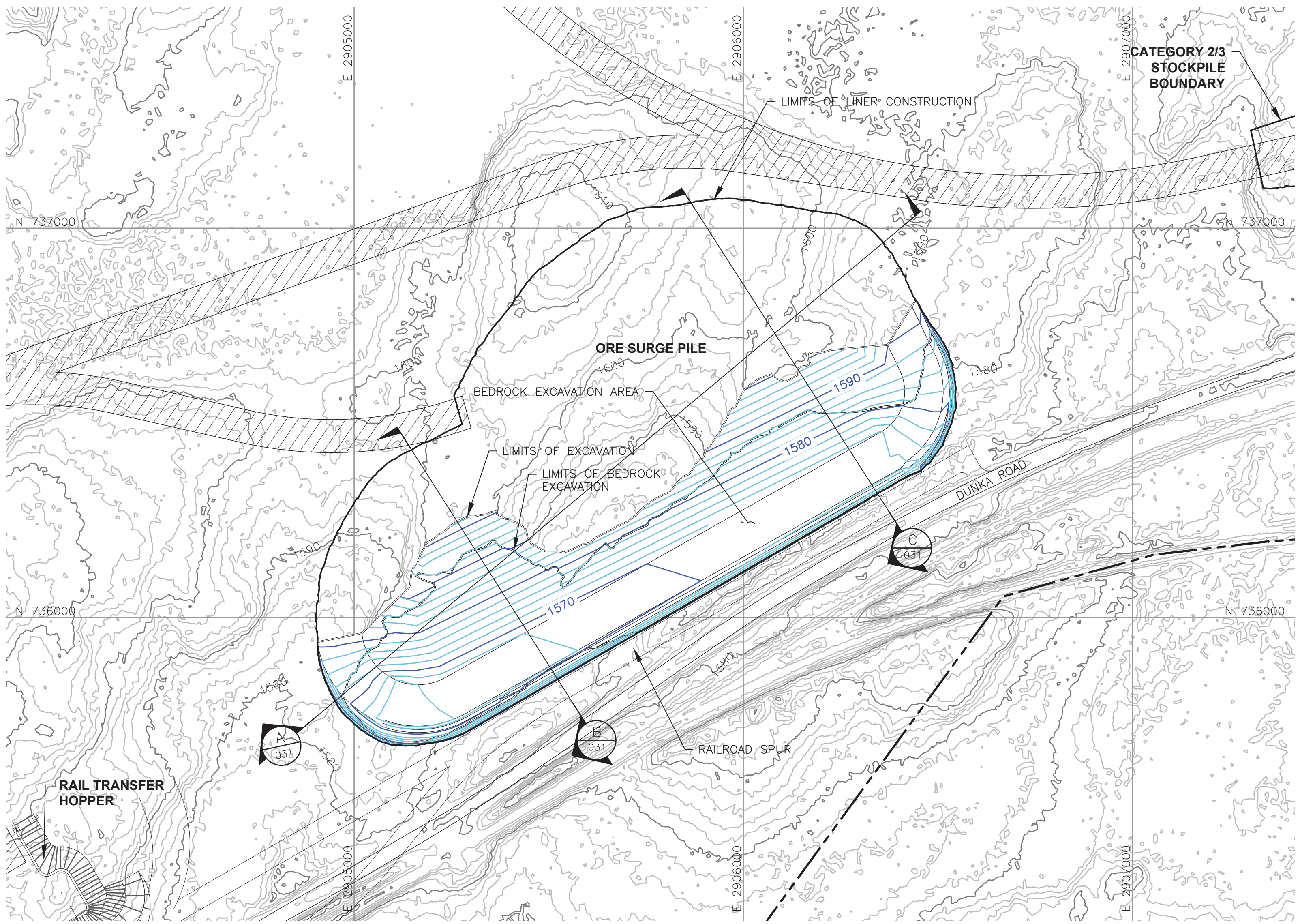
GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980-0540
Fax: (303) 985-2080
www.golder.com

DWG. NO. SKP-025 REV

INCHES 1 2

LEGEND

- EXISTING GROUND TOPOGRAPHY (SEE REFERENCE 1)
- PROPOSED MINE YEAR 1 EXCAVATION TOPOGRAPHY
- MINE SITE BOUNDARY
- MINE YEAR 1 ORE STOCKPILE OUTLINES (SEE NOTE 2)
- HAUL ROADS
- CROSS SECTION IDENTIFIER
- SHEET WHERE SECTION IS LOCATED



0 200 400
SCALE IN FEET

NOTES

1. OPEN PIT AND HAUL ROAD LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

PLANT DRAWING NUMBER:

ORE SURGE PILE
SUBGRADE EXCAVATION PLAN

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS: ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE
PRINTED NAME BRENT R. BRONSON
DATE 8/21/17 LICENSE # 46492

DRAWN: MTM
CHECKED:
GOLDER PROJECT NO.: 113-2209
SCALE: AS SHOWN

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

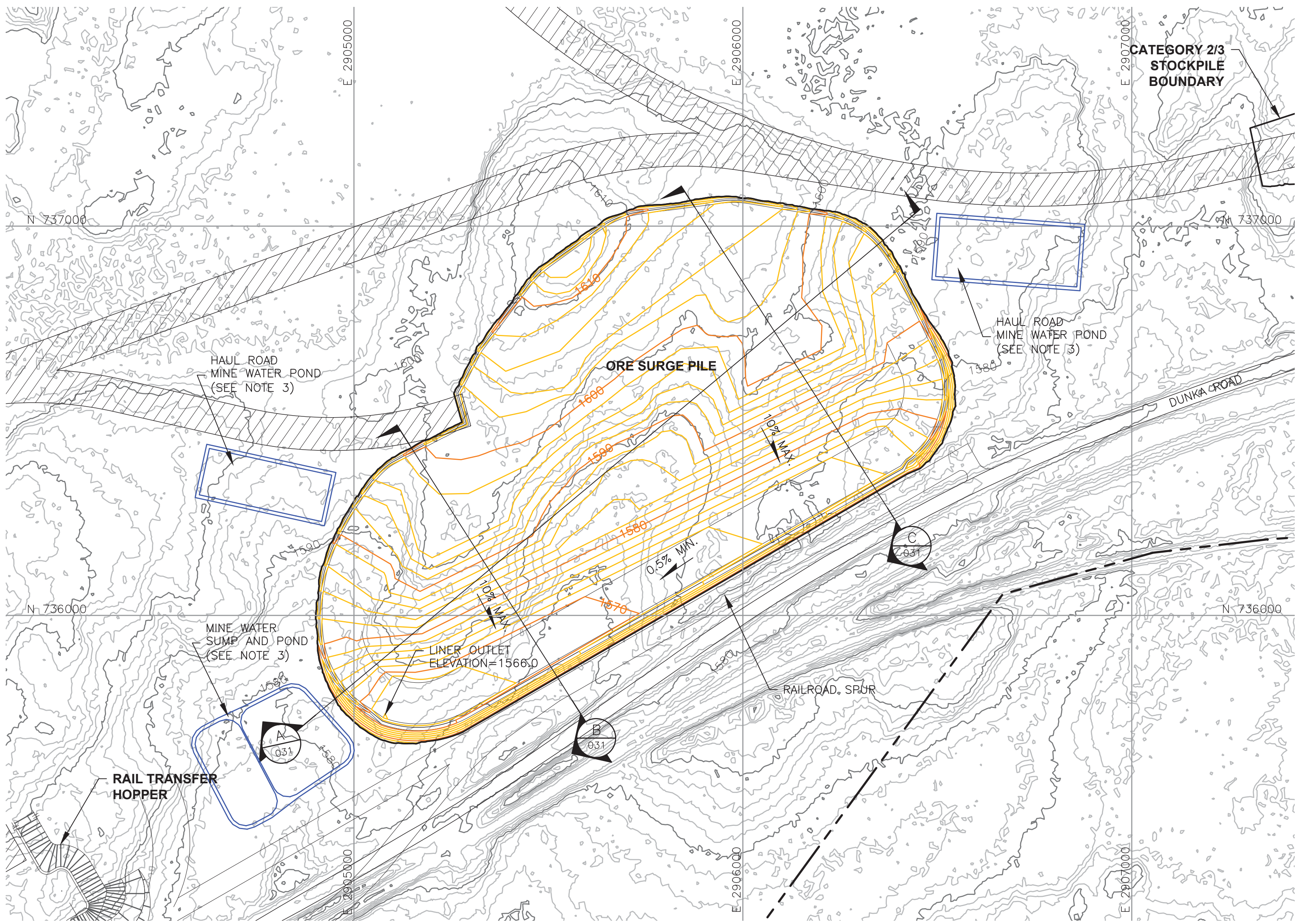
Golder Associates

GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980-0540
Fax: (303) 985-2080
www.golder.com

DWG. NO. SKP-026
REV

LEGEND

- EXISTING GROUND TOPOGRAPHY (SEE REFERENCE 1)
- PROPOSED MINE YEAR 1 GRADING TOPOGRAPHY
- MINE SITE BOUNDARY
- CROSS SECTION IDENTIFIER
- SHEET WHERE SECTION IS LOCATED
- SLOPE
- MINE YEAR 1 ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)
- HAUL ROADS
- MINE WATER SUMP/POND (SEE NOTE 3)



0 200 400
SCALE IN FEET

NOTES

1. OPEN PIT AND HAUL ROAD LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. SEE MECHANICAL INFRASTRUCTURE PERMIT SUPPORT DRAWINGS.
4. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS MINNESOTA STATE PLANE.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE
PRINTED NAME BRENT R. BRONSON
DATE 8/21/17 LICENSE # 46492

DRAWN: MTM
CHECKED:
GOLDER PROJECT NO.: 113-2209
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

ORE SURGE PILE
FOUNDATION GRADING PLAN

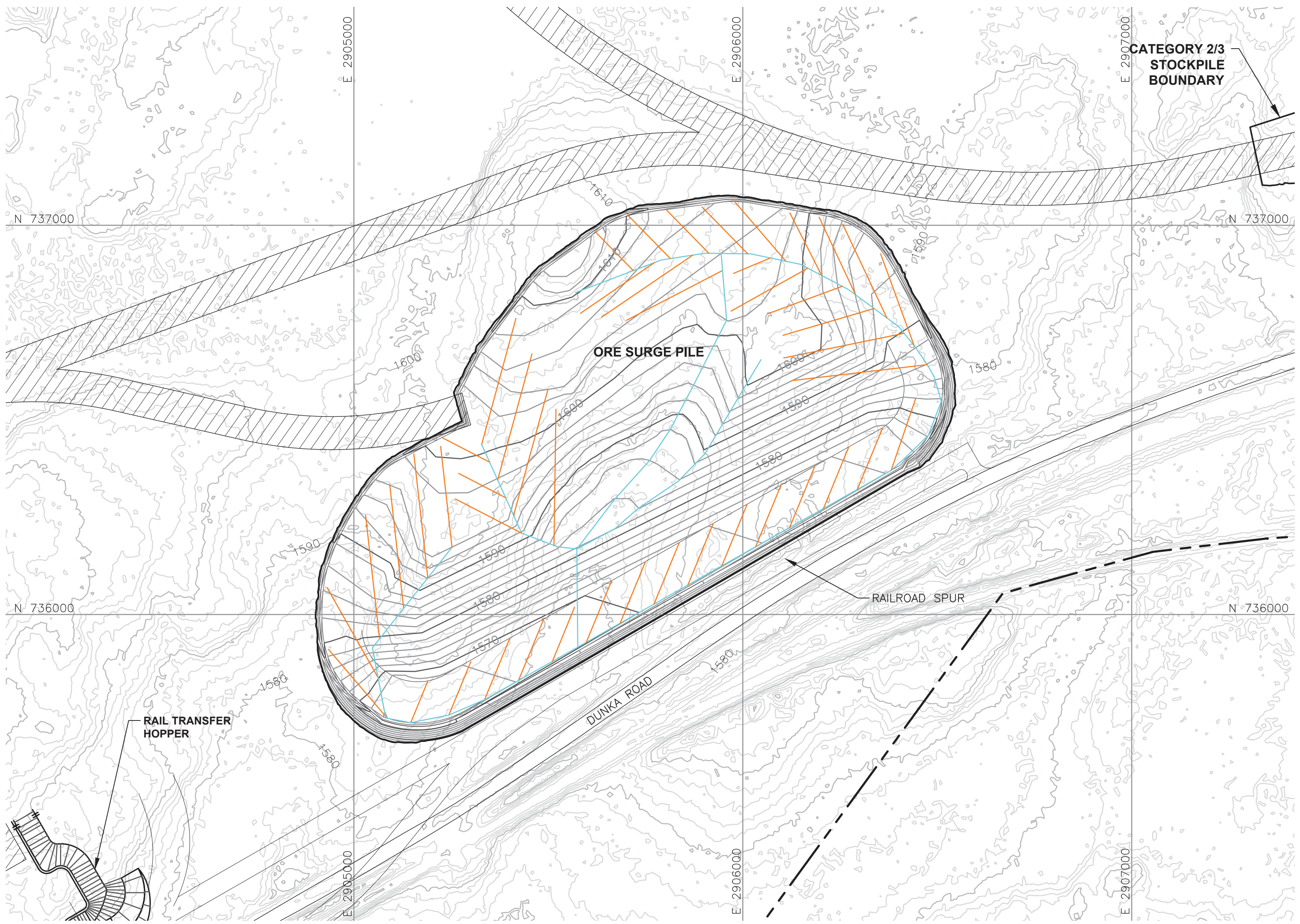
POLYMET MINING

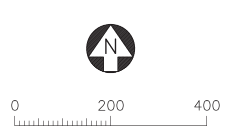
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

Golder Associates
GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980-0540
Fax: (303) 985-2080
www.golder.com

DWG. NO. SKP-027
REV

INCHES 1 2





LEGEND

EXISTING GROUND TOPOGRAPHY

PROPOSED GRADING TOPOGRAPHY

MINE SITE BOUNDARY

MINE YEAR 1 ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)

HAUL ROADS

TERTIARY COLLECTION PIPING (SEE NOTE 3)
4–INCH

SECONDARY COLLECTION PIPING (SEE NOTE 3)
6–INCH

NOTES

1. OPEN PIT AND HAUL ROAD LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. ACTUAL NUMBER AND LOCATION OF UNDERDRAIN PIPES AND SUMPS WILL NEED TO BE DETERMINED DURING CONSTRUCTION BASED ON ENCOUNTERED FIELD CONDITIONS. SEE DETAIL 5 ON DRAWING 035 FOR UNDERDRAIN.
2. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

PLANT DRAWING NUMBER:

ORE SURGE PILE
UNDERDRAIN PIPING PLAN

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE
PRINTED NAME BRENT R. BRONSON
DATE 8/21/17 LICENSE # 46492

DRAWN: MTM
CHECKED:
GOLDER PROJECT NO.: 113–2209
SCALE: AS SHOWN

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

Golder Associates
GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980–0540
Fax: (303) 985–2080
www.golder.com

DWG. NO. SKP–028
REV

INCHES 1 2

LEGEND

EXISTING GROUND TOPOGRAPHY

PROPOSED GRADING TOPOGRAPHY

MINE SITE BOUNDARY

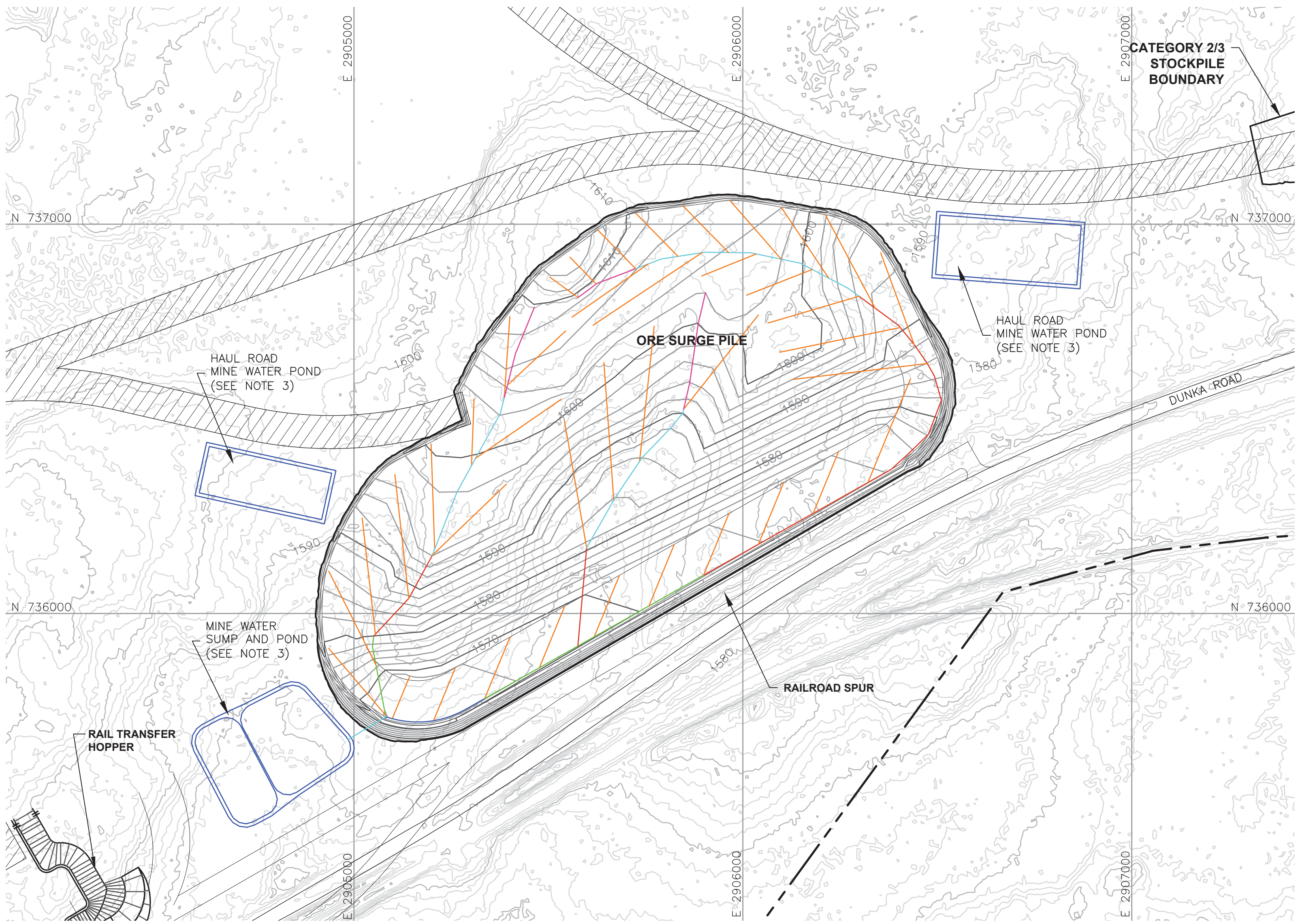
MINE YEAR 1 ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)

HAUL ROADS

MINE WATER SUMP/POND (SEE NOTE 3)

MINE YEAR 1 – TERTIARY COLLECTION PIPING
- 4–INCH

MINE YEAR 1 – PRIMARY AND SECONDARY COLLECTION PIPING
- 4–INCH
- 6–INCH
- 8–INCH
- 10–INCH
- 12–INCH



0 200 400
SCALE IN FEET

NOTES

1. OPEN PIT AND HAUL ROAD LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. SEE MECHANICAL INFRASTRUCTURE PERMIT SUPPORT DRAWINGS.
4. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

PLANT DRAWING NUMBER:

ORE SURGE PILE OVERLINER DRAINAGE PIPING PLAN

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE
PRINTED NAME BRENT R. BRONSON
DATE 8/21/17 LICENSE # 46492

DRAWN: MTM
CHECKED:
GOLDER PROJECT NO.: 113-2209
SCALE: AS SHOWN

POLYMET MINING

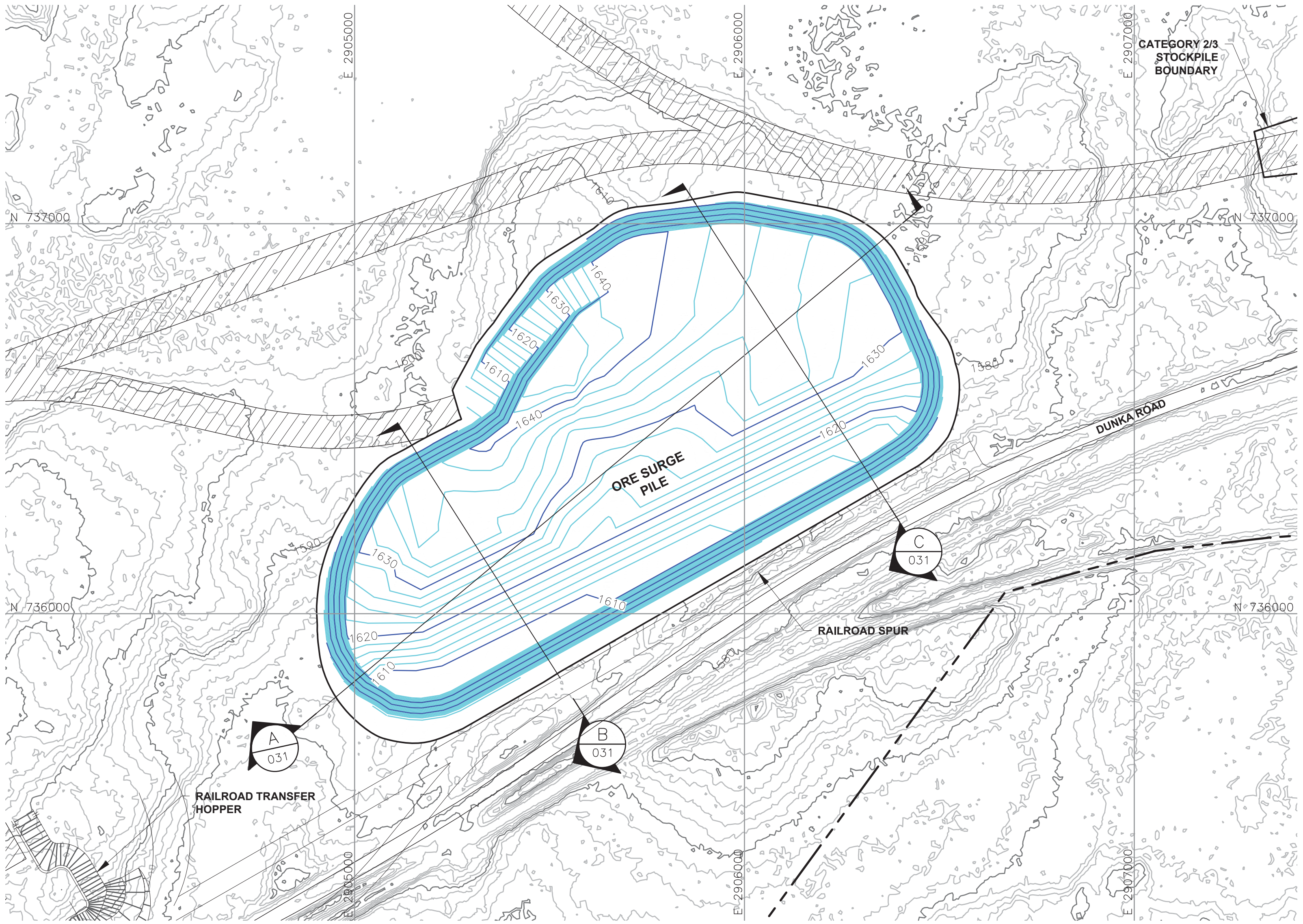
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

Golder Associates
GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980–0540
Fax: (303) 985–2080
www.golder.com

DWG. NO. SKP–029
REV

CADD USER: Jenkins, Crystal FILE: N:\11\113–2209_H SKP FEB2013\1132209H020.DWG PLOT SCALE: 1:1 PLOT DATE: 8/18/2017 11:20 AM

INCHES 1 2



LEGEND

EXISTING GROUND TOPOGRAPHY

PROPOSED STOCKPILE LAYOUTS

HAUL ROADS

MINE SITE BOUNDARY

MINE YEAR 1 PIT BOUNDARY (SEE NOTE 1)

MINE YEAR 1 ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)

MAXIMUM ORE, WASTE ROCK STOCKPILE OUTLINES (SEE NOTE 2)

CROSS SECTION IDENTIFIER

SHEET WHERE SECTION IS LOCATED

NOTES

1. OPEN PIT AND HAUL ROAD LAYOUTS PROVIDED BY BARR ENGINEERING IN OCTOBER 2011.
2. STOCKPILE LAYOUTS PROVIDED BY BARR ENGINEERING IN APRIL 2011 AND MODIFIED BY GOLDER.
3. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.

REFERENCES

1. EXISTING GROUND TOPOGRAPHY PROVIDED BY BARR ENGINEERING, AUGUST 2011.
2. COORDINATE SYSTEM REFERENCE IS NAD83 MINNESOTA STATE PLANE NORTH.
3. VERTICAL DATUM REFERENCE IS FEET ABOVE MEAN SEA LEVEL (AMSL).

N

0 200 400
SCALE IN FEET

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE

PRINTED NAME BRENT R. BRONSON

DATE 8/21/17 LICENSE # 46492

DRAWN: MTM

CHECKED:

GOLDER PROJECT NO.: 113-2209

SCALE: AS SHOWN

PLANT DRAWING NUMBER:

ORE SURGE PILE
TYPICAL CONFIGURATION

POLYMET MINING

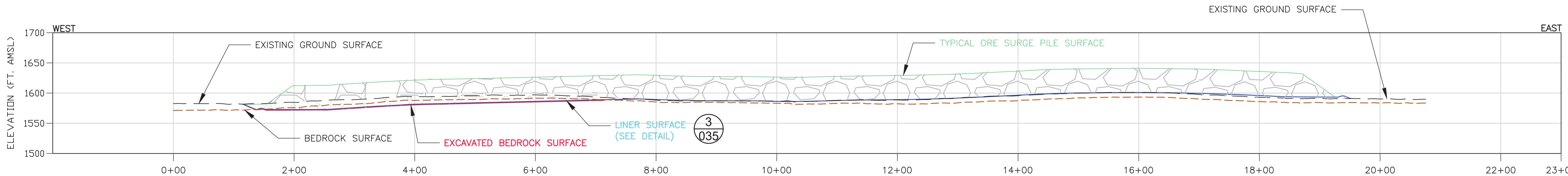
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

Golder Associates

GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980-0540
Fax: (303) 985-2080
www.golder.com

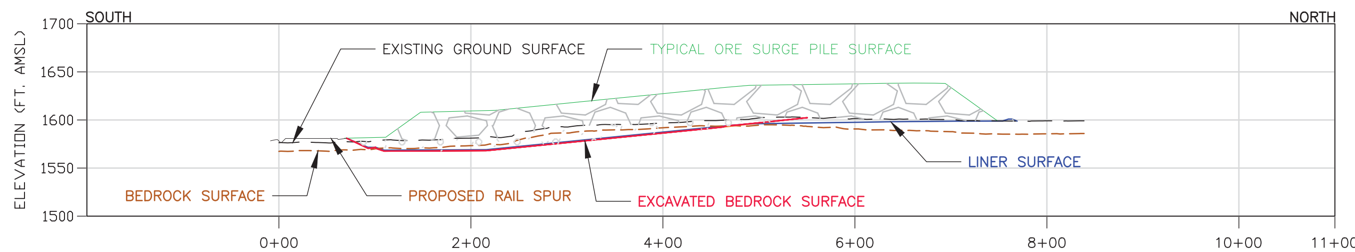
DWG. NO. SKP-030 REV

INCHES 1 2



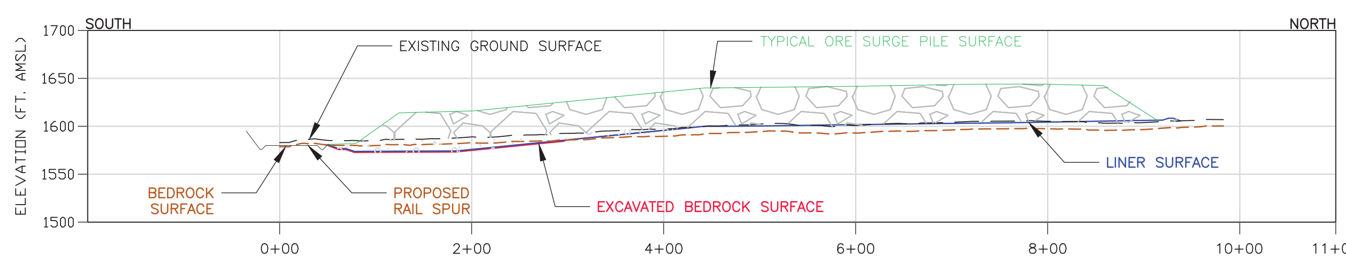
A 031 SECTION

0 100 200
HORIZONTAL SCALE IN FEET
2X VERTICAL EXAGGERATION



B 031 SECTION

0 100 200
HORIZONTAL SCALE IN FEET
2X VERTICAL EXAGGERATION



C 031 SECTION

0 100 200
HORIZONTAL SCALE IN FEET
2X VERTICAL EXAGGERATION

LEGEND

ORE LIMITS AT TYPICAL CAPACITY

LINER SURFACE

EXISTING GROUND SURFACE

OVERBURDEN SOIL AND BEDROCK EXCAVATION SURFACE

BEDROCK SURFACE

NOTES

1. STOCKPILE SIDE SLOPES AT ANGLE OF REPOSE.
2. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.
3. SEE CROSS SECTION LOCATIONS ON DRAWINGS 3, 4, 5, 26, AND 27

PLANT DRAWING NUMBER:

ORE SURGE PILE
DESIGN SECTIONS

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS

ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE

PRINTED NAME BRENT R. BRONSON

DATE 8/21/17 LICENSE # 46492

DRAWN: MTM

CHECKED:

GOLDER PROJECT NO.: 113-2209

SCALE: AS SHOWN

POLYMET MINING

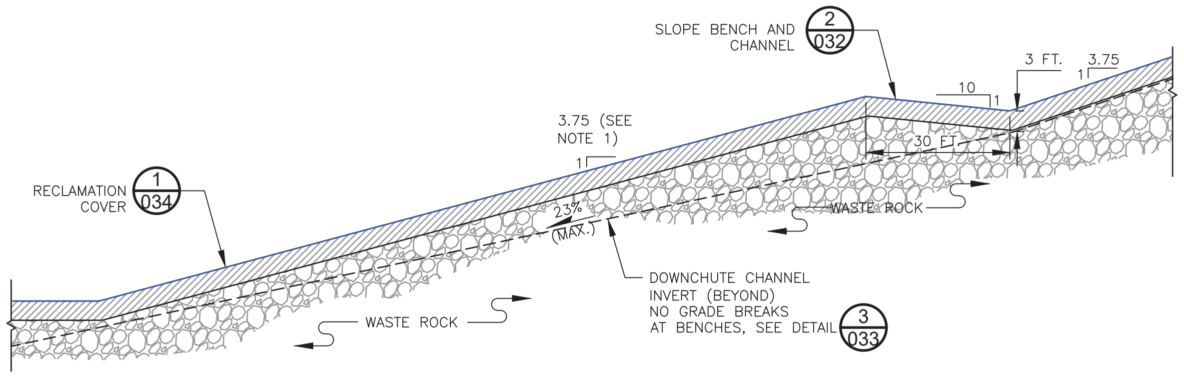
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

Golder Associates
GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980-0540
Fax: (303) 985-2080
www.golder.com

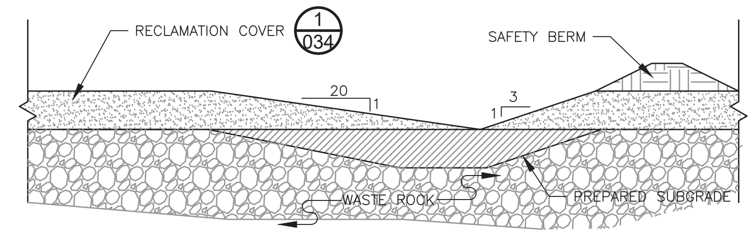
DWG. NO. SKP-031

REV

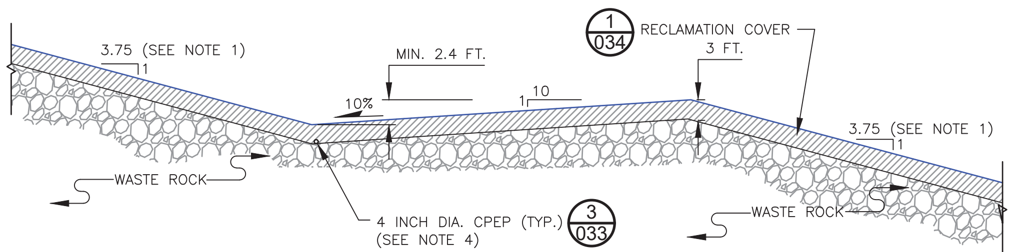
INCHES 1 2



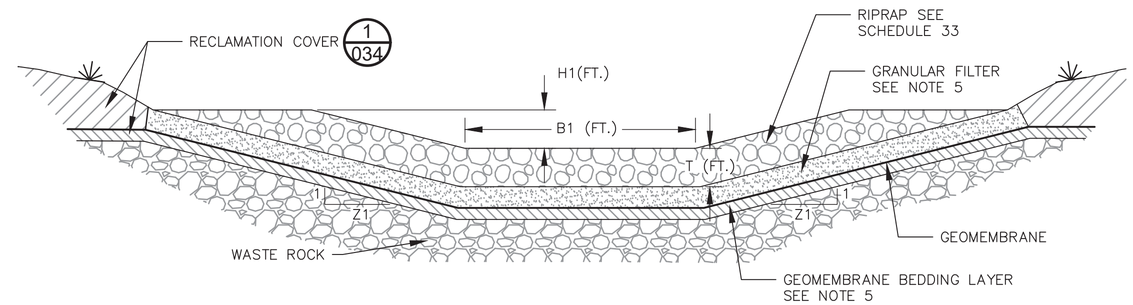
1 032 TYPICAL SLOPE AND DOWNCHUTE GRADING DETAIL
N.T.S.



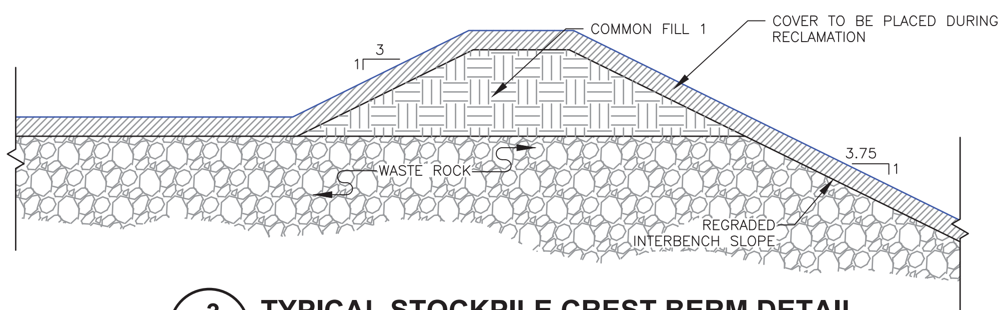
5 032 TYPICAL TOP SURFACE CHANNEL SECTION
N.T.S.



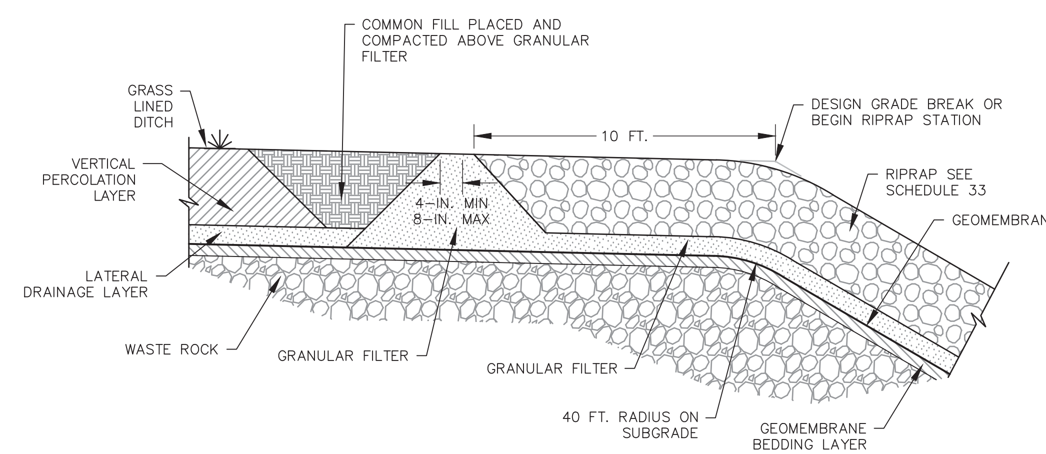
2 032 TYPICAL SLOPE BENCH AND CHANNEL RECLAMATION DETAIL
N.T.S.



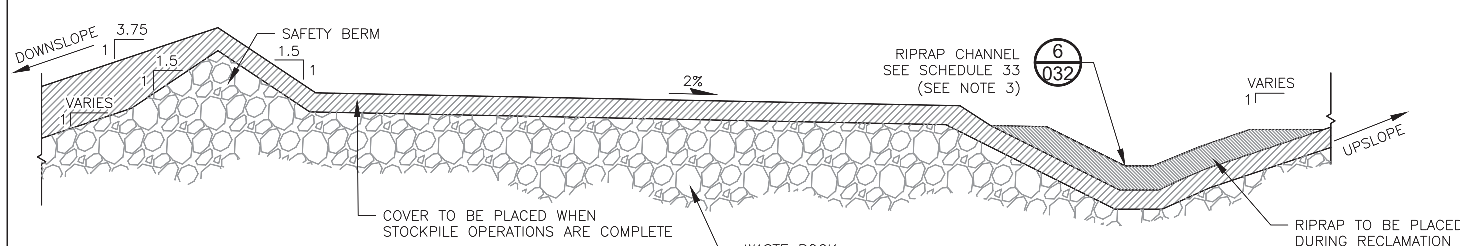
6 032 TYPICAL RIPRAP-LINED CHANNEL AND DOWNCHUTE
N.T.S. (SEE SCHEDULE 33 FOR DIMENSIONS - SKP-033)



3 032 TYPICAL STOCKPILE CREST BERM DETAIL
N.T.S.



7 032 UPSTREAM END OF RIPRAP CHANNEL
N.T.S.



4 032 STOCKPILE RAMP TYPICAL DETAIL
N.T.S.

NOTES

1. THE MAXIMUM SLOPE GRADES ARE 3.75H:1V FOR RECLAIMED STOCKPILE AREAS.
2. ASSUME 1.4H:1V INTERBENCH SLOPES FOR ACTIVE AREAS (EQUAL TO NOMINAL ANGLE OF REPOSE FOR WASTE ROCK MATERIAL). REGRADE PRIOR TO PLACEMENT OF RECLAMATION COVER.
3. SEE SCHEDULE 33 ON DRAWING SKP-033.
4. AT BASE OF COVER SYSTEM GRANULAR DRAINAGE LAYER PLACE DRAIN PIPE AT SLOPE-BENCH INTERSECTION. PIPE TO BE CONTINUOUS ALONG BENCHES BETWEEN DOWNCHUTE CHANNELS.
5. RIPRAP-LINED CHANNEL AND DOWNCHUTE DETAILS REPRESENT PRELIMINARY DESIGNS. DETAILED DIMENSIONS AND TECHNICAL SPECIFICATIONS TO BE PROVIDED PRIOR TO CONSTRUCTION, I.E. AS A PART OF FINAL DESIGN.
6. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.

PLANT DRAWING NUMBER:

CATEGORY 1 STOCKPILE RECLAMATION AND OPERATIONS SURFACE WATER MANAGEMENT DETAILS – SHEET 1 OF 2

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE

PRINTED NAME BRENT R. BRONSON

DATE 8/21/17 LICENSE # 46492

DRAWN: MTM

CHECKED:

GOLDER PROJECT NO.: 113-2209

SCALE: AS SHOWN

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

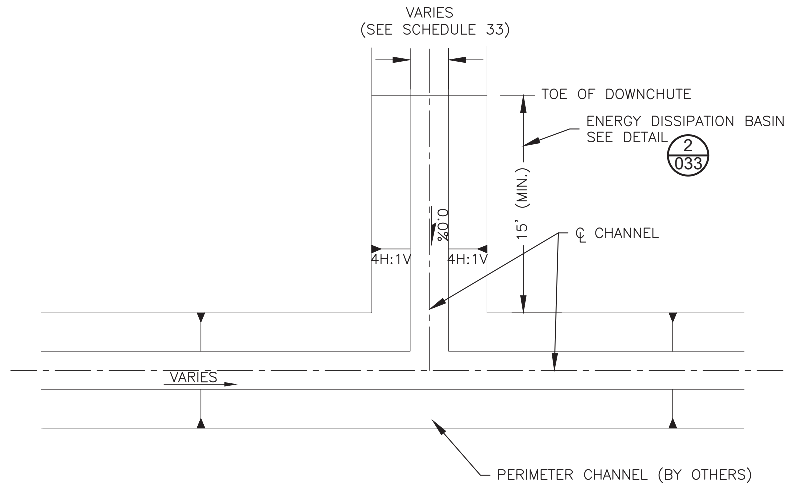
Golder Associates

GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980-0540
Fax: (303) 985-2080
www.golder.com

DWG. NO. SKP-032

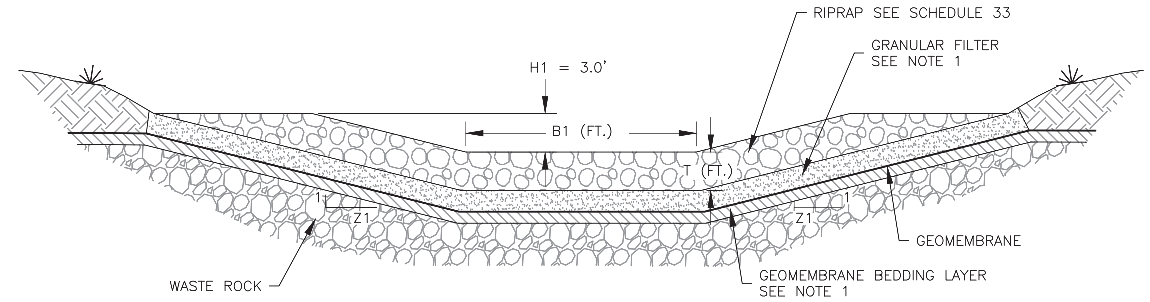
REV

INCHES 1 2



1/033 DOWNCHUTE CHANNEL CONFLUENCE DETAIL

N.T.S.

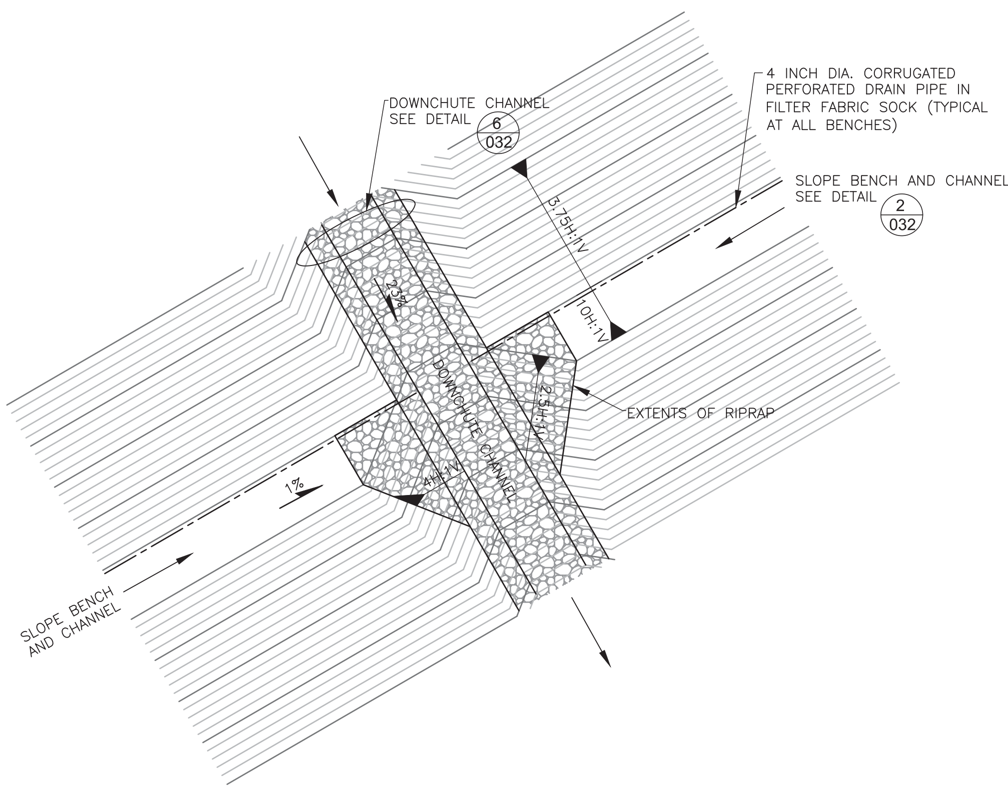


2/033 TYPICAL ENERGY DISSIPATION BASIN (SEE SCHEDULE 33 FOR DIMENSIONS)

N.T.S.

SCHEDULE 33: RIPRAP-LINED CHANNEL DIMENSIONS

CHANNEL ID	BOTTOM WIDTH, B1 (FT)	SIDE SLOPE, Z1 (H:1V)	MIN. DEPTH, H1 (FT)	RIPRAP SIZE, D_{50} (IN)	RIPRAP LAYER THICKNESS, T (FT)	MAX SLOPE, (FT/FT)
DC1-A	20	4	3	12	2	0.23
DC1-B	20	4	3	12	2	0.23
DC1-C	25	4	3	12	2	0.23
DC1-D	20	4	3	12	2	0.23
DC1-E	25	4	3	12	2	0.23
DC1-F	20	4	3	9	1.5	0.23
DC1-G	20	4	3	12	2	0.23
DC1-HRE	8	4	3	9	1.5	0.06
DC1-H	20	4	3	9	1.5	0.23
DC1-HRS	8	4	3	9	1.5	0.06
DC1-HRU	8	4	3	9	1.5	0.07
DC1-I	20	4	3	12	2	0.23
DC1-J	20	4	3	18	3	0.23
DC1-K	25	4	3	12	2	0.23
DC1-L	25	4	3	12	2	0.23



3/033 SLOPE BENCH AND CHANNEL TO DOWNCHUTE TRANSITION

N.T.S.

NOTES

1. ENERGY DISSIPATION BASIN DETAIL REPRESENTS PRELIMINARY DESIGN. DETAILED DIMENSIONS AND TECHNICAL SPECIFICATIONS TO BE PROVIDED PRIOR TO CONSTRUCTION, I.E. AS A PART OF FINAL DESIGN.
2. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE

PRINTED NAME BRENT R. BRONSON

DATE 8/21/17 LICENSE # 46492

DRAWN: MTM

CHECKED:

GOLDER PROJECT NO.: 113-2209

SCALE: AS SHOWN

PLANT DRAWING NUMBER:

CATEGORY 1 STOCKPILE RECLAMATION AND OPERATIONS SURFACE WATER MANAGEMENT DETAILS – SHEET 2 OF 2

POLYMET MINING

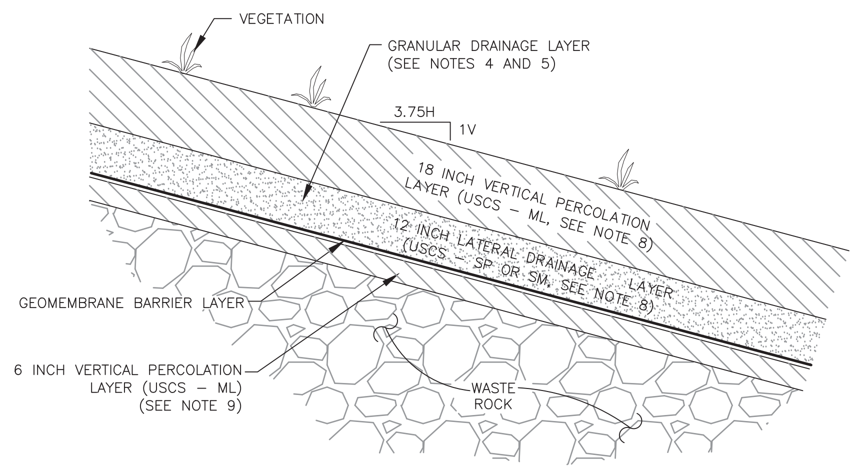
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

Golder Associates
GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980-0540
Fax: (303) 985-2080
www.golder.com

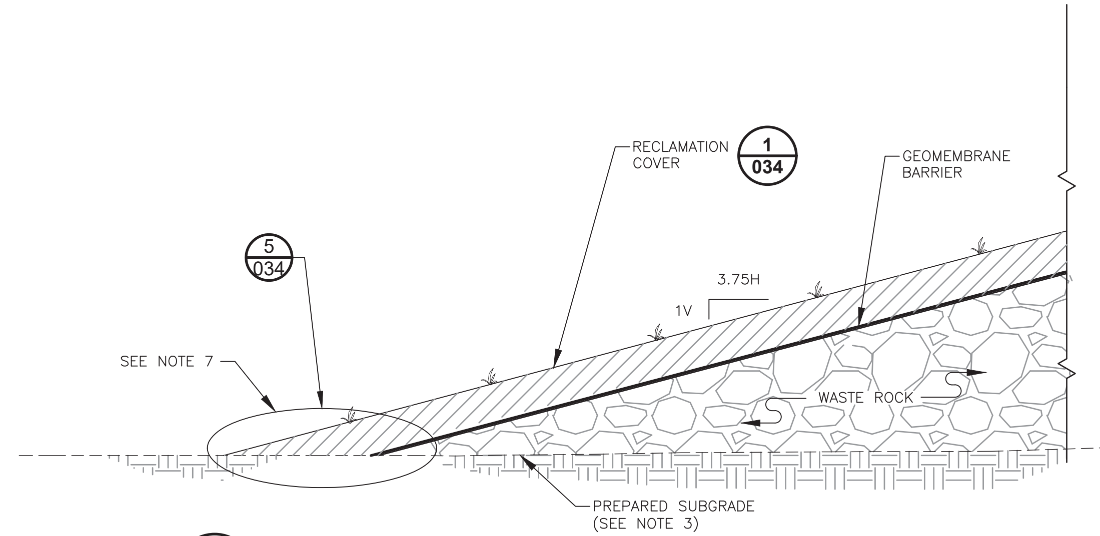
DWG. NO. SKP-033

REV

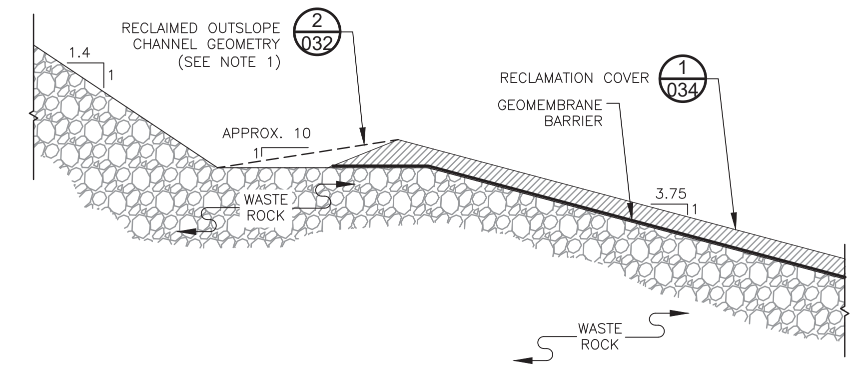
INCHES 1 2



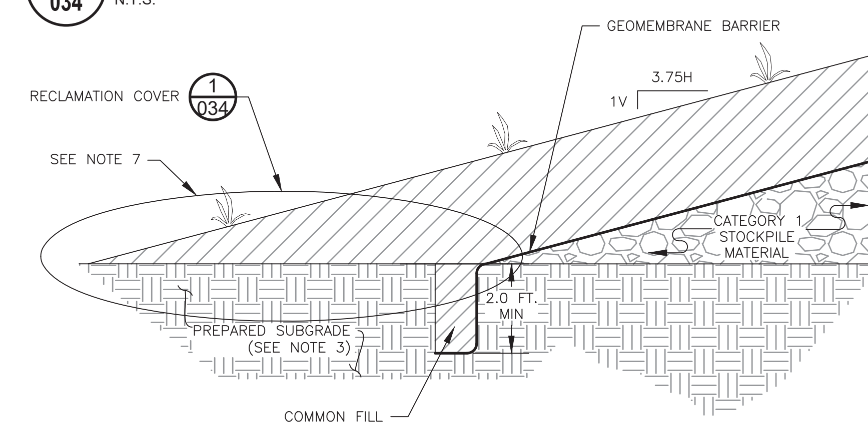
1 / 034 TYPICAL CATEGORY 1 RECLAMATION COVER DETAIL
N.T.S.



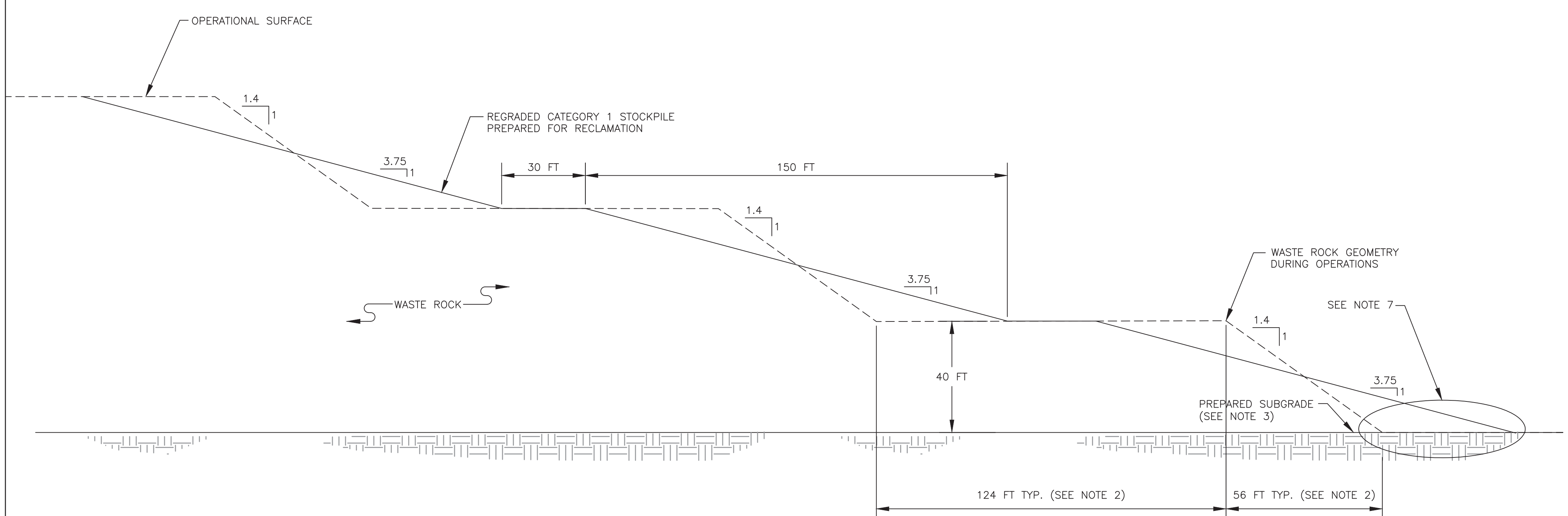
2 / 034 CATEGORY 1 RECLAMATION COVER DESIGN SECTION
N.T.S.



3 / 034 RECLAMATION TO OPERATIONAL AREA TIE IN DETAIL
N.T.S.



5 / 034 GEOMEMBRANE COVER ANCHOR TRENCH DETAIL
N.T.S.



4 / 034 CATEGORY 1 STOCKPILE TYPICAL GEOMETRY DURING OPERATIONS AND REGRADED FOR RECLAMATION
N.T.S.

NOTES

1. TEMPORARY SLOPE BENCH CHANNEL SHOULD BE CONSTRUCTED WITH MINIMUM DEPTH OF 2.4 FT. ON THE BENCHES BY GRADING CHANNEL SIDE SLOPES TO 10H:1V ON 30 FT. WIDE BENCHES.
2. STOCKPILE GEOMETRY DURING OPERATIONS BASED ON ASSUMED WASTE ROCK ANGLE OF REPOSE OF 35.5 DEGREES (1.4H:1V).
3. GEOTECHNICALLY UNSUITABLE SOILS TO BE REMOVED AND REPLACED WITH COMPACTED STRUCTURAL FILL WITHIN 100 FT. OF CATEGORY 1 STOCKPILE PERIMETER LIMITS.
4. ON TOP OF STOCKPILE ON 1% SLOPE AREAS, PLACE 4 INCH DIAMETER PERFORATED CORRUGATED POLYETHYLENE PIPE (CPEP) WITH FILTER FABRIC SOCK AT 75 FOOT SPACING TO FACILITATE DRAINAGE OF GRANULAR DRAINAGE LAYER TO TOP SURFACE CHANNEL. PIPE LOCATION TO BE FIELD FIT.
5. AT STOCKPILE BENCHES, PLACE 4 INCH PERFORATED CPEP DRAIN PIPE WITH FILTER FABRIC SOCK AT BASE OF COVER SYSTEM GRANULAR DRAINAGE LAYER AT SLOPE–BENCH INTERSECTION WITH OUTFLOW DIRECTED TO DOWNCHUTE CHANNELS.
6. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.
7. EDGE OF LINER TO TIE IN TO CATEGORY 1 STOCKPILE GROUNDWATER CONTAINMENT SYSTEM.
8. REFER TO UNIFIED SOIL CLASSIFICATION SYSTEM FOR COVER SOIL DESCRIPTION.
9. PLACE ADDITIONAL SOIL FILL AS NEEDED TO FILL VOIDS ON WASTE ROCK SURFACE/FINAL SLOPE PRIOR TO PLACEMENT OF 6–INCH VERTICAL PERCOLATION LAYER. THIS SOIL FILL IS NOT SHOWN ON THE TYPICAL COVER DETAIL.

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE
PRINTED NAME BRENT R. BRONSON
DATE 8/21/17 LICENSE # 46492

DRAWN: MTM
CHECKED:
GOLDER PROJECT NO.: 113-2209
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

CATEGORY 1 STOCKPILE
PHASED COVER DESIGN

POLYMET MINING

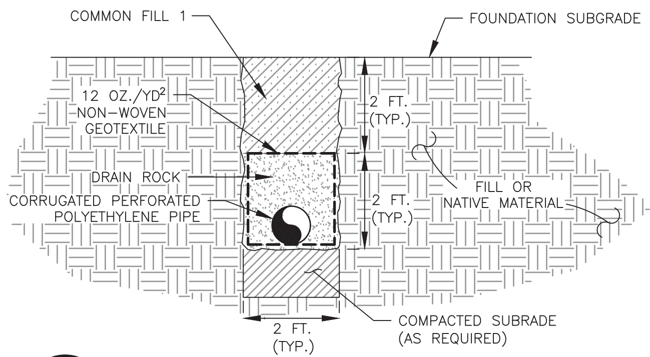
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

Golder Associates

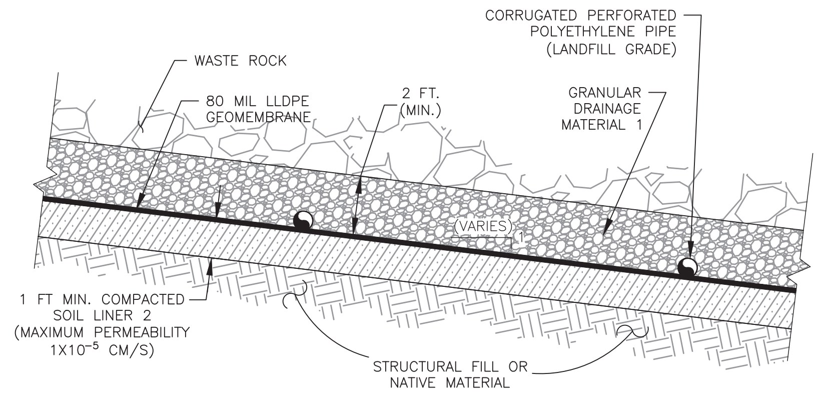
GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980–0540
Fax: (303) 985–2080
www.golder.com

DWG. NO. SKP–034
REV

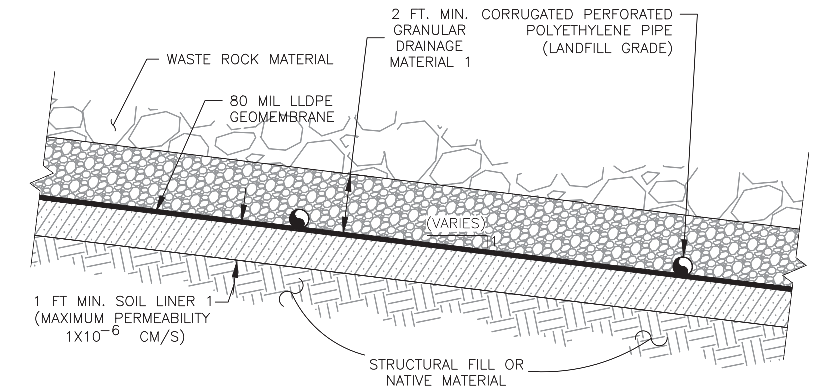
INCHES 1 2



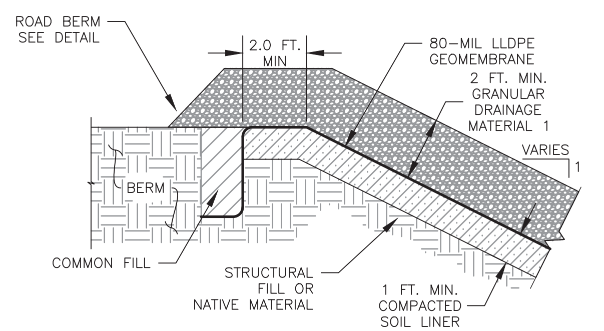
1 / 035 **TYPICAL FOUNDATION UNDERDRAIN**
N.T.S.



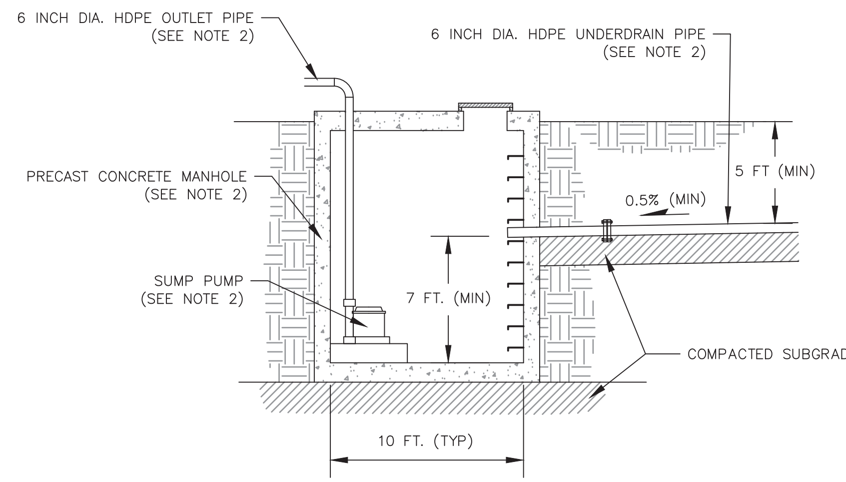
2 / 035 **CATEGORY 2/3 STOCKPILE LINER**
N.T.S.



3 / 035 **CATEGORY 4 STOCKPILE AND ORE SURGE PILE LINER**
N.T.S.



4 / 035 **GEOMEMBRANE LINER ANCHOR TRENCH DETAIL**
N.T.S.



5 / 035 **UNDERDRAIN SUMP MANHOLE**
N.T.S.

NOTES

1. SEE GENERAL NOTES AND LEGEND ON DRAWING 002.
2. UNDERDRAIN SUMP MANHOLE DIMENSIONS, SUMP PUMP CAPACITY AND PIPE DIMENSIONS ARE PRELIMINARY AND WILL BE SIZED BASED ON ENCOUNTERED FIELD CONDITIONS. UNDERDRAIN SUMPS WILL BE PUMPED TO MINE WATER SUMPS (SEE MECHANICAL INFRASTRUCTURE PERMIT SUPPORT DRAWINGS).

VER NO	DATE	DESCRIPTION
A	12/02/11	ISSUED FOR REVIEW FOR INCLUSION IN ROCK AND OVERBURDEN MANAGEMENT PLAN (ROMP)
B	2/15/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
C	5/29/13	ISSUED FOR REVIEW FOR INCLUSION IN ROMP
D	1/14/14	ISSUED FOR AGENCY REVIEW
E	4/10/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
F	5/22/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
G	8/21/17	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	G	8/21/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE

PRINTED NAME BRENT R. BRONSON

DATE 8/21/17 LICENSE # 46492

DRAWN: MTM

CHECKED:

GOLDER PROJECT NO.: 113-2209

SCALE: AS SHOWN

PLANT DRAWING NUMBER:

CONSTRUCTION DETAILS

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

Golder Associates

GOLDER ASSOCIATES INC.
44 UNION BOULEVARD, SUITE 300
LAKEWOOD, CO USA 80233
Ph: (303) 980-0540
Fax: (303) 985-2080
www.golder.com

DWG. NO. SKP-035

REV

INCHES 1 2

Mine Site Stormwater
Permit Application Support Drawings

Errata Sheet

Poly Met Mining, Inc. NorthMet Project

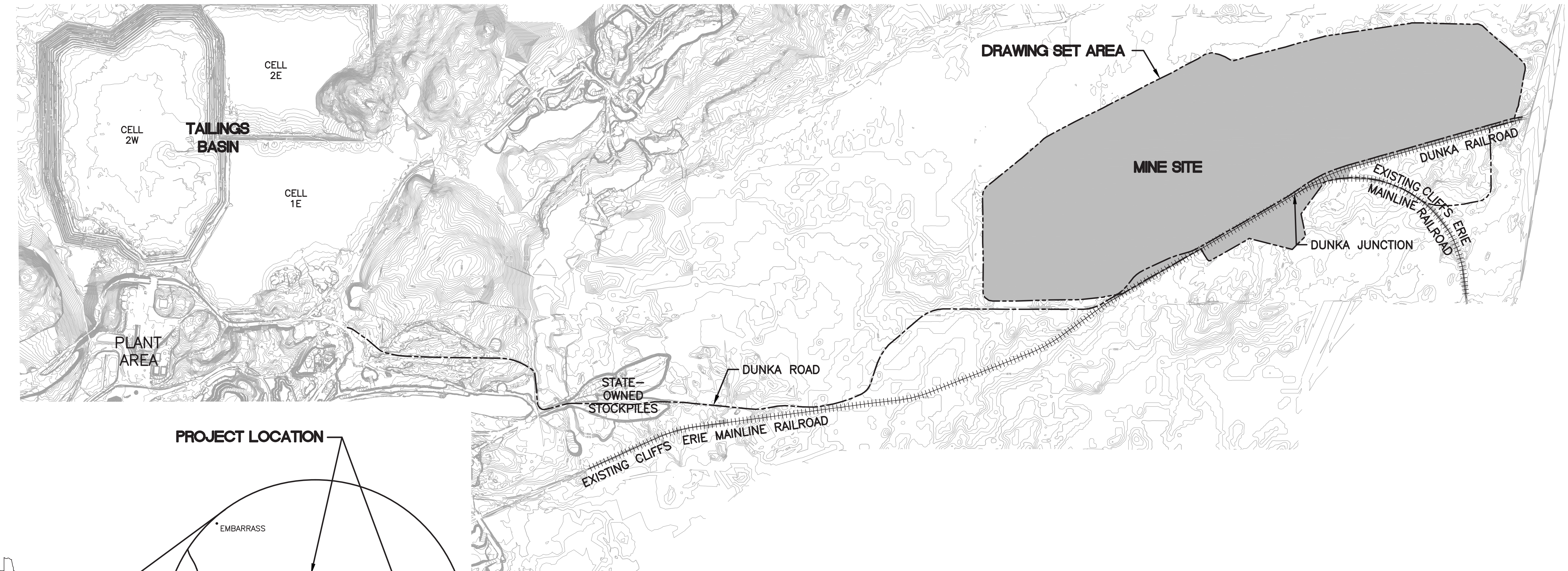
Permit Application Support Drawings: Mine Site Stormwater

August 2017 (version 3)

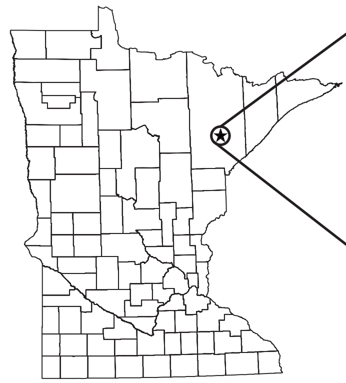
Engineering design is currently in progress. The table below lists changes that have been identified to-date and have not yet been incorporated in the attached permit application support drawings within this set. Final design will incorporate these changes along with additional site-specific information (e.g., supplementary geotechnical data); therefore, additional adjustments may be made during final design that will be incorporated into the final design drawing set.

Drawing Sheet(s)	Change
Global change to all sheets, as needed	The terminology "mine drainage" as noted in these drawings will be changed to "mine water".
SW-003, SW-004, SW-005, SW-006, SW-031	Temporary sedimentation basins or stormwater infiltration basins may be added to meet construction stormwater requirements. These construction stormwater features require additional site-specific data and will be evaluated in final design.
SW-002, SW-003, SW-004, SW-005, SW-006, SW-008, SW-009, SW-010, SW-013, SW-014, SW-015, SW-016, SW-017, SW-018, SW-019, SW-021, SW-031	The "Mine Site Boundary" will be replaced by the "Mining Area Boundary" as shown on figures included in the Permit to Mine Application.

POLY MET MINING, INC. NORTHMET PROJECT
PERMIT APPLICATION SUPPORT DRAWINGS
MINE SITE STORMWATER
HOYT LAKES, MINNESOTA

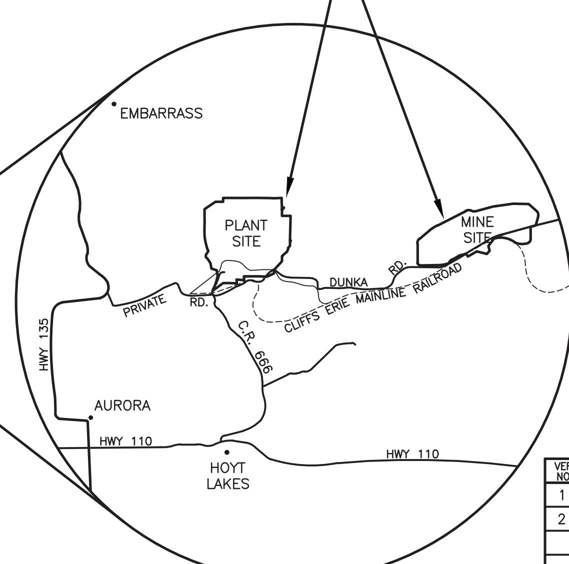


SITE MAP



LOCATION MAP

NOT TO SCALE



VICINITY MAP

NOT TO SCALE

VER NO	DATE	DESCRIPTION
1	5/26/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
2	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/7/2017
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB/ATS
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE STORMWATER
LOCATION MAP AND SITE MAP

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. SW-001
REV B

INCHES 1 2

GENERAL LEGEND

EXISTING

1000	EXISTING CONTOUR – MAJOR
⊗	EXISTING POWER POLE
	EXISTING RAILROAD
	WATER EDGE/CREEK CENTER LINE
	EXISTING ROAD
R/W	RIGHT OF WAY
	PROPERTY LINE
	MINE SITE BOUNDARY
	EXISTING STRUCTURES
	WETLAND BOUNDARY
OE	EXISTING OVERHEAD ELECTRIC
UE	EXISTING UNDERGROUND ELECTRIC
	EXISTING CULVERT
	PROPOSED MINE WATER CULVERT

PROPOSED

1000	PROPOSED CONTOUR – MAJOR
	PROPOSED CONTOUR – MINOR
	PROPOSED ACCESS ROADS
<<	PROPOSED STORMWATER DRAIN
	SURFACE DRAINAGE

SHEET INDEX

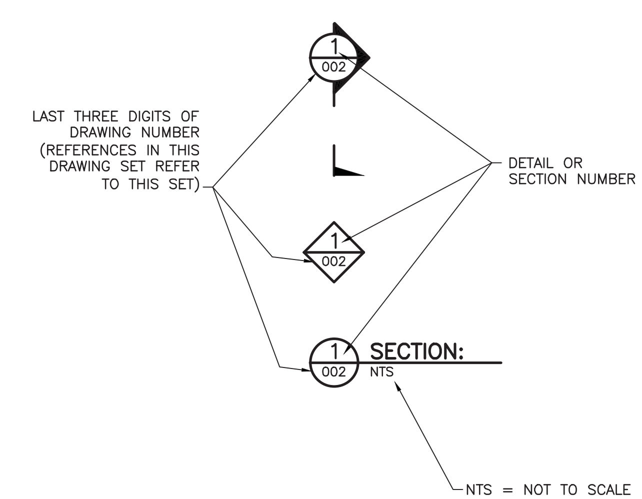
NOTES

1. COORDINATE SYSTEM IS MINNESOTA STATE PLANE NORTH ZONE, NAD83.
2. ELEVATIONS ARE BASED ON MEAN SEA LEVEL (MSL), NAVD88.
3. EXISTING TOPOGRAPHIC INFORMATION SHOWN ON THE DRAWINGS WAS PREPARED BY AEROMETRIC, INC. FROM LIDAR DATA COLLECTED ON MARCH 17, 2010.
4. CULVERT DIMENSIONS ARE PRELIMINARY. FINAL DIMENSIONS SHALL BE DETERMINED DURING FINAL DESIGN.
5. THE BEDROCK PROFILES SHOWN ON THESE DRAWINGS REPRESENT THE BEST AVAILABLE INFORMATION FOR PLANNING PURPOSES. THE BEDROCK SURFACE FROM WHICH THE PROFILES ARE EXTRACTED IS A THREE–DIMENSIONAL, MODELED SURFACE THAT RESULTED FROM DEDUCTING THE DEPTH TO BEDROCK IDENTIFIED ON LOGS OF BORINGS CONDUCTED AT THE MINE SITE FROM THE LIDAR TOPOGRAPHIC GROUND SURFACE MODEL. THE RESULTING DATA WAS THEN MODELED IN GIS SOFTWARE TO DEVELOP A THREE–DIMENSIONAL BEDROCK SURFACE. THE PROFILES SHOW SIGNIFICANT DETAIL IN LOCAL ELEVATIONS, WHICH MAY OR MAY NOT ACTUALLY EXIST. THE BEDROCK SURFACE PROFILES SHOULD BE TAKEN AS REPRESENTATIVE, BUT NOT NECESSARILY PRECISE.

ABBREVIATIONS

CATEGORY 1 STOCKPILE	–	CATEGORY 1 WASTE ROCK STOCKPILE
CATEGORY 2/3 STOCKPILE	–	CATEGORY 2/3 WASTE ROCK STOCKPILE
CL	–	CENTERLINE
CPS	–	CENTRAL PUMPING STATION
D50	–	THE MEDIAN PARTICLE DIAMETER OF A PARTICLESIZE DISTRIBUTION; THE SIZE AT WHICH 50% OF THE PARTICLES IN THE MATERIAL PARTICLE SIZE DISTRIBUTION CURVE ARE SMALLER
EL	–	ELEVATION
INV	–	INVERT
I, I, III, IV, V	–	ROMAN NUMERALS FOR RIPRAP CLASSIFICATION
kV	–	KILOVOLT
LF	–	LINEAR FEET
MP	–	MINNESOTA POWER
MPP	–	MINE TO PLANT PIPELINES
NWL	–	NORMAL WATER LEVEL
RCP	–	REINFORCED CONCRETE PIPE
O.C.	–	ON CENTER
OSLA	–	OVERBURDEN STORAGE AND LAYDOWN AREA
PVI	–	POINT OF VERTICAL
SWPPP	–	STORMWATER POLLUTION PREVENTION PLAN
WWTS	–	WASTE WATER TREATMENT SYSTEM
(E)	–	EAST
(W)	–	WEST

DRAWING NUMBERING



VER NO	DATE	DESCRIPTION
1	5/26/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
2	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS			
	ISSUED	VERSION	DATE
FOR PERMITTING		2	6/7/2017
FOR CONSTRUCTION			
NOT APPROVED FOR CONSTRUCTION.			

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB/ATS
CHECKED: ATS
BARR PROJECT NO.: 23/69–0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE STORMWATER
LEGEND AND SHEET INDEX

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

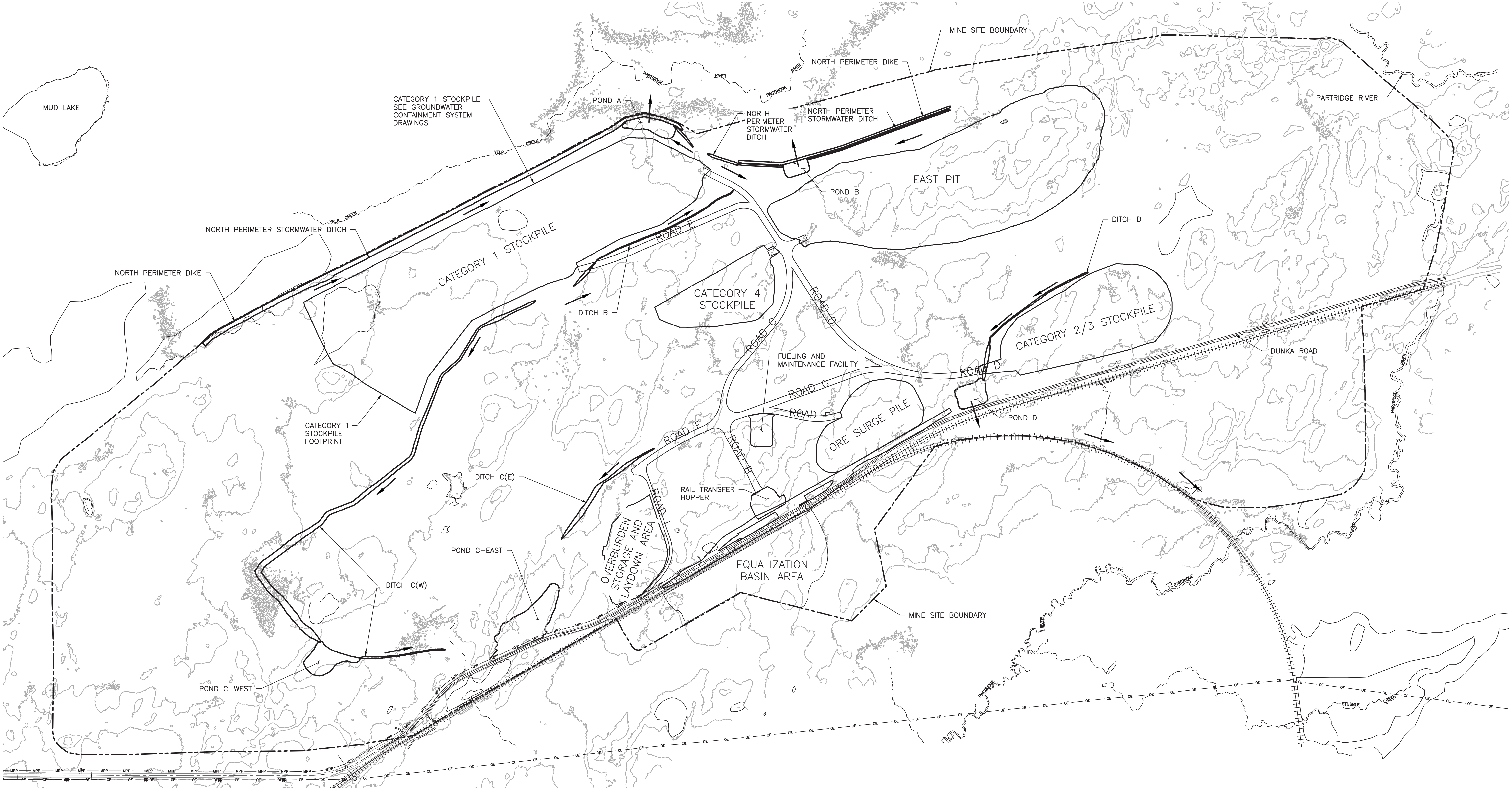
BARR

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1–800–632–2277

DWG. NO. SW–002
REV B

CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM–05–SW–002.DWG PLOT SCALE: 1:2 PLOT DATE: 6/1/2017 9:21 AM

INCHES 1 2



1 PLAN: STORMWATER SITE DRAINAGE MINE YEAR 1

0 700 1400
SCALE IN FEET

CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-05-SW-003.DWG PLOT SCALE: 1:2 PLOT DATE: 6/1/2017 9:22 AM

PLANT DRAWING NUMBER:

MINE SITE STORMWATER
SITE DRAINAGE PLAN
MINE YEAR 1

VER NO	DATE	DESCRIPTION
1	5/26/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
2	6/7/2017	PERMIT APPLICATION UPDATES

ISSUED	VERSION	DATE
FOR PERMITTING	2	6/7/2017
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB/ATS
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR

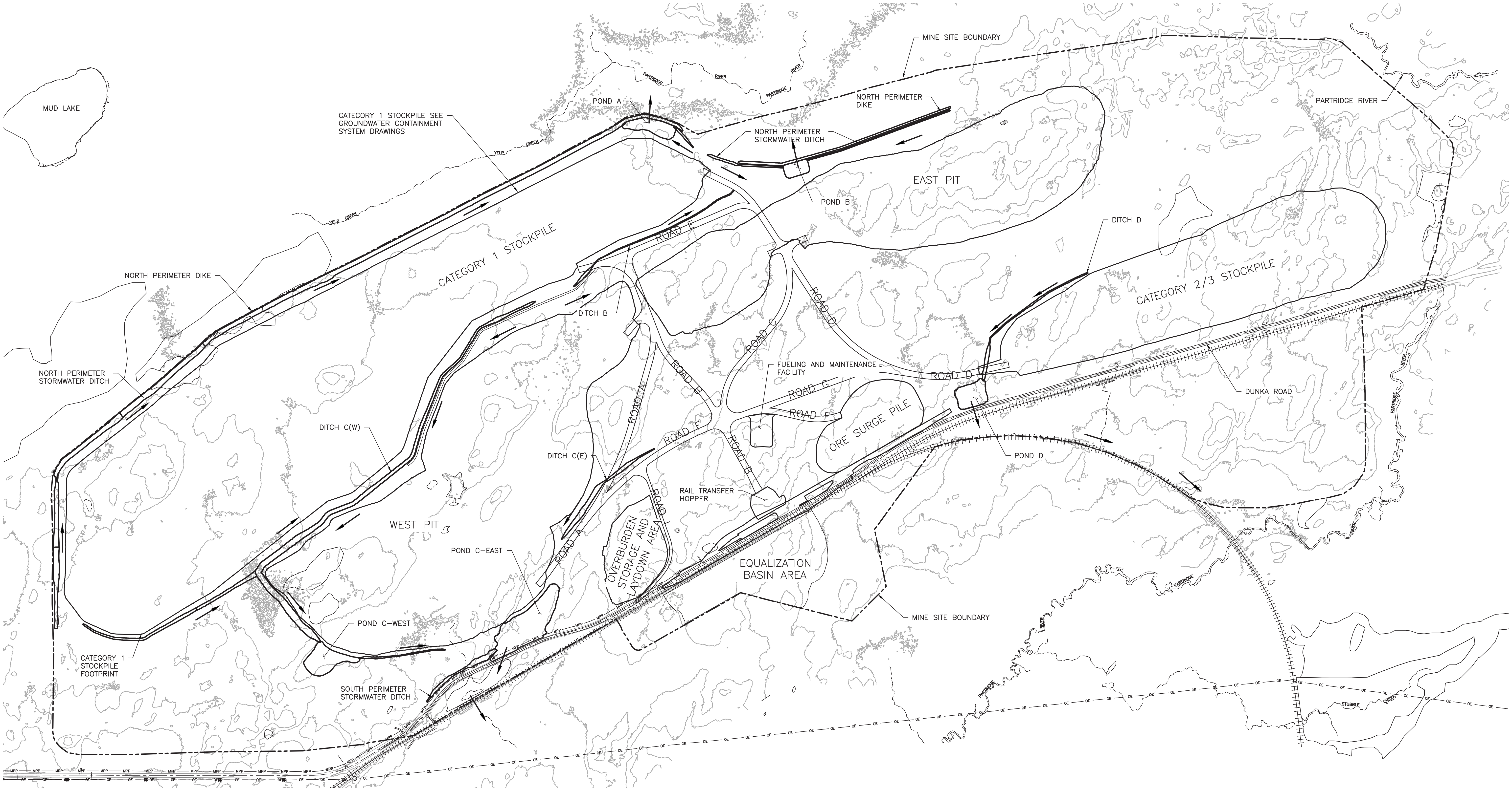
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. SW-003

REV B

INCHES 1 2

CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-05-SW-004.DWG PLOT SCALE: 1:2 PLOT DATE: 6/1/2017 9:19 AM



1 PLAN: STORMWATER SITE DRAINAGE MINE YEAR 11

0 700 1400
SCALE IN FEET

VER NO	DATE	DESCRIPTION
1	5/26/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
2	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS	ISSUED	VERSION	DATE
	FOR PERMITTING	2	6/7/2017
	FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB/ATS
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE STORMWATER
SITE DRAINAGE PLAN
MINE YEAR 11

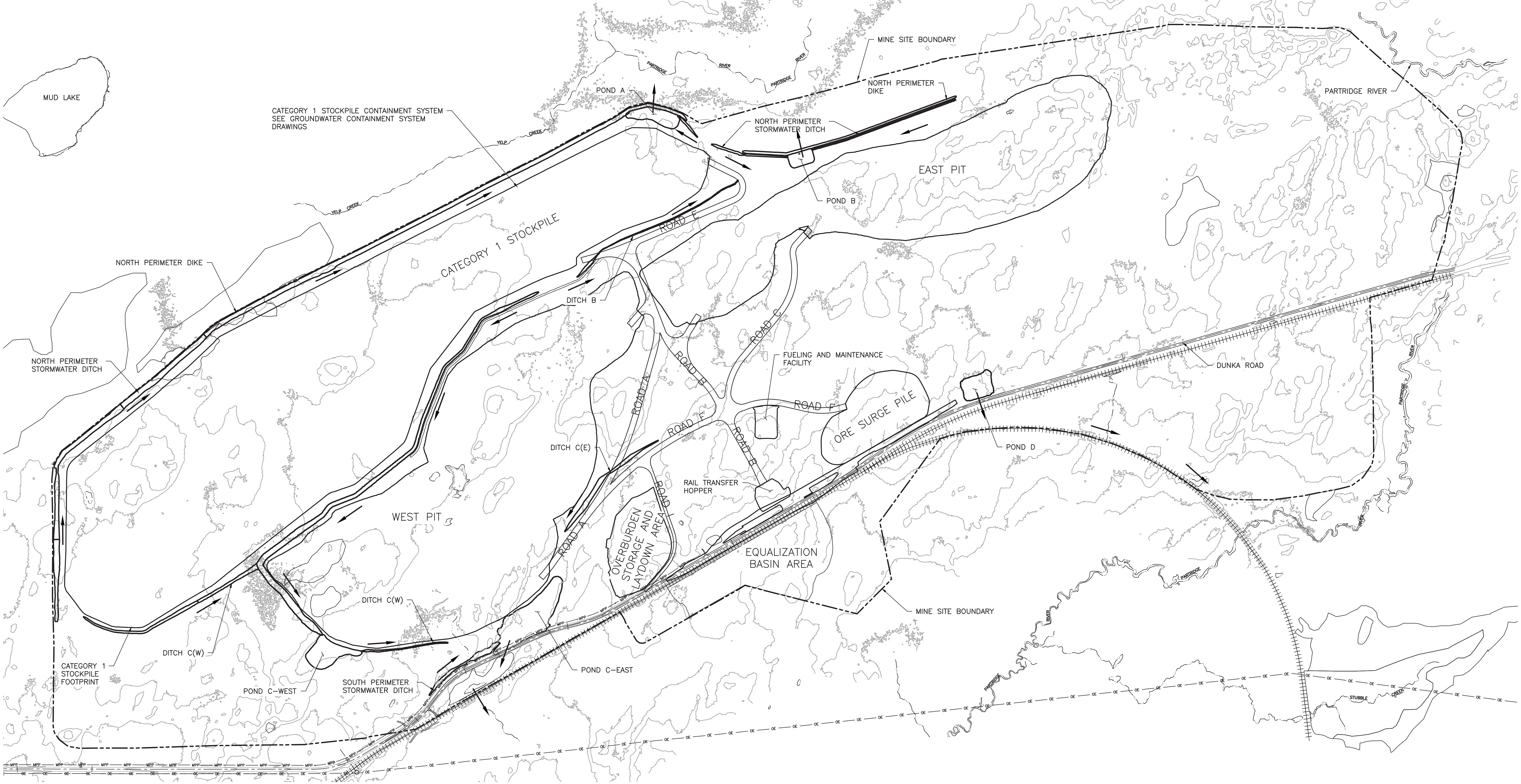
POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. SW-004
REV B

INCHES 1 2



1 PLAN: STORMWATER SITE DRAINAGE MINE YEAR 20

0 700 1400
SCALE IN FEET

VER NO	DATE	DESCRIPTION
1	5/26/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
2	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/7/2017
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB/ATS
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE STORMWATER
SITE DRAINAGE PLAN
MINE YEAR 20

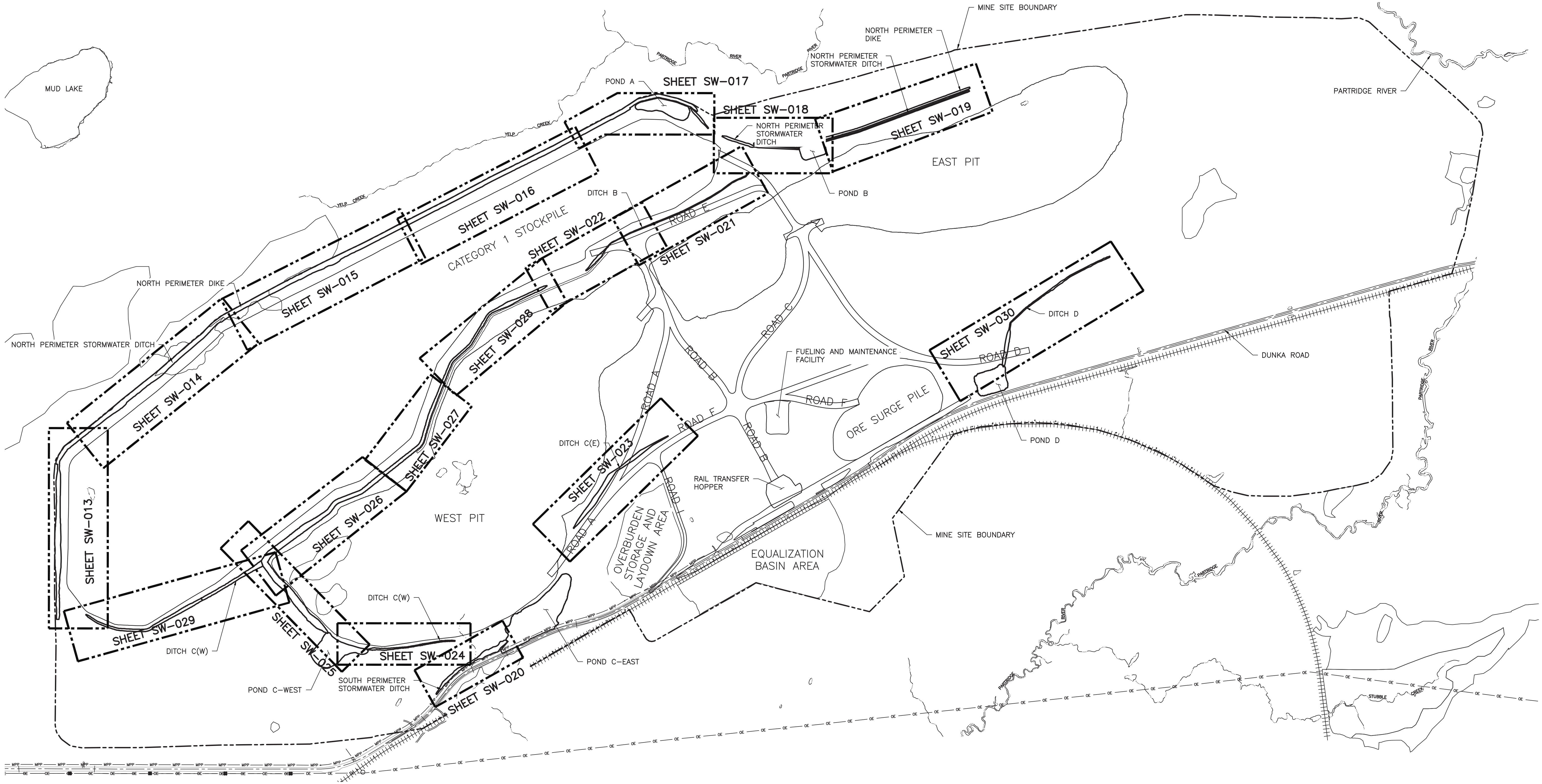
POLYMET MINING
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. SW-005
REV B

CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-05-SW-005.DWG PLOT SCALE: 1:2 PLOT DATE: 6/1/2017 9:06 AM

INCHES 1 2



1 PLAN: STORMWATER SHEET LOCATION MAP

0 700 1400
SCALE IN FEET

VER NO	DATE	DESCRIPTION
1	5/26/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
2	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/7/2017
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB/ATS
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE STORMWATER
SHEET LOCATION MAP

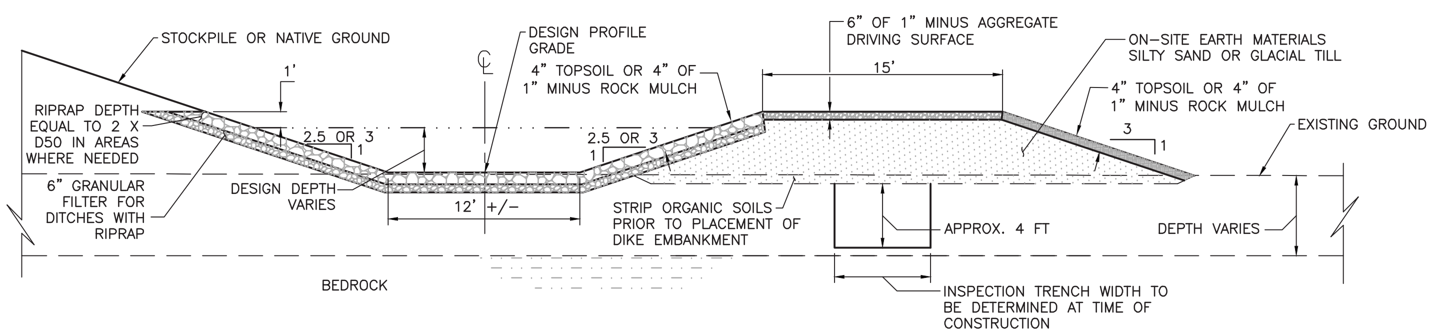
POLYMET MINING
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. SW-006
REV B

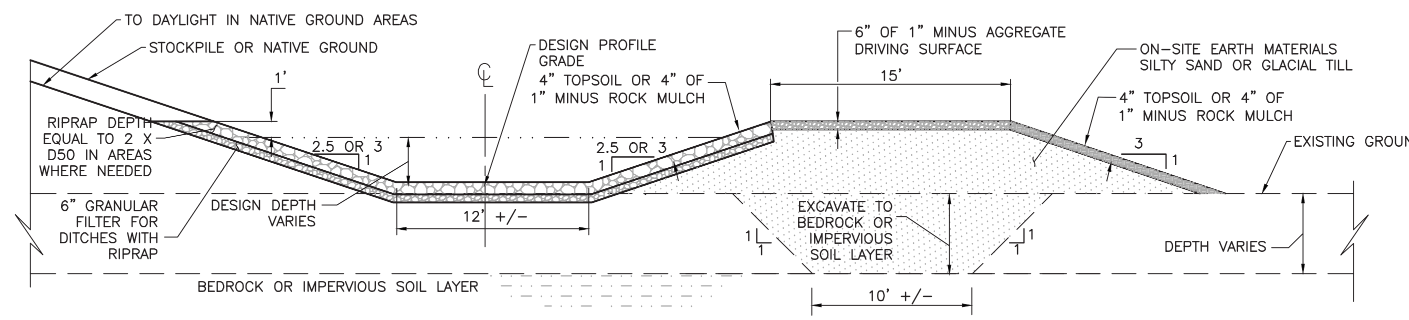
CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-05-SW-006.DWG PLOT SCALE: 1:2 PLOT DATE: 6/1/2017 9:06 AM

INCHES 1 2



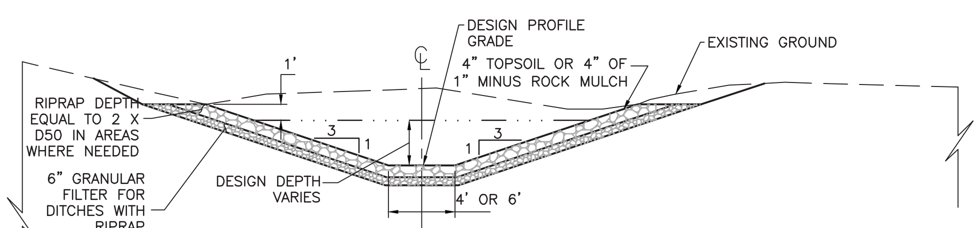
1 SECTION: TYPICAL PERIMETER DIKE AND DITCH WITHOUT SEEPAGE CUTOFF TRENCH

0 6 12
SCALE IN FEET



2 SECTION: TYPICAL PERIMETER DIKE AND DITCH WITH SEEPAGE CUTOFF TRENCH

0 6 12
SCALE IN FEET



3 SECTION: TYPICAL INTERIOR DITCH

0 6 12
SCALE IN FEET

NOTES

1. DITCHES NOT REQUIRING RIPRAP WILL BE CONSTRUCTED WITH NATIVE SOILS AND EITHER 4" TOPSOIL OR 4" OF 1" MINUS ROCK MULCH TO DESIGN PROFILE GRADE.
2. RESTORE ALL DISTURBED AREAS NOT STABILIZED WITH RIPRAP IN ACCORDANCE WITH THE SWPPP.
3. DESIGN DEPTH ESTABLISHED IN FINAL DESIGN OR IN FIELD. TOP OF DIKE TO FLOWLINE OF DITCH SHALL PROVIDE 1 FOOT OF FREEBOARD FROM DESIGN DEPTH.
4. INSPECTION TRENCH TO BE CONSTRUCTED ALONG ENTIRE LENGTH OF PERIMETER DIKES WHERE NON-ORGANIC MATERIALS ARE PRESENT.
5. PERIMETER DITCH AND DIKE ALONG THE NORTH SIDE OF THE CATEGORY 1 STOCKPILE (STATION 10+00 TO 143+53) SHALL HAVE 2.5H:1V SIDE SLOPES. ALL OTHER DITCHES AND DIKES SHALL HAVE SIDE SLOPES OF 3H:1V.

VER NO	DATE	DESCRIPTION
1	5/26/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
2	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/7/2017
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB/ATS
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE STORMWATER
TYPICAL DIKES AND DITCHES
CROSS SECTIONS

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

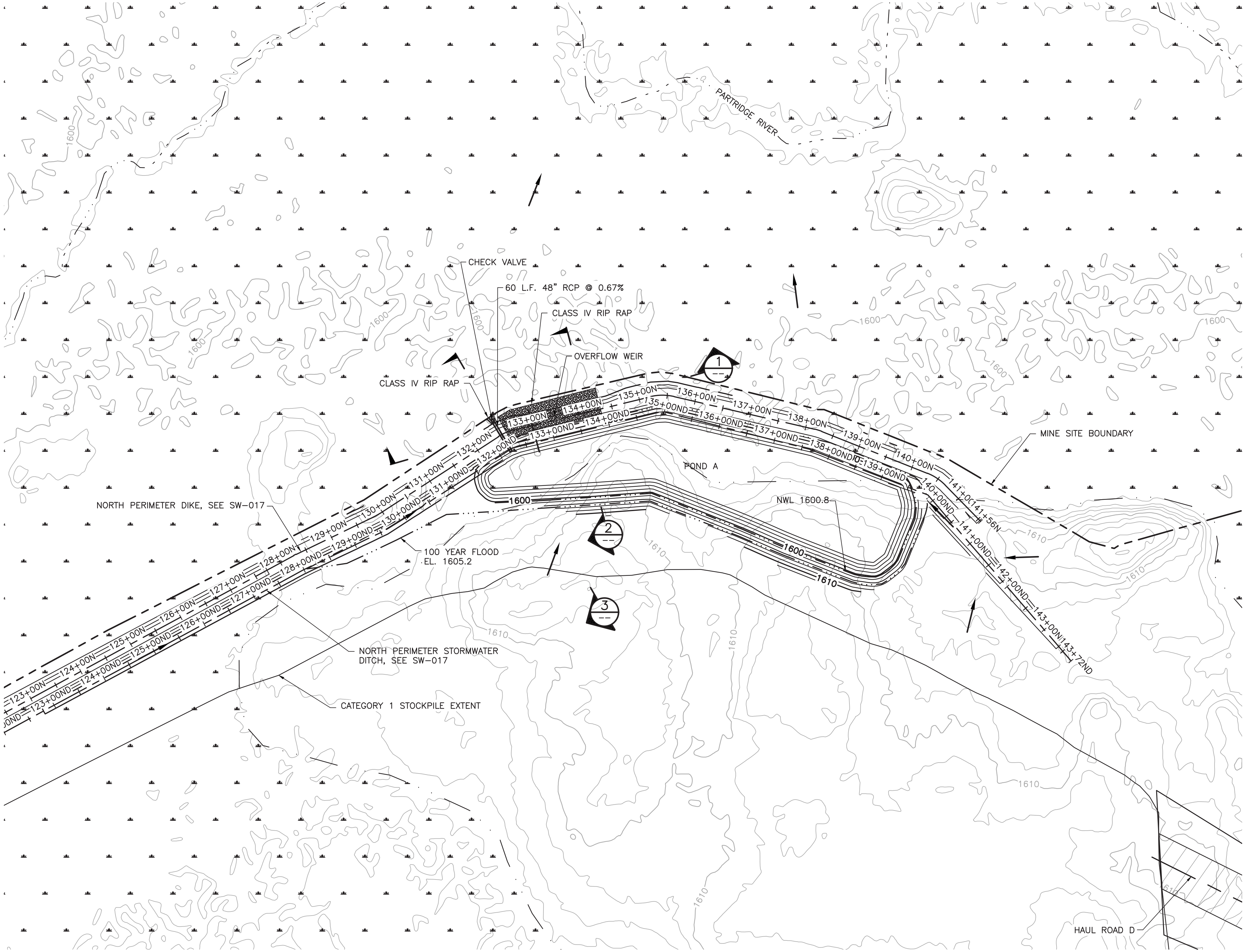
BARR

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. SW-007

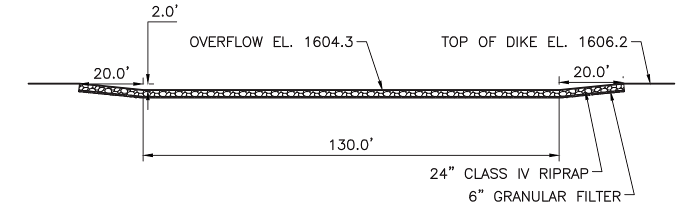
REV B

INCHES 1 2



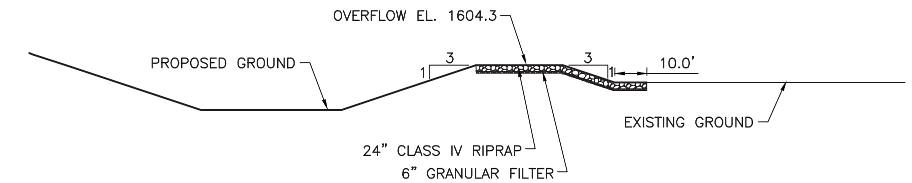
1 PLAN: STORMWATER SEDIMENTATION POND A

0 100 200
SCALE IN FEET



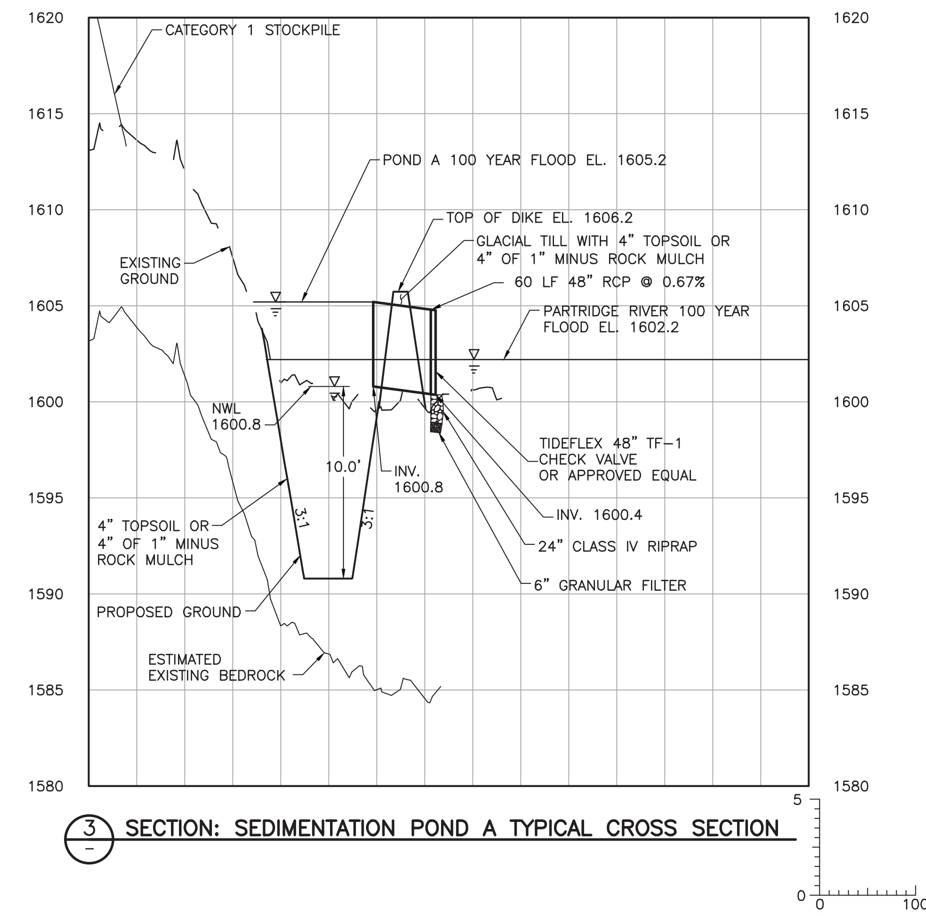
1 SECTION: OVERFLOW WEIR CREST

0 30 60
SCALE IN FEET



2 SECTION: OVERFLOW WEIR SPILLWAY

0 30 60
SCALE IN FEET



3 SECTION: SEDIMENTATION POND A TYPICAL CROSS SECTION

NOTES

1. ALL DISTURBED AREAS WILL BE RESTORED IN ACCORDANCE WITH THE SWPPP.

VER NO	DATE	DESCRIPTION
1	5/26/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
2	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	12	6/7/2017
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB/ATS
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE STORMWATER SEDIMENTATION POND A GRADING PLAN AND DETAILS

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

POLYMET MINING

BARR ENGINEERING COMPANY
4700 WEST 77TH STREET
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

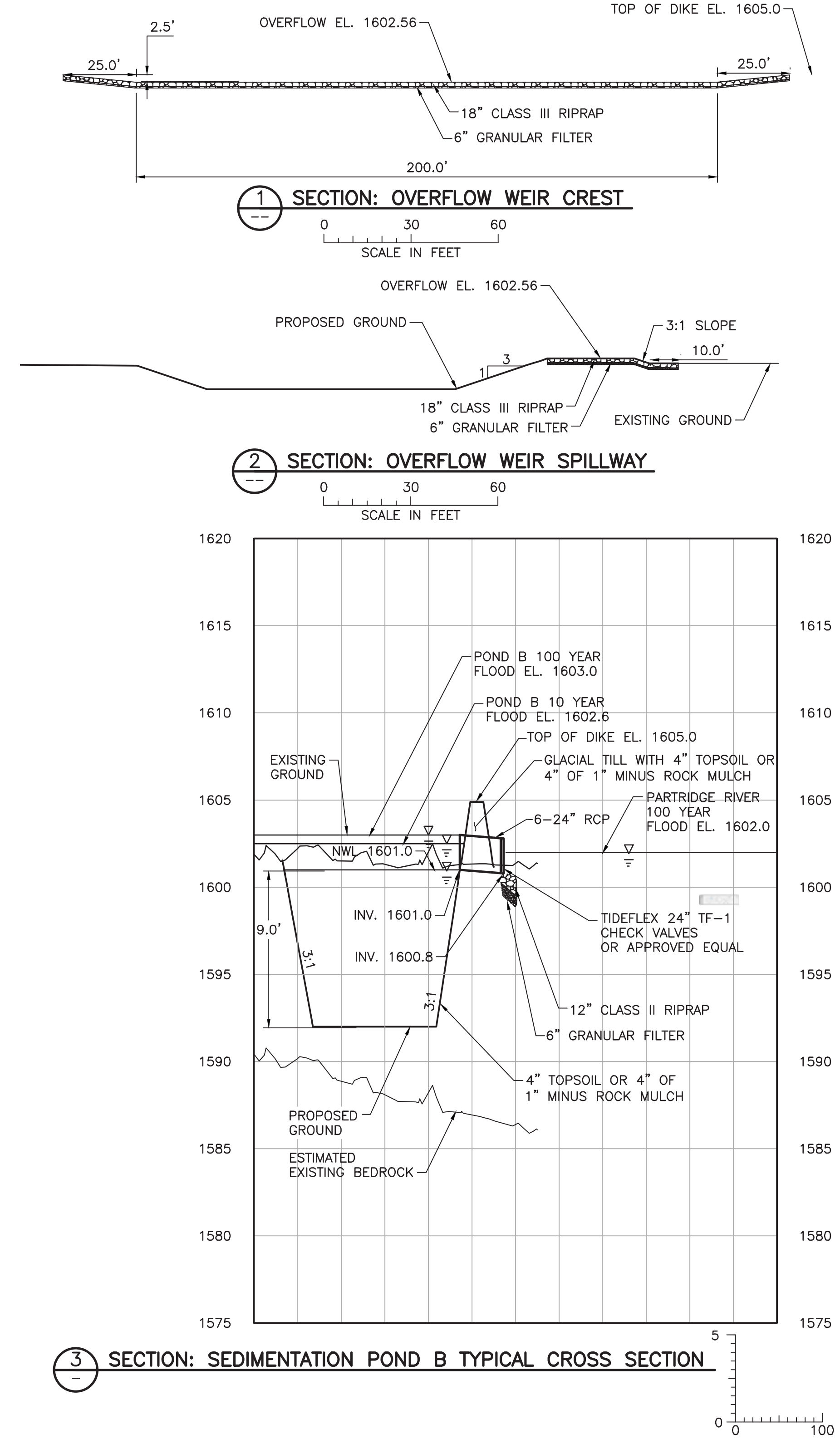
DWG. NO. SW-008 REV B

CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-05-SW-008.DWG PLOT SCALE: 1:2 PLOT DATE: 6/6/2017 11:50 AM

INCHES 1 2

1 PLAN: STORMWATER SEDIMENTATION POND B

0 100 200 SCALE IN FEET



NOTES

1. ALL DISTURBED AREAS WILL BE RESTORED IN ACCORDANCE WITH THE SWPPP.

VER NO	DATE	DESCRIPTION
1	5/26/15	ISSED FOR INCLUSION IN PERMIT APPLICATION
2	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/7/2017
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB/ATS
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE STORMWATER SEDIMENTATION POND B GRADING PLAN AND DETAILS

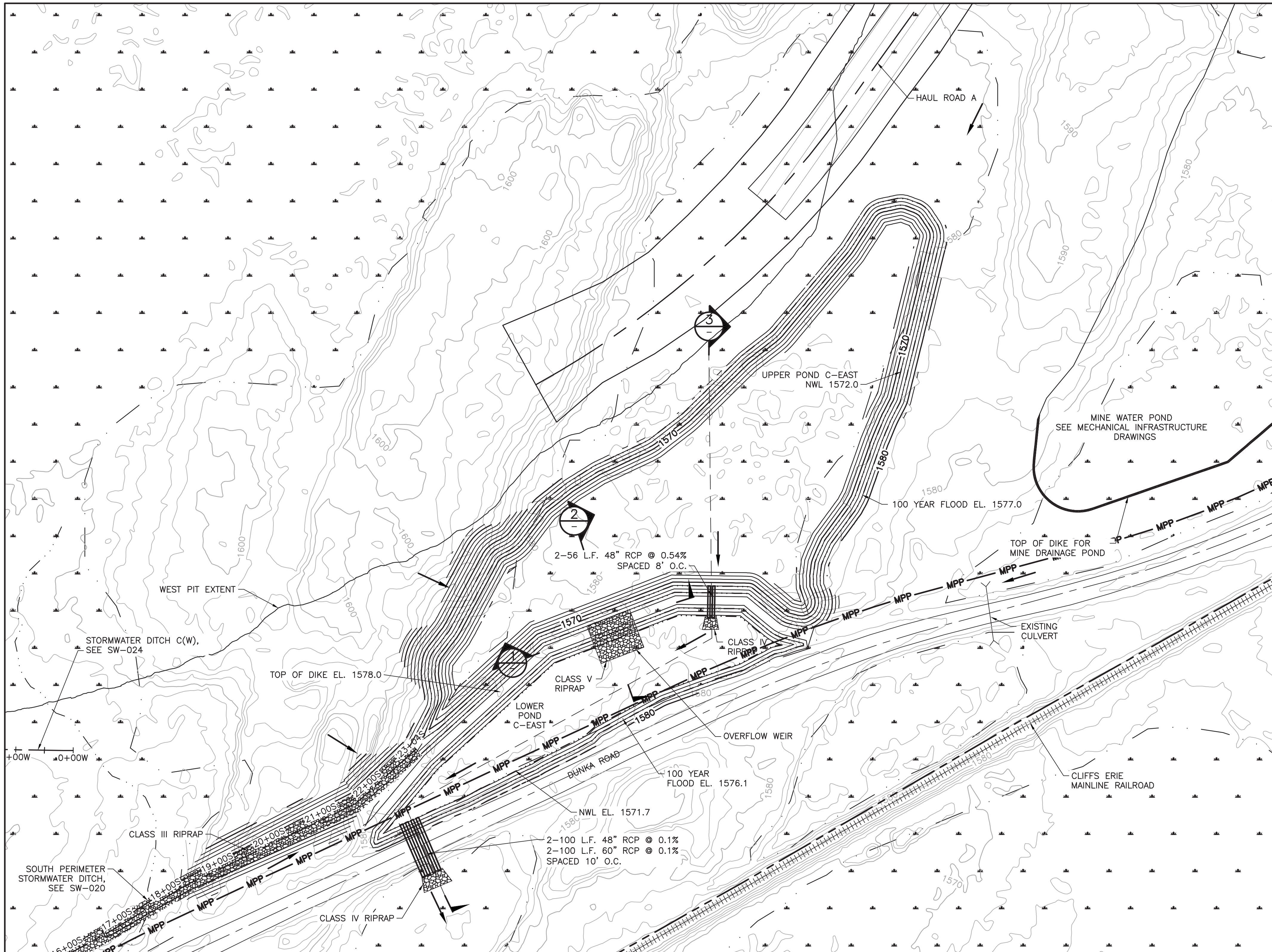
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. SW-009
REV B

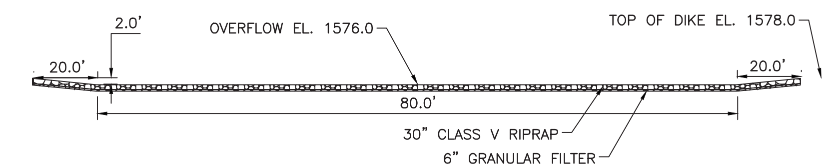
CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-05-SW-009.DWG PLOT SCALE: 1:2 PLOT DATE: 6/1/2017 9:02 AM

INCHES 1 2



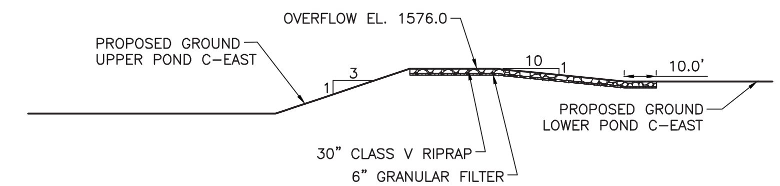
1 PLAN: STORMWATER SEDIMENTATION POND C-EAST

0 100 200 SCALE IN FEET



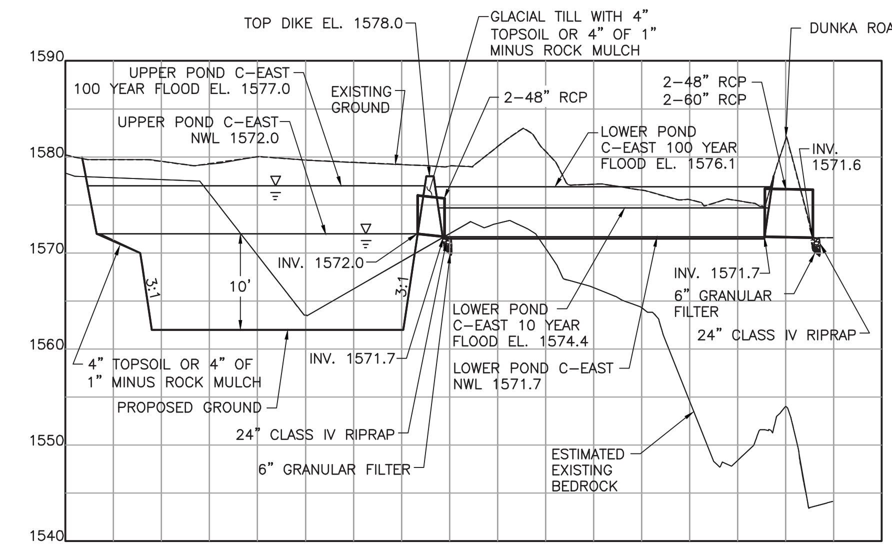
1 SECTION: OVERFLOW WEIR CREST

N.T.S.



2 SECTION: UPPER POND OVERFLOW WEIR SPILLWAY

0 30 60 SCALE IN FEET



3 SECTION: UPPER POND SEDIMENTATION POND C-EAST TYPICAL CROSS SECTION

10 0 100 SCALE IN FEET

NOTES

1. ALL DISTURBED AREAS WILL BE RESTORED IN ACCORDANCE WITH THE SWPPP.

VER NO	DATE	DESCRIPTION
1	5/26/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
2	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/7/2017
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB/ATS
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

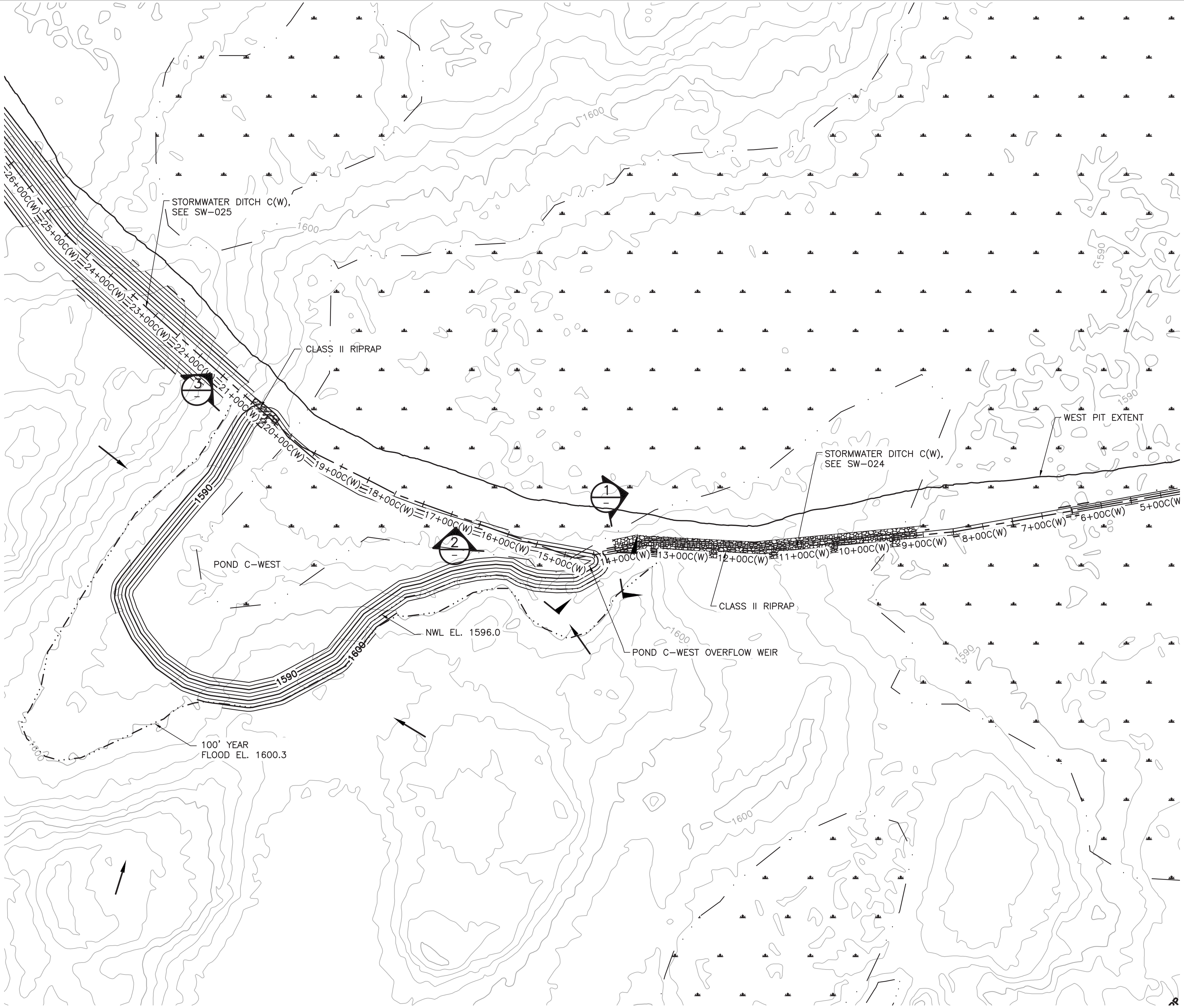
MINE SITE STORMWATER SEDIMENTATION POND C-EAST GRADING PLAN AND DETAILS

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

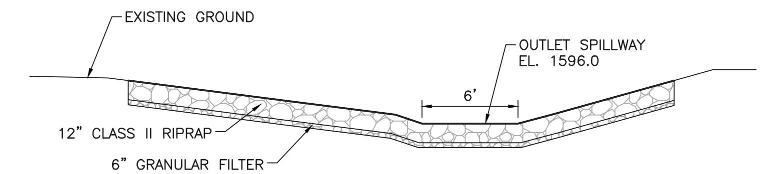
DWG. NO. SW-010 REV B

INCHES 1 2

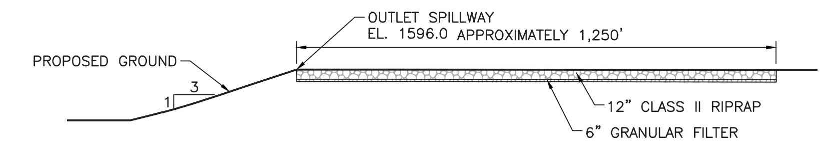


1 PLAN: STORMWATER SEDIMENTATION POND C-WEST

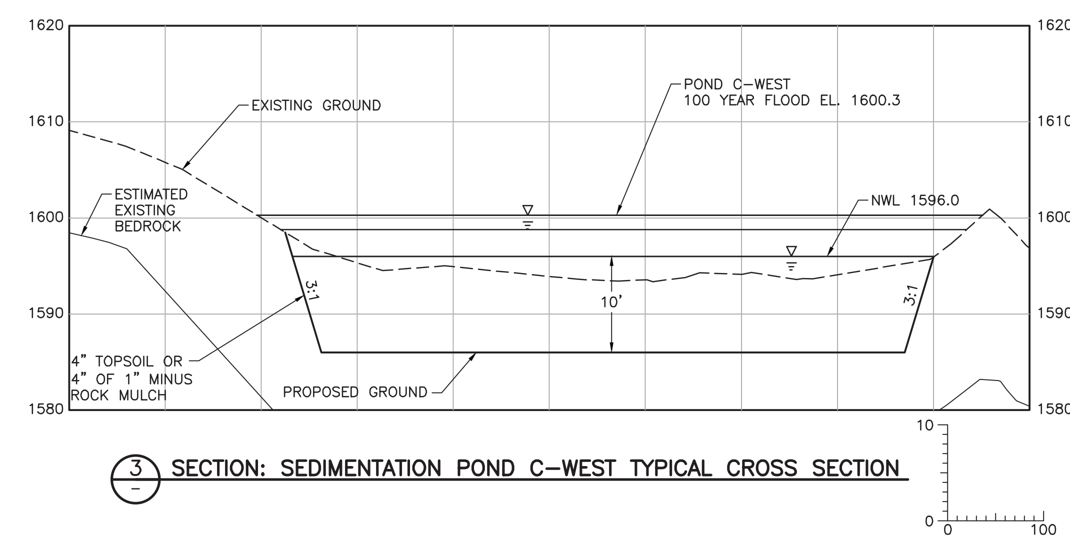
0 100 200 SCALE IN FEET



1 SECTION: OVERFLOW WEIR CREST
N.T.S.



2 SECTION: OVERFLOW WEIR SPILLWAY
N.T.S.



3 SECTION: SEDIMENTATION POND C-WEST TYPICAL CROSS SECTION

PLANT DRAWING NUMBER:

MINE SITE STORMWATER
SEDIMENTATION POND C-WEST
GRADING PLAN AND DETAILS

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

VER NO	DATE	DESCRIPTION
1	5/26/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
2	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/7/2017
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

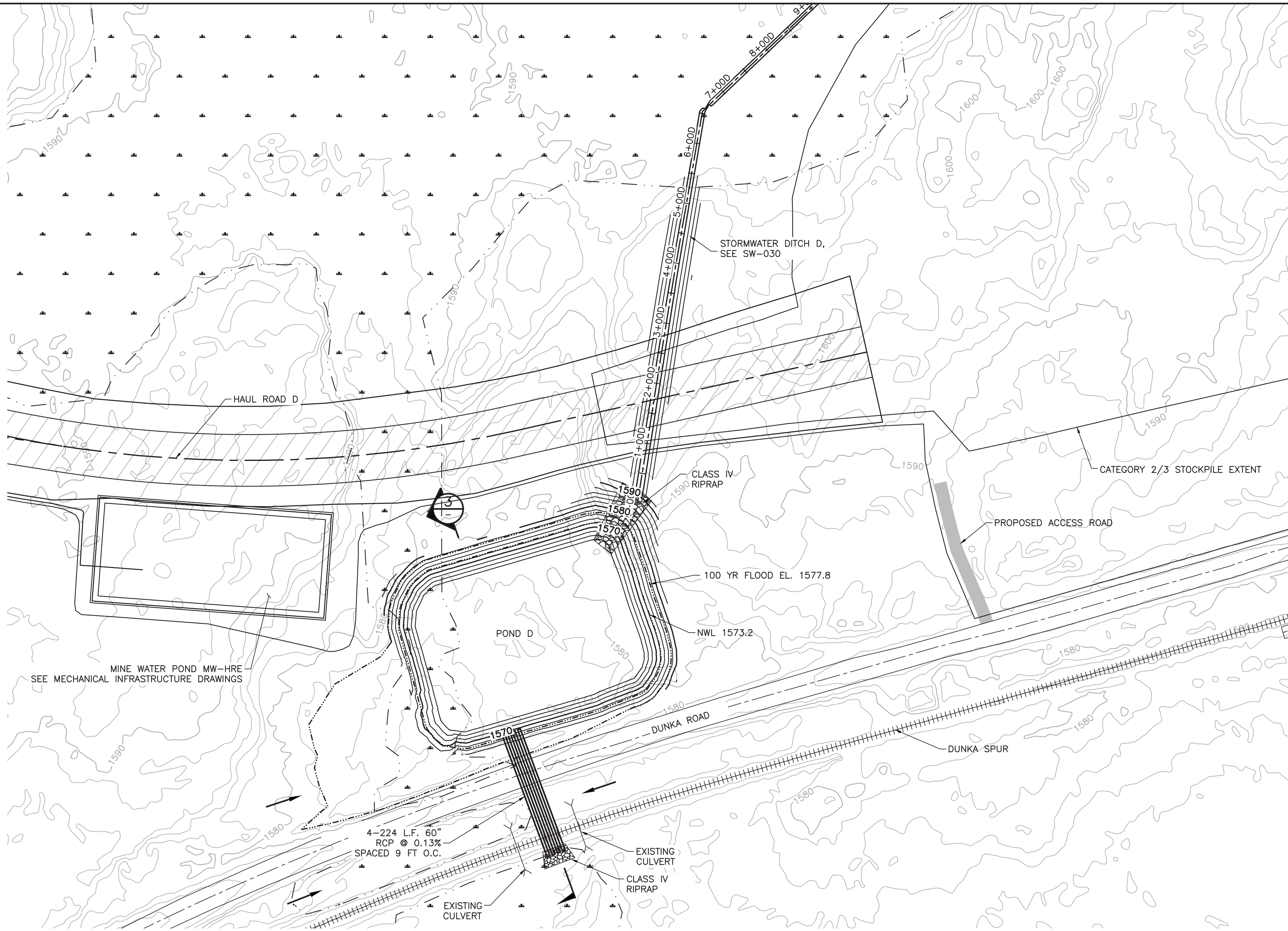
DRAWN: KKB/ATS
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN
DWG. NO. SW-011
REV B

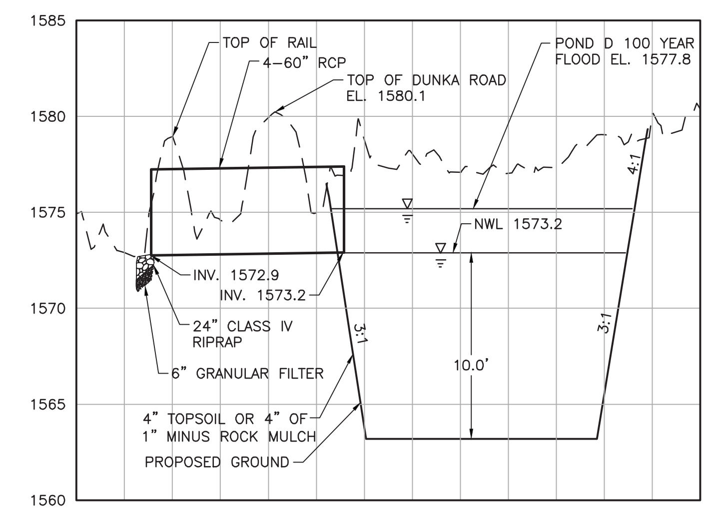
NOTES

1. ALL DISTURBED AREAS WILL BE RESTORED IN ACCORDANCE WITH THE SWPPP.

CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-05-SW-011.DWG PLOT SCALE: 1:2 PLOT DATE: 6/1/2017 8:21 AM

INCHES 1 2





3 SECTION: SEDIMENTATION POND D TYPICAL CROSS SECTION

0 100 SCALE IN FEET

1 PLAN: STORMWATER SEDIMENTATION POND D

0 100 200 SCALE IN FEET

NOTES

1. ALL DISTURBED AREAS WILL BE RESTORED IN ACCORDANCE WITH THE SWPPP.

VER NO	DATE	DESCRIPTION
1	5/26/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
2	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/7/2017
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB/ATS
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE STORMWATER
SEDIMENTATION POND D
GRADING PLAN AND DETAILS

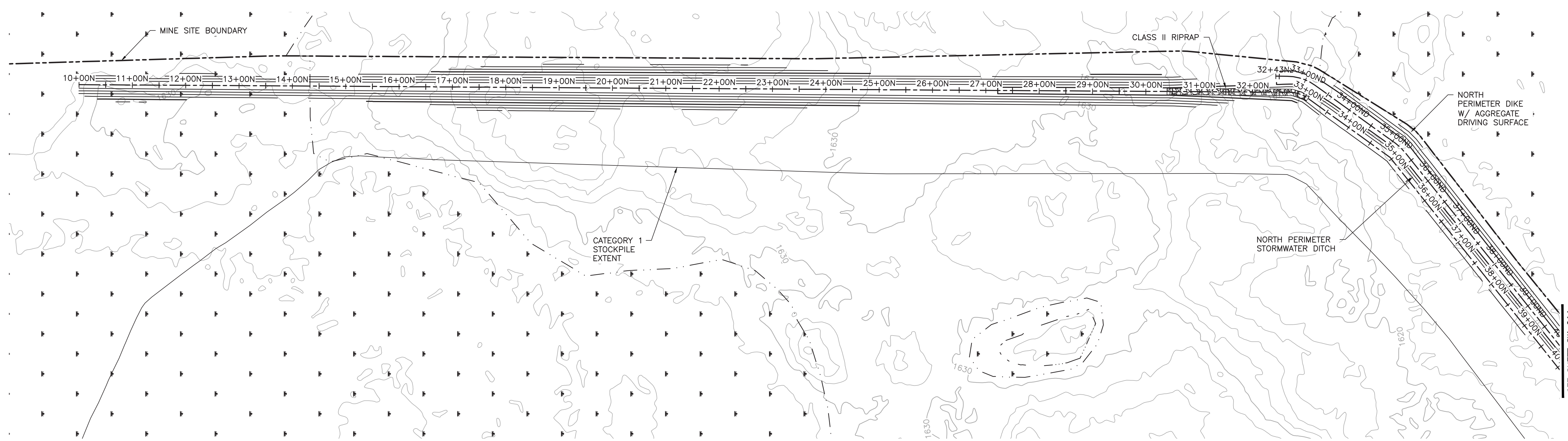
POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

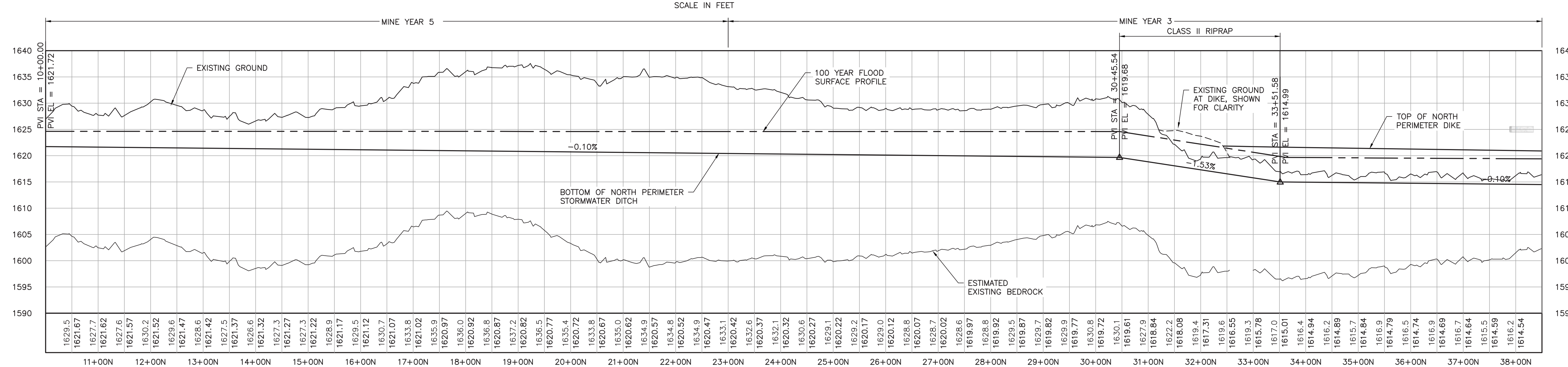
DWG. NO. SW-012
REV B

INCHES 1 2



1 PLAN: NORTH PERIMETER STORMWATER DITCH & DIKE STA. 10+00N–38+50N

0 100 200
SCALE IN FEET



2 PROFILE: NORTH PERIMETER STORMWATER DITCH & DIKE STA. 10+00N–38+50N

10
0 100
SCALE IN FEET

NOTES:

1. ALL STATIONS SHOWN ON PROFILE ARE BASED ON DITCH CENTERLINE STATIONS.
2. EXISTING GROUND PROFILE REPRESENTS GRADE AT DITCH CENTERLINE.

VER NO	DATE	DESCRIPTION
1	5/26/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
2	6/7/2017	PERMIT APPLICATION UPDATES

ISSUED	VERSION	DATE
FOR PERMITTING	2	6/7/2017
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB/ATS
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE STORMWATER
NORTH DIKE AND DITCH PLAN AND PROFILE
STATION 10+00N – 38+50N

POLYMET MINING

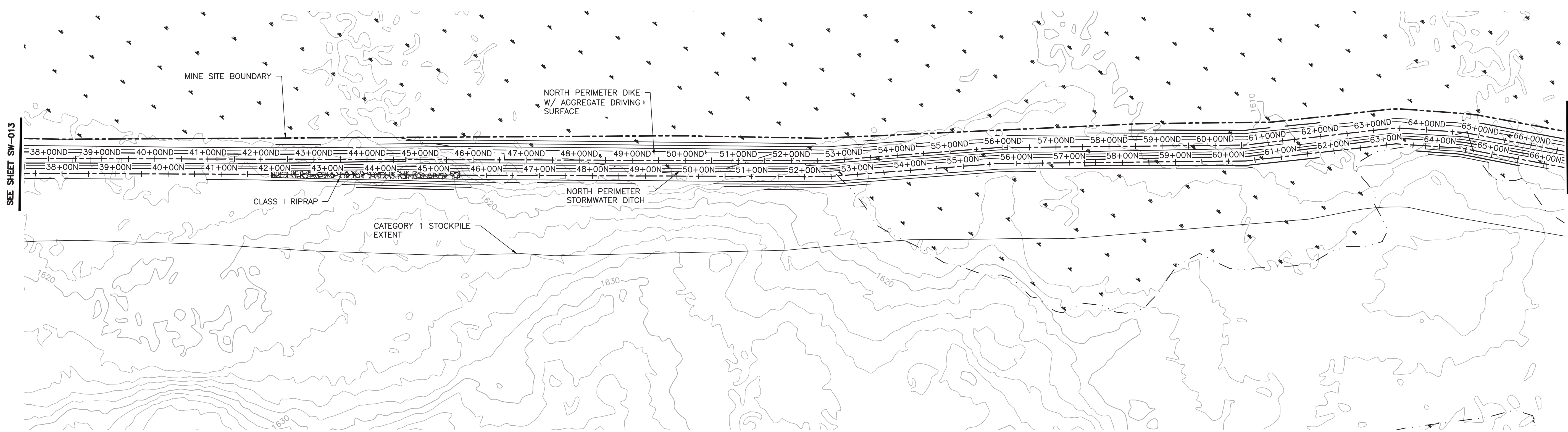
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. SW-013
REV B

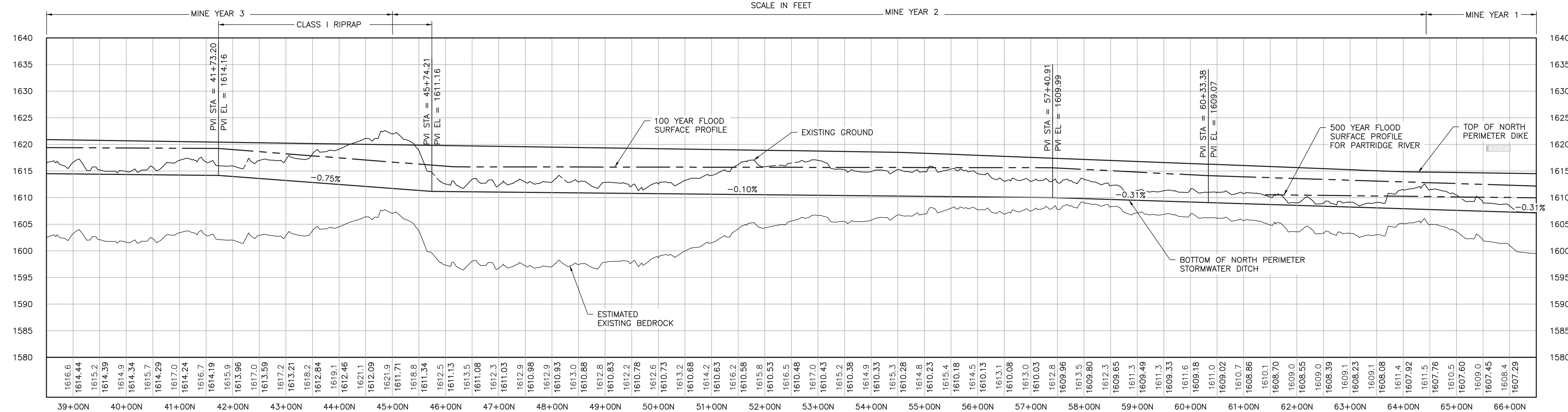
CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-05-SW-013.DWG PLOT SCALE: 1:2 PLOT DATE: 6/1/2017 8:16 AM

INCHES



1 PLAN: NORTH PERIMETER STORMWATER DITCH & DIKE STA. 38+50N–66+50N

0 100 200
SCALE IN FEET



2 PROFILE: NORTH PERIMETER STORMWATER DITCH & DIKE STA. 38+50N–66+50N

10
0 100
SCALE IN FEET

NOTES:

1. ALL STATIONS SHOWN ON PROFILE ARE BASED ON DITCH CENTERLINE STATIONS.
2. EXISTING GROUND PROFILE REPRESENTS GRADE AT DITCH CENTERLINE.

VER NO	DATE	DESCRIPTION
1	5/26/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
2	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/7/2017
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB/ATS
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE STORMWATER
NORTH DIKE AND DITCH PLAN AND PROFILE
STATION 38+50N – 66+50N

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

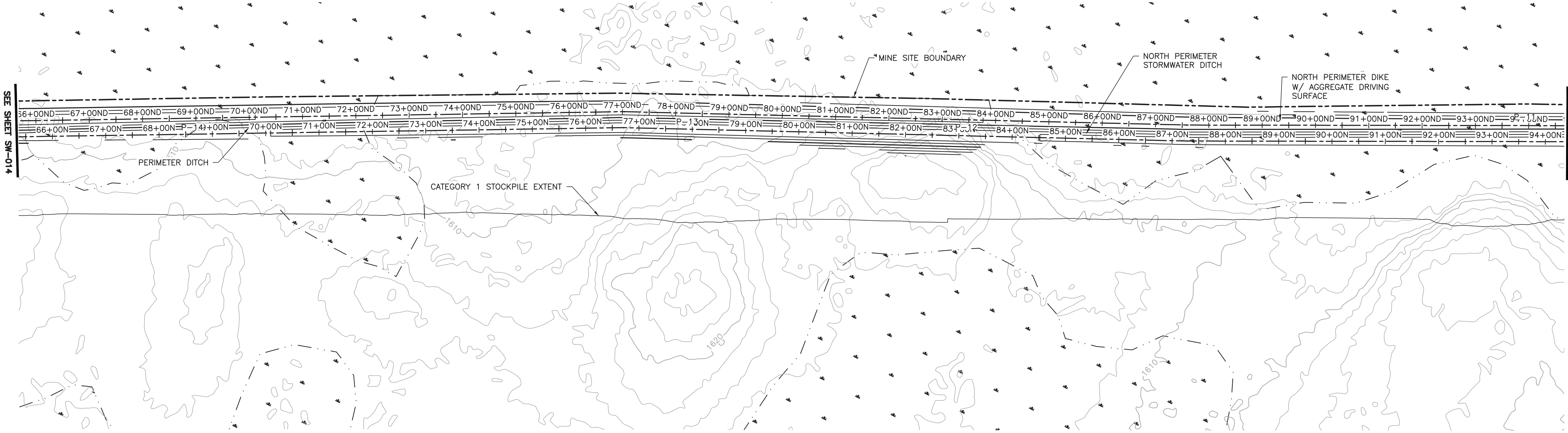
DWG. NO. SW-014
REV B

CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-05-SW-014.DWG PLOT SCALE: 1:2 PLOT DATE: 6/1/2017 8:20 AM

INCHES 1 2

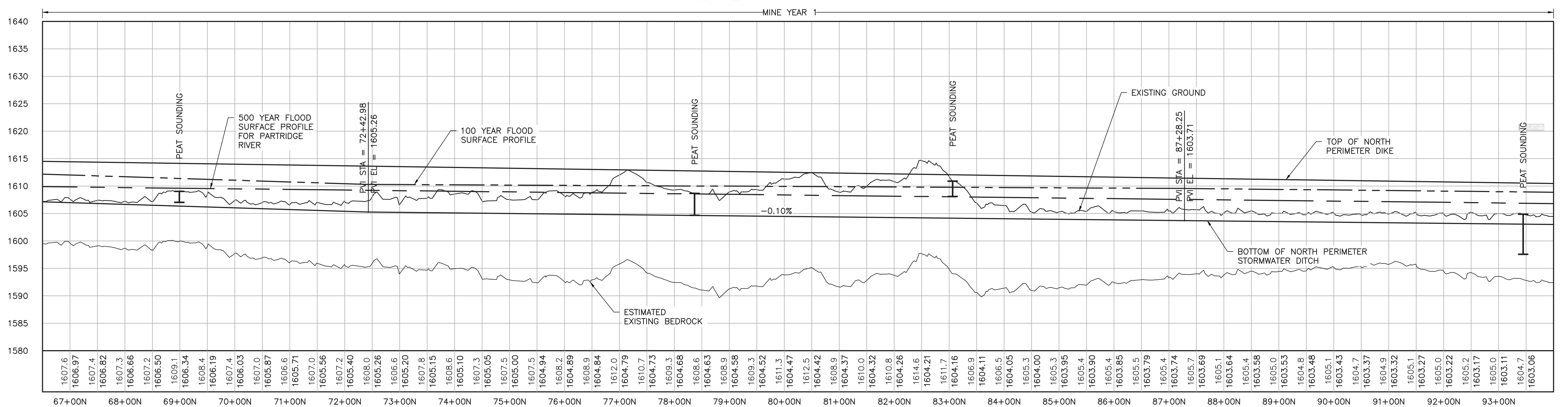
SEE SHEET SW-014

SEE SHEET SW-016



1 PLAN: NORTH PERIMETER STORMWATER DITCH & DIKE STA. 66+50N–94+00N

0 100 200
SCALE IN FEET



2 PROFILE: NORTH PERIMETER STORMWATER DITCH & DIKE STA. 66+50N–94+00N

10
0
0 100
SCALE IN FEET

NOTES:

1. ALL STATIONS SHOWN ON PROFILE ARE BASED ON DITCH CENTERLINE STATIONS.
2. EXISTING GROUND PROFILE REPRESENTS GRADE AT DITCH CENTERLINE.

VER NO	DATE	DESCRIPTION
1	5/26/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
2	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/7/2017
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB/ATS
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE STORMWATER
NORTH DIKE AND DITCH PLAN AND PROFILE
STATION 66+50N – 94+00N

POLYMET MINING

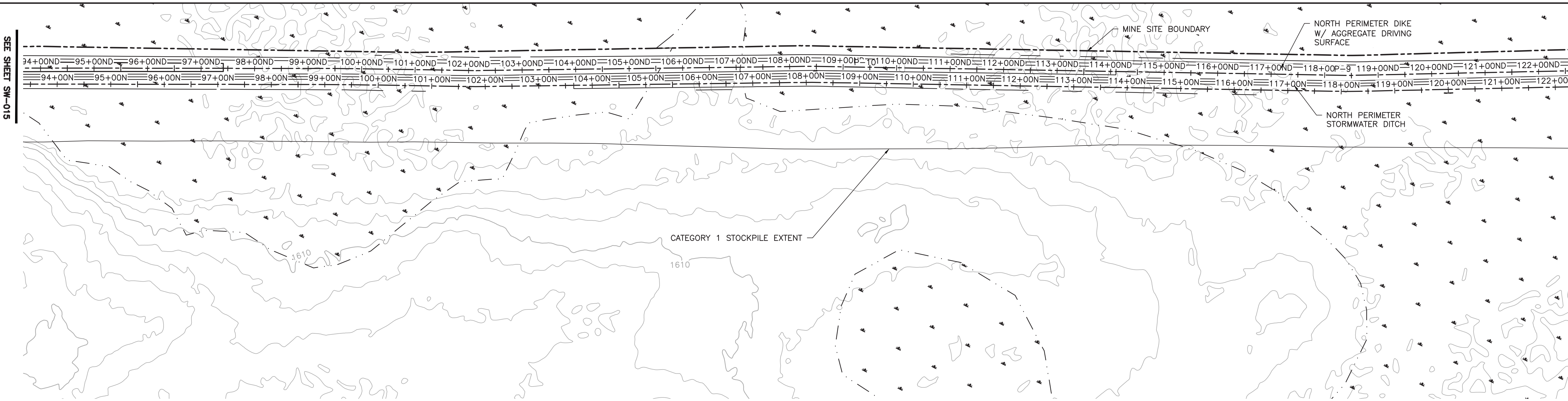
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. SW-015
REV B

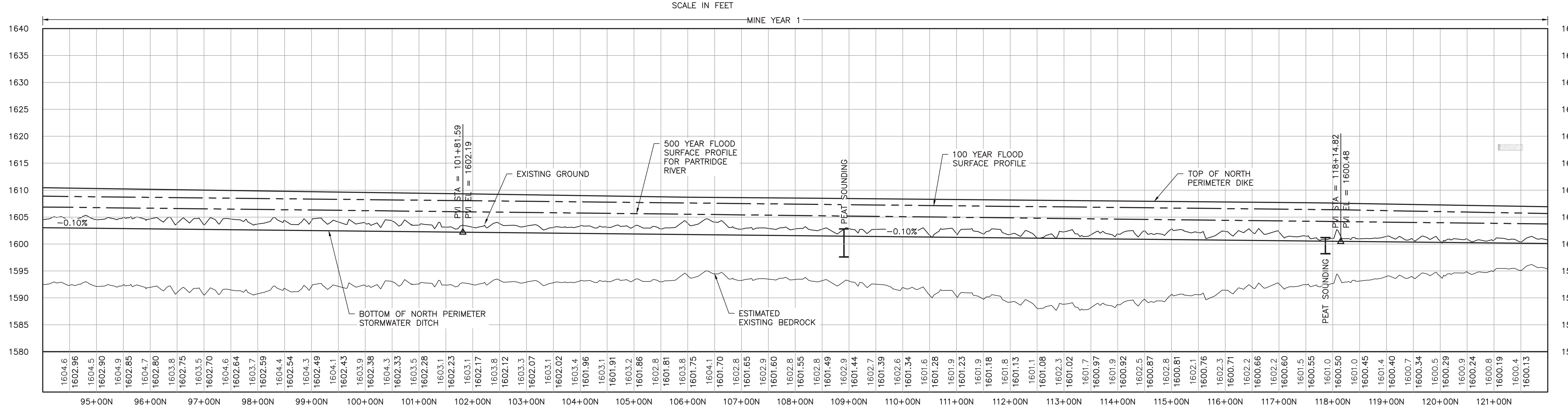
CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-05-SW-015.DWG PLOT SCALE: 1:2 PLOT DATE: 6/1/2017 8:17 AM

INCHES 1 2



1 PLAN: NORTH PERIMETER STORMWATER DITCH & DIKE STA. 94+00N–122+00N

0 100 200
SCALE IN FEET



2 PROFILE: NORTH PERIMETER STORMWATER DITCH & DIKE STA. 94+00N–122+00N

10
0 100
SCALE IN FEET

NOTES:

1. ALL STATIONS SHOWN ON PROFILE ARE BASED ON DITCH CENTERLINE STATIONS.
2. EXISTING GROUND PROFILE REPRESENTS GRADE AT DITCH CENTERLINE.

VER NO	DATE	DESCRIPTION
1	5/26/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
2	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/7/2017
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB/ATS
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE STORMWATER
NORTH DIKE AND DITCH PLAN AND PROFILE
STATION 94+00N – 122+00N

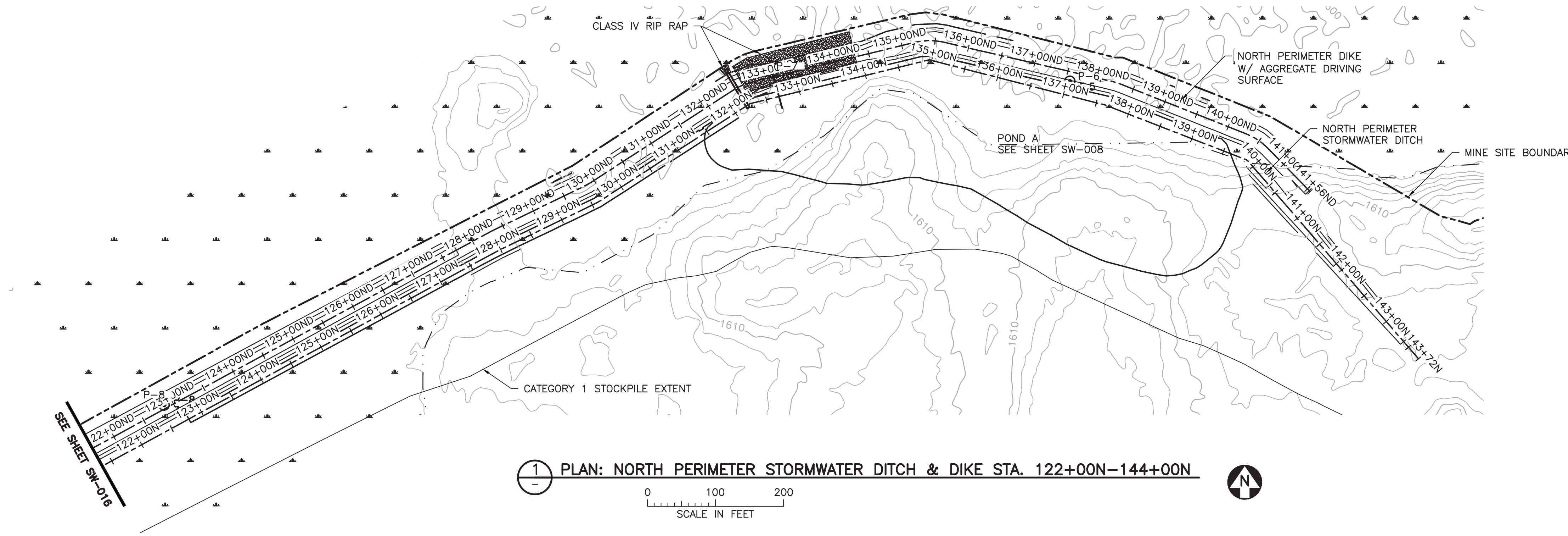
POLYMET MINING
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. SW-016
REV B

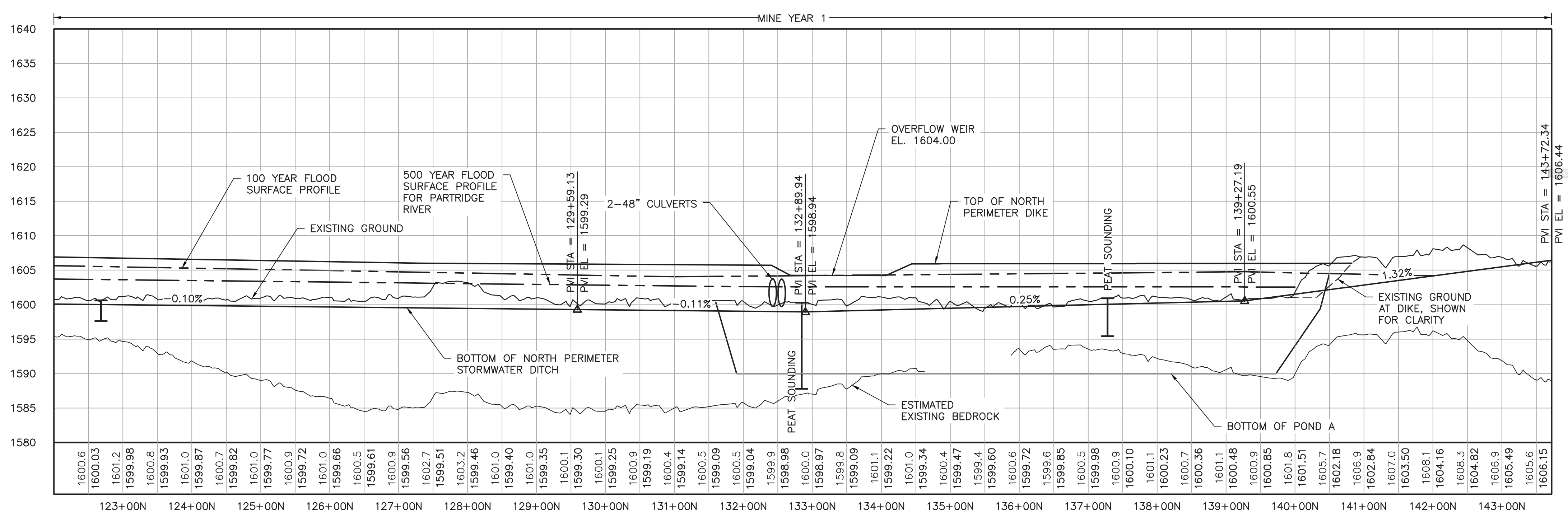
CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-05-SW-016.DWG PLOT SCALE: 1:2 PLOT DATE: 6/1/2017 8:18 AM

INCHES 1 2



1 PLAN: NORTH PERIMETER STORMWATER DITCH & DIKE STA. 122+00N–144+00N

0 100 200
SCALE IN FEET



2 PROFILE: NORTH PERIMETER STORMWATER DITCH & DIKE STA. 122+00N–144+00N

SCALE IN FEET

NOTES:

1. ALL STATIONS SHOWN ON PROFILE ARE BASED ON DITCH CENTERLINE STATIONS.
2. EXISTING GROUND PROFILE REPRESENTS GRADE AT DITCH CENTERLINE.
3. BOTTOM OF DITCH PROFILE LINE SHOWN TO PRESENT HYDRAULIC GRADE REQUIREMENTS, RESULTING "FILL" AREAS SHALL BE LEFT AS IS. DO NOT PLACE FILL TO RAISE GROUND TO DITCH PROFILE LINE.

VER NO	DATE	DESCRIPTION
1	5/26/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
2	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/7/2017
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB/ATS
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE STORMWATER
NORTH DIKE AND DITCH PLAN AND PROFILE
STATION 122+00N – 144+00N

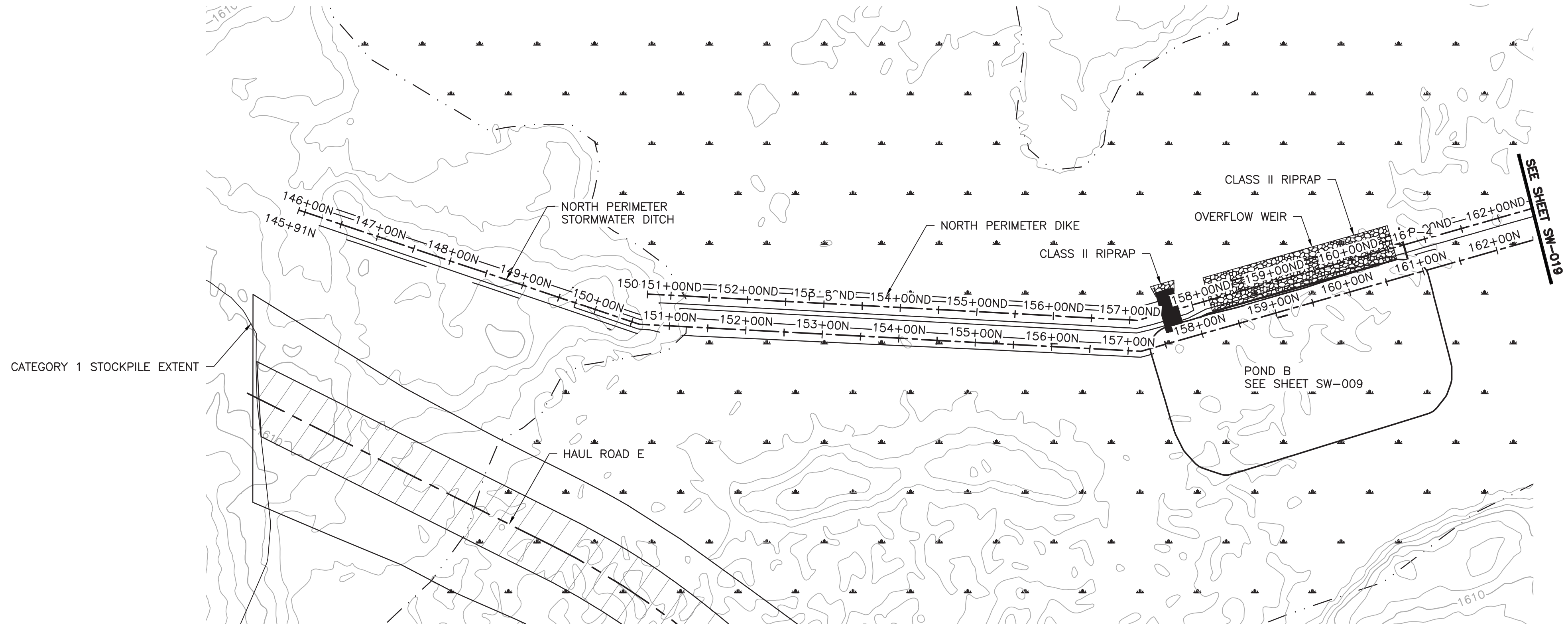
POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

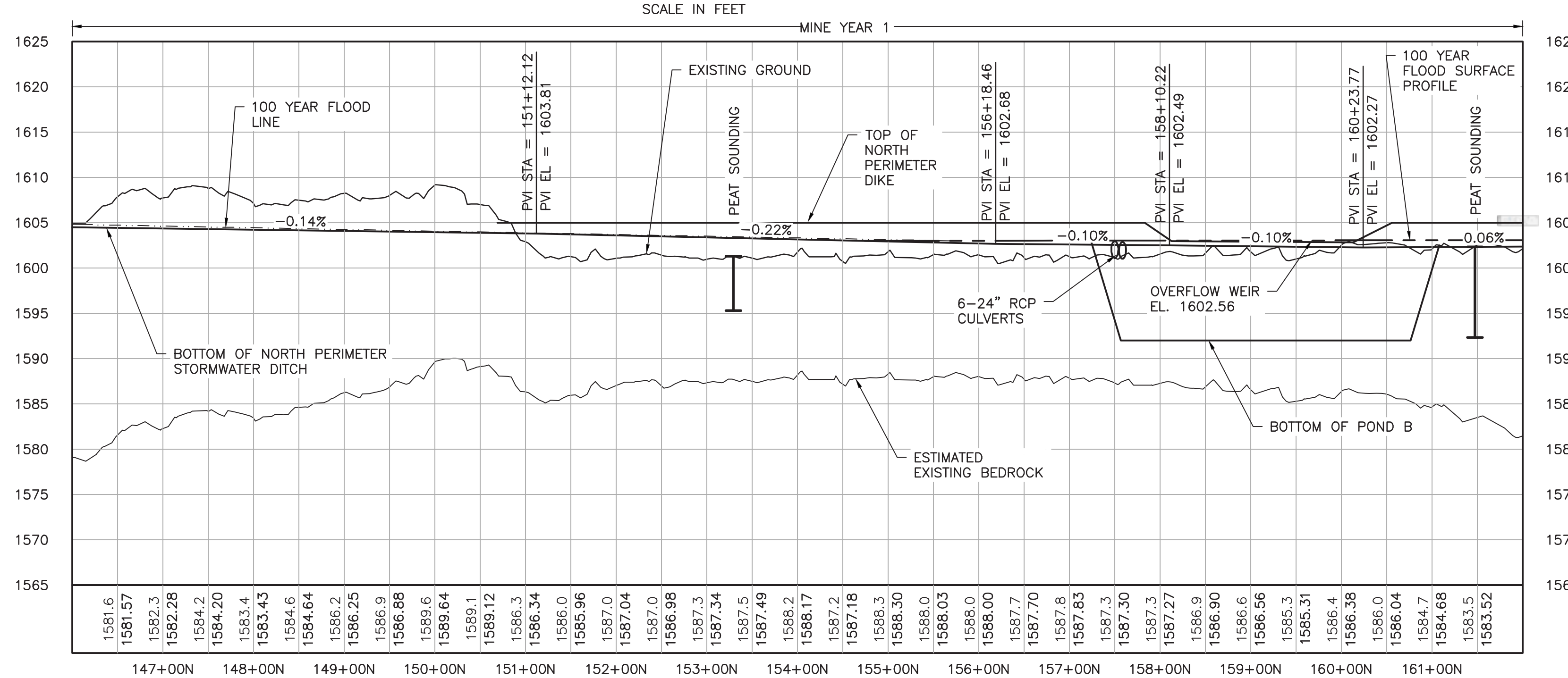
DWG. NO. SW-017
REV B

CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-05-SW-017.DWG PLOT SCALE: 1:2 PLOT DATE: 6/1/2017 8:19 AM



1 PLAN: NORTH PERIMETER STORMWATER DITCH & DIKE STA. 146+00N–162+00N

0 100 200
SCALE IN FEET



2 PROFILE: NORTH PERIMETER STORMWATER DITCH & DIKE STA. 146+00N–162+00N

10
0 100
SCALE IN FEET

NOTES:

1. ALL STATIONS SHOWN ON PROFILE ARE BASED ON DITCH CENTERLINE STATIONS.
2. EXISTING GROUND PROFILE REPRESENTS GRADE AT DITCH CENTERLINE.
3. BOTTOM OF DITCH PROFILE LINE SHOWN TO PRESENT HYDRAULIC GRADE REQUIREMENTS, RESULTING "FILL" AREAS SHALL BE LEFT AS IS. DO NOT PLACE FILL TO RAISE GROUND TO DITCH PROFILE LINE.

VER NO	DATE	DESCRIPTION
1	5/26/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
2	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/7/2017
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB/ATS
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

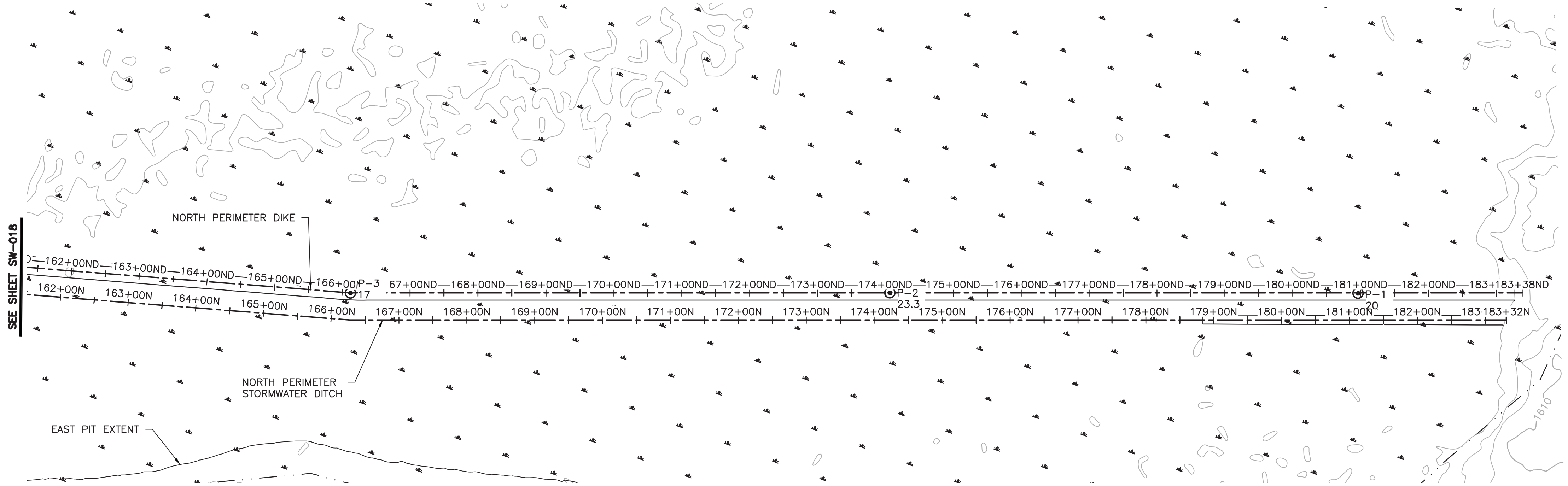
MINE SITE STORMWATER
NORTH DIKE AND DITCH PLAN AND PROFILE
STATION 146+00N – 162+00N

POLYMET MINING
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

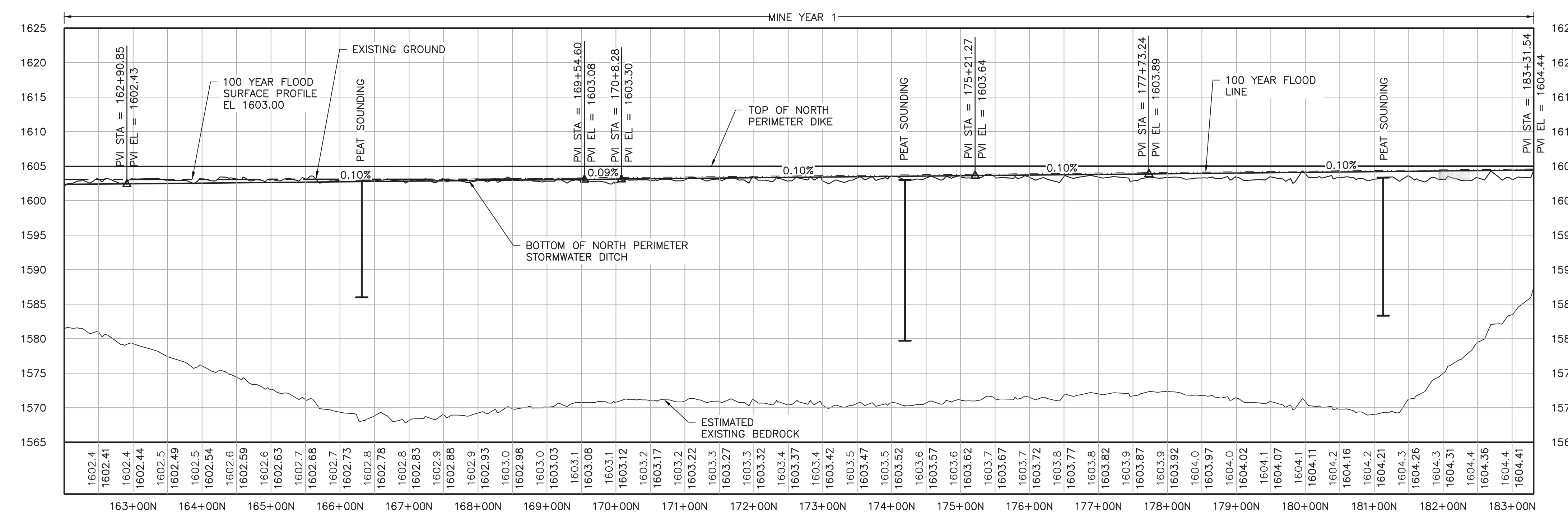
BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. SW-018
REV B

INCHES 1 2



1 PLAN: NORTH PERIMETER STORMWATER DITCH & DIKE STA. 162+00N–183+00N



2 PROFILE: NORTH PERIMETER STORMWATER DITCH & DIKE STA. 162+00N–183+00N

NOTES:

1. ALL STATIONS SHOWN ON PROFILE ARE BASED ON DITCH CENTERLINE STATIONS.
2. EXISTING GROUND PROFILE REPRESENTS GRADE AT DITCH CENTERLINE.
3. BOTTOM OF DITCH PROFILE LINE SHOWN TO PRESENT HYDRAULIC GRADE REQUIREMENTS, RESULTING "FILL" AREAS SHALL BE LEFT AS IS. DO NOT PLACE FILL TO RAISE GROUND TO DITCH PROFILE LINE.

VER NO	DATE	DESCRIPTION
1	5/26/15	ISSUED FOR INCLUSION IN PAERMIT APPLICATIONS
2	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/7/2017
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB/ATS
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE STORMWATER
NORTH DIKE AND DITCH PLAN AND PROFILE
STATION 162+00N – 183+00N

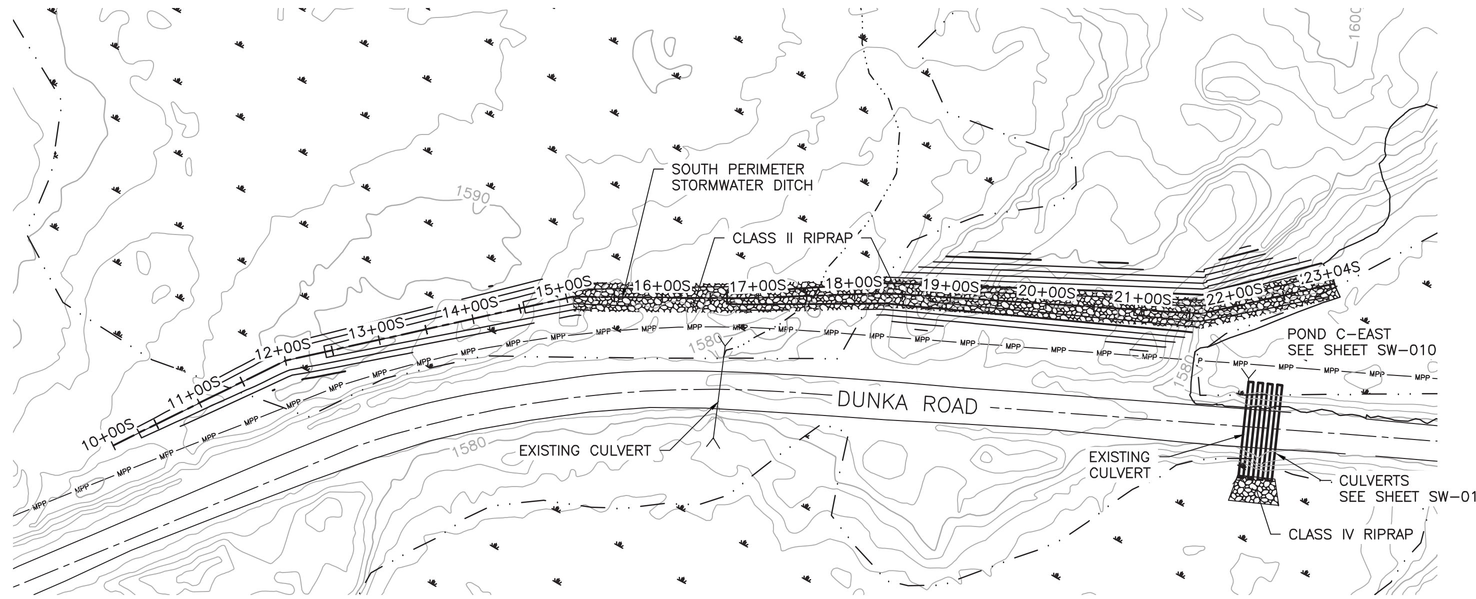
POLYMET MINING
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. SW-019
REV B

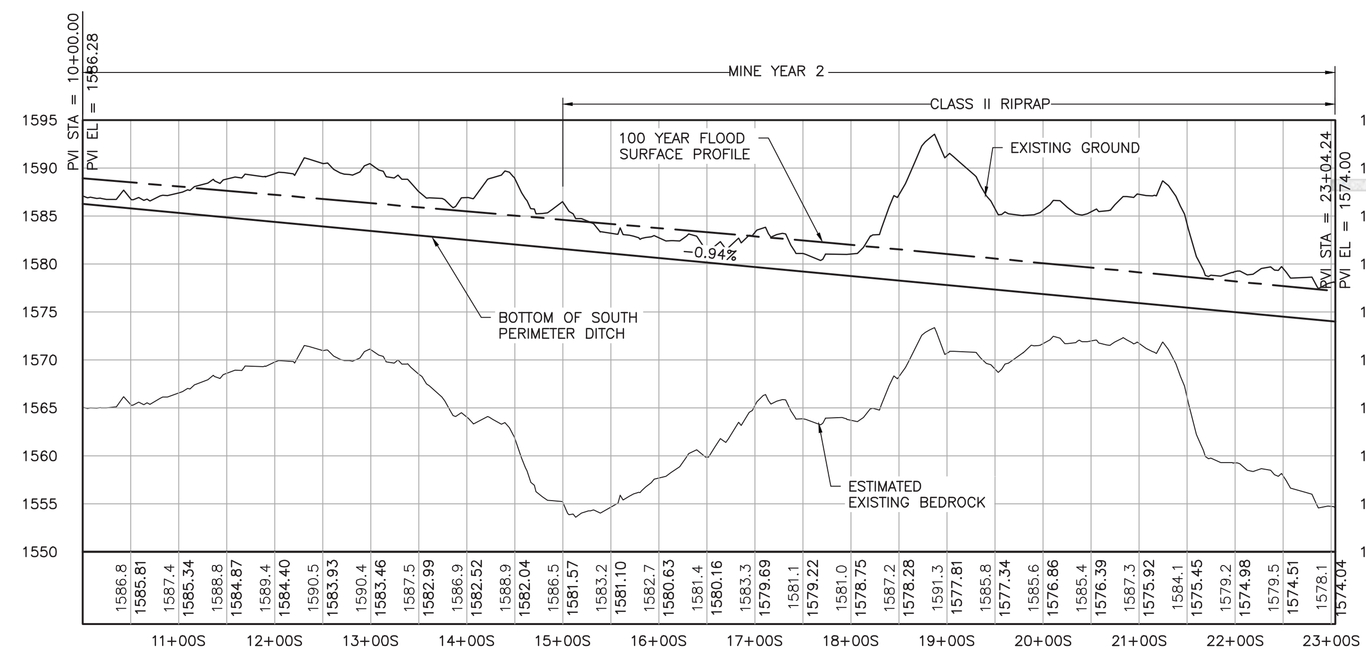
CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-05-SW-019.DWG PLOT SCALE: 1:2 PLOT DATE: 6/1/2017 7:57 AM

INCHES 1 2



1 PLAN: SOUTH PERIMETER DITCH STA. 10+00S–22+95S

0 100 200
SCALE IN FEET



2 PROFILE: SOUTH PERIMETER DITCH STA. 10+00S–22+95S

10
0 0 100
SCALE IN FEET

NOTES:

1. ALL STATIONS SHOWN ON PROFILE ARE BASED ON DITCH CENTERLINE STATIONS.
2. EXISTING GROUND PROFILE REPRESENTS GRADE AT DITCH CENTERLINE.

VER NO	DATE	DESCRIPTION
1	5/26/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/7/2017
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB/ATS
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE STORMWATER
SOUTH DIKE AND DITCH PLAN AND PROFILE
STATION 10+00S – 22+95S

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

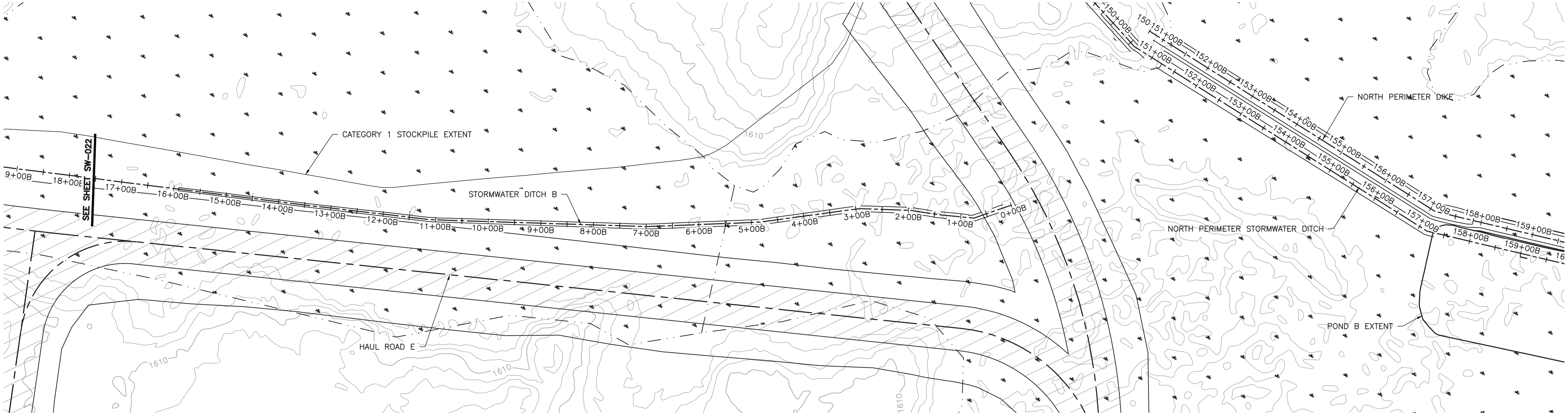
BARR

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. SW-020
REV B

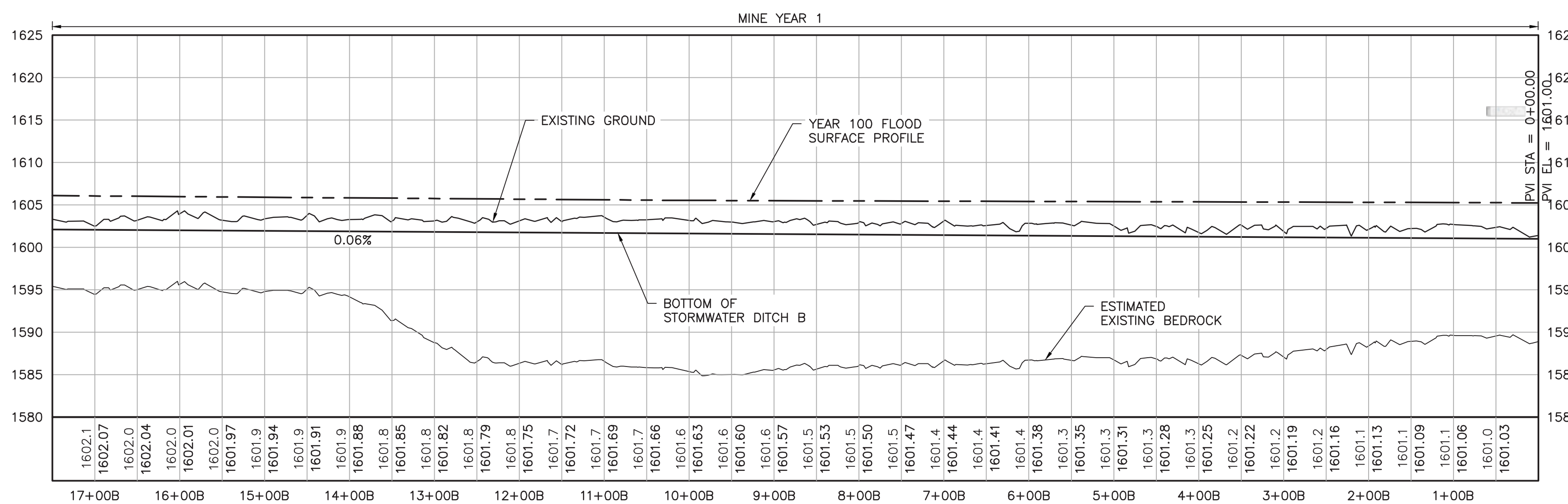
CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-05-SW-020.DWG PLOT SCALE: 1:2 PLOT DATE: 6/1/2017 7:58 AM

INCHES 1 2



1 PLAN: STORMWATER DITCH B STA. 0+00B–17+50B

0 100 200
SCALE IN FEET



2 PROFILE: STORMWATER DITCH B STA. 0+00B–17+50B

10
0 0 100
SCALE IN FEET

NOTES:

1. ALL STATIONS SHOWN ON PROFILE ARE BASED ON DITCH CENTERLINE STATIONS.
2. EXISTING GROUND PROFILE REPRESENTS GRADE AT DITCH CENTERLINE.

VER NO	DATE	DESCRIPTION
1	5/26/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/7/2017
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB/ATS
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE STORMWATER
DITCH B PLAN AND PROFILE
STATION 0+00B – 17+50B

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

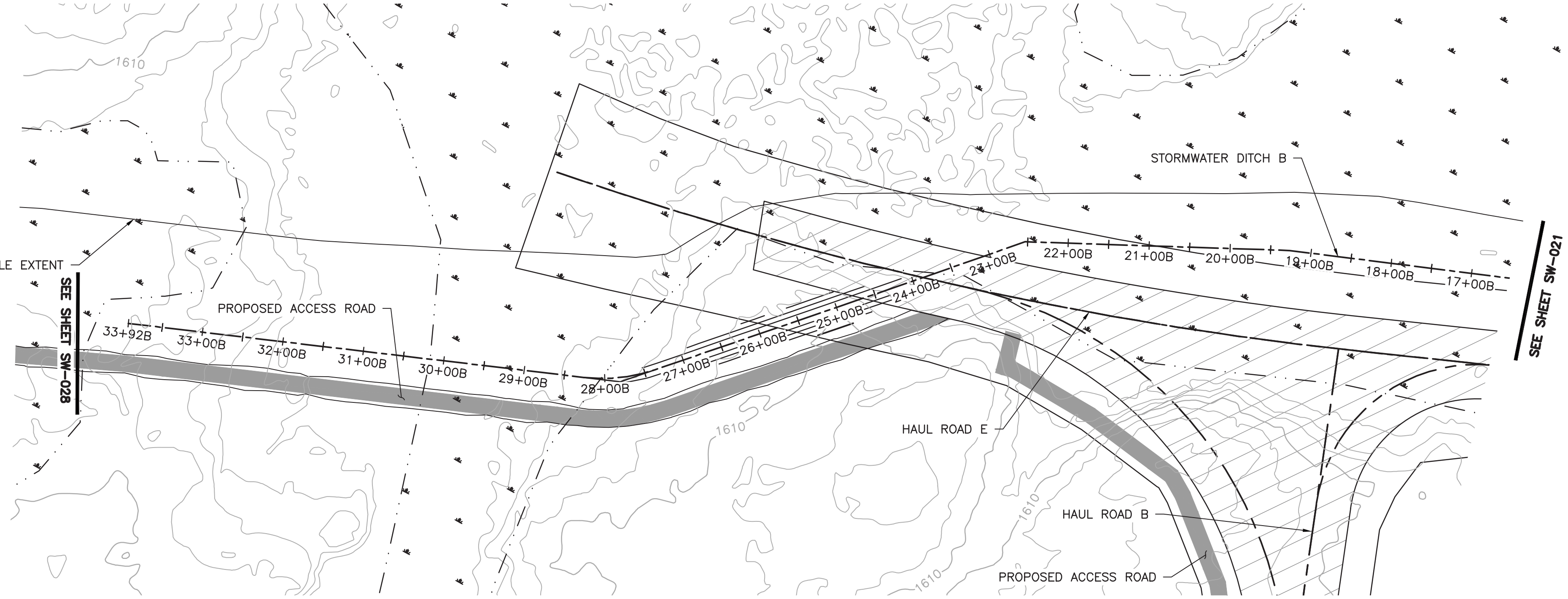
BARR

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. SW-021

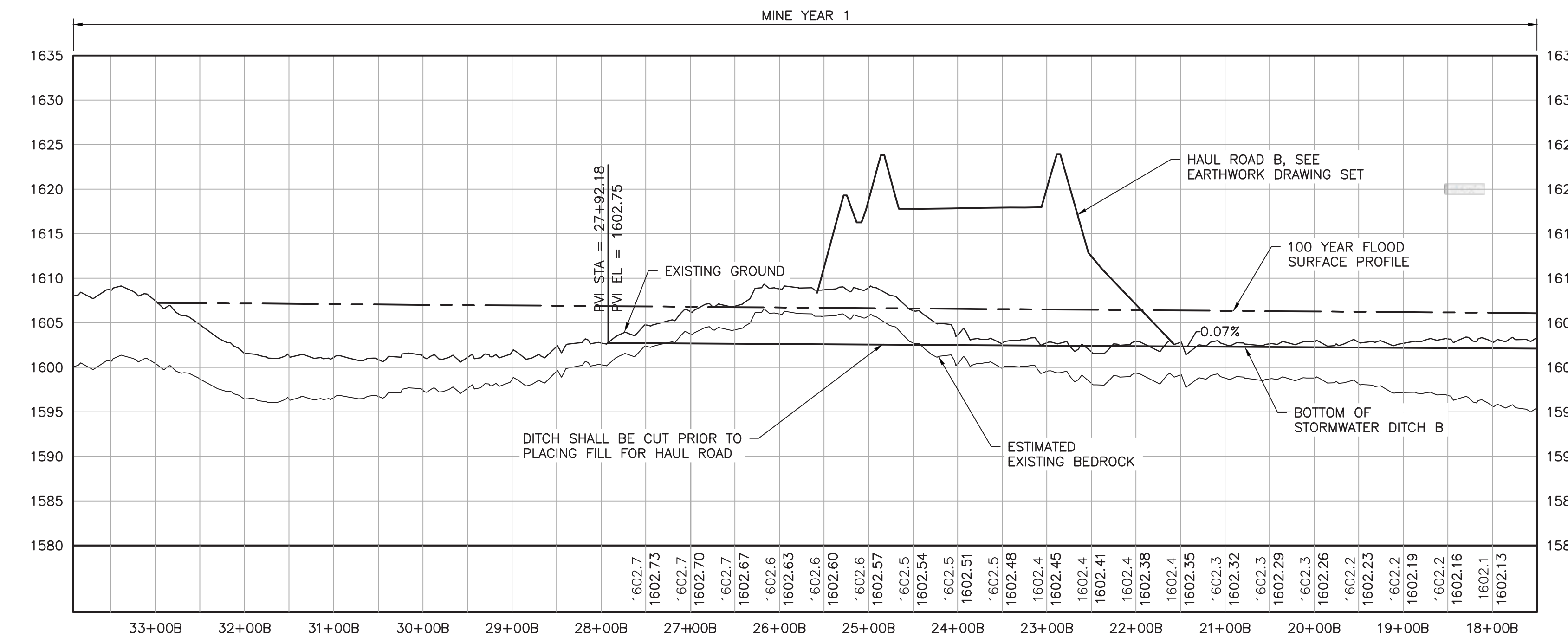
REV B

INCHES 1 2



1 PLAN: STORMWATER DITCH B STA. 17+50B–33+92B

0 100 200
SCALE IN FEET



2 PROFILE: STORMWATER DITCH B STA. 17+50B–33+92B

10
0 0 100
SCALE IN FEET

NOTES:

1. ALL STATIONS SHOWN ON PROFILE ARE BASED ON DITCH CENTERLINE STATIONS.
2. EXISTING GROUND PROFILE REPRESENTS GRADE AT DITCH CENTERLINE.
3. BOTTOM OF DITCH PROFILE LINE SHOWN TO PRESENT HYDRAULIC GRADE REQUIREMENTS, RESULTING "FILL" AREAS SHALL BE LEFT AS IS. DO NOT PLACE FILL TO RAISE GROUND TO DITCH PROFILE LINE.

VER NO	DATE	DESCRIPTION
1	5/26/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/7/2017
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB/ATS
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE STORMWATER
DITCH B PLAN AND PROFILE
STATION 17+50B – 33+92B

POLYMET MINING

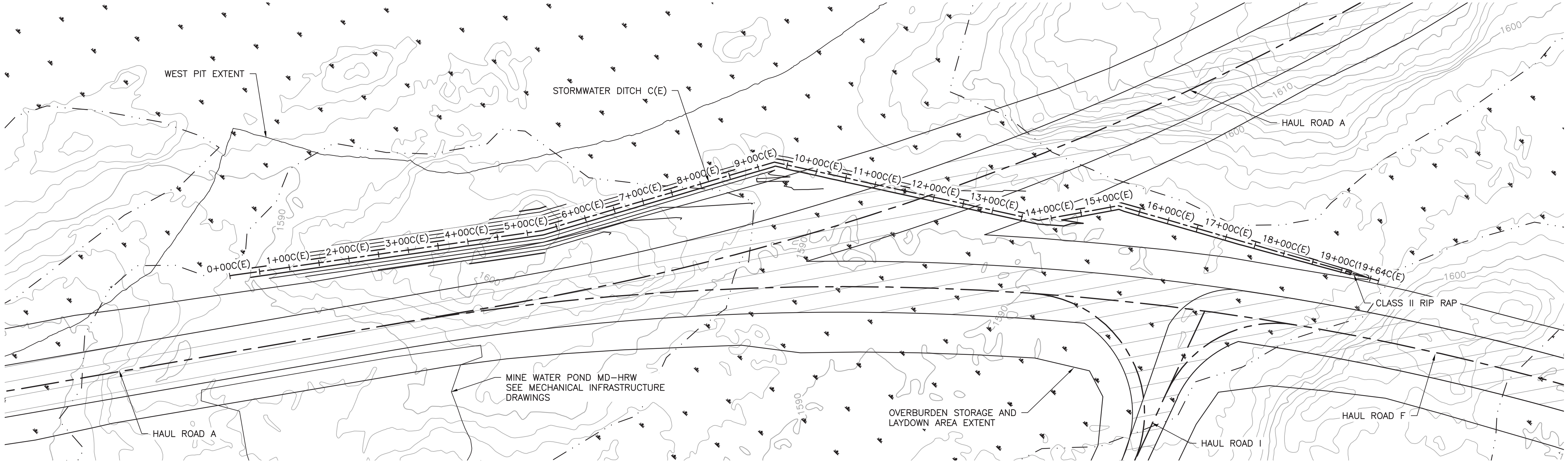
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. SW-022
REV B

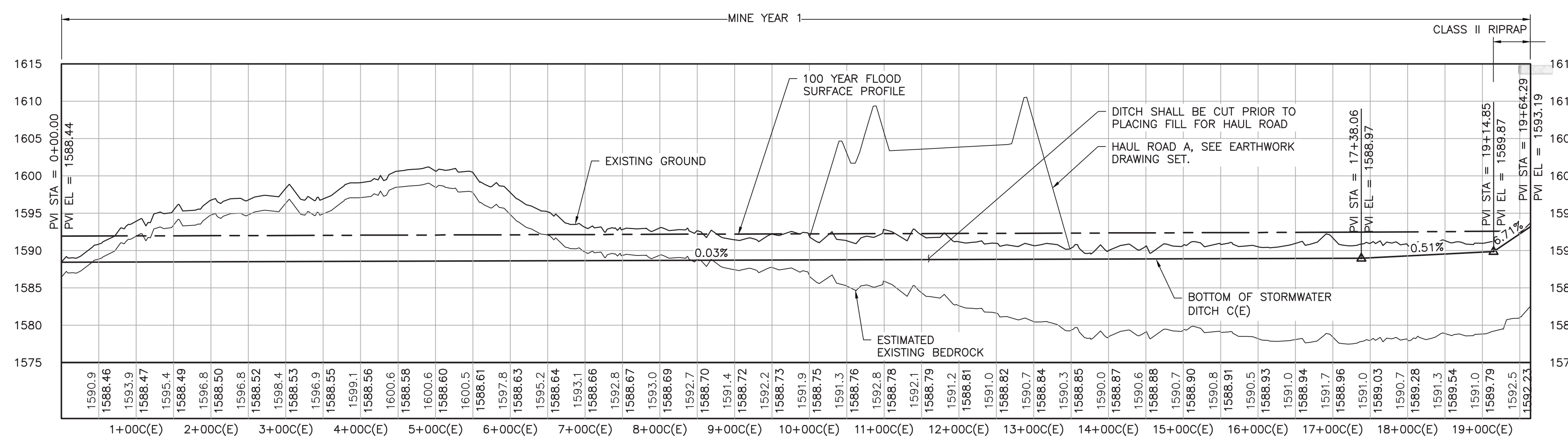
CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-05-SW-022.DWG PLOT SCALE: 1:2 PLOT DATE: 6/1/2017 7:56 AM

INCHES 1 2



1 PLAN: STORMWATER DITCH C(E) STA. 0+00C(E)–19+64C(E)

0 100 200
SCALE IN FEET



2 PROFILE: STORMWATER DITCH C(E) STA. 0+00C(E)–19+64C(E)

10
0 100
SCALE IN FEET

NOTES:

1. ALL STATIONS SHOWN ON PROFILE ARE BASED ON DITCH CENTERLINE STATIONS.
2. EXISTING GROUND PROFILE REPRESENTS GRADE AT DITCH CENTERLINE.

VER NO	DATE	DESCRIPTION
1	5/26/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
2	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/7/2017
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB/ATS
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE STORMWATER
DITCH C(E) PLAN AND PROFILE
STATION 0+00C(E) – 19+64C(E)

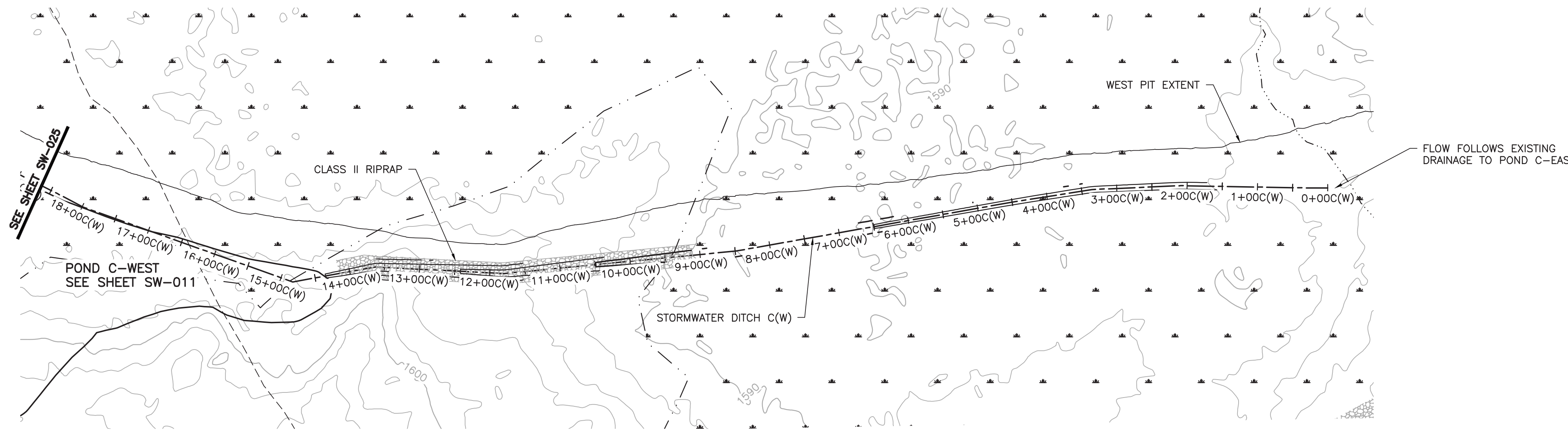
POLYMET MINING
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. SW-023
REV B

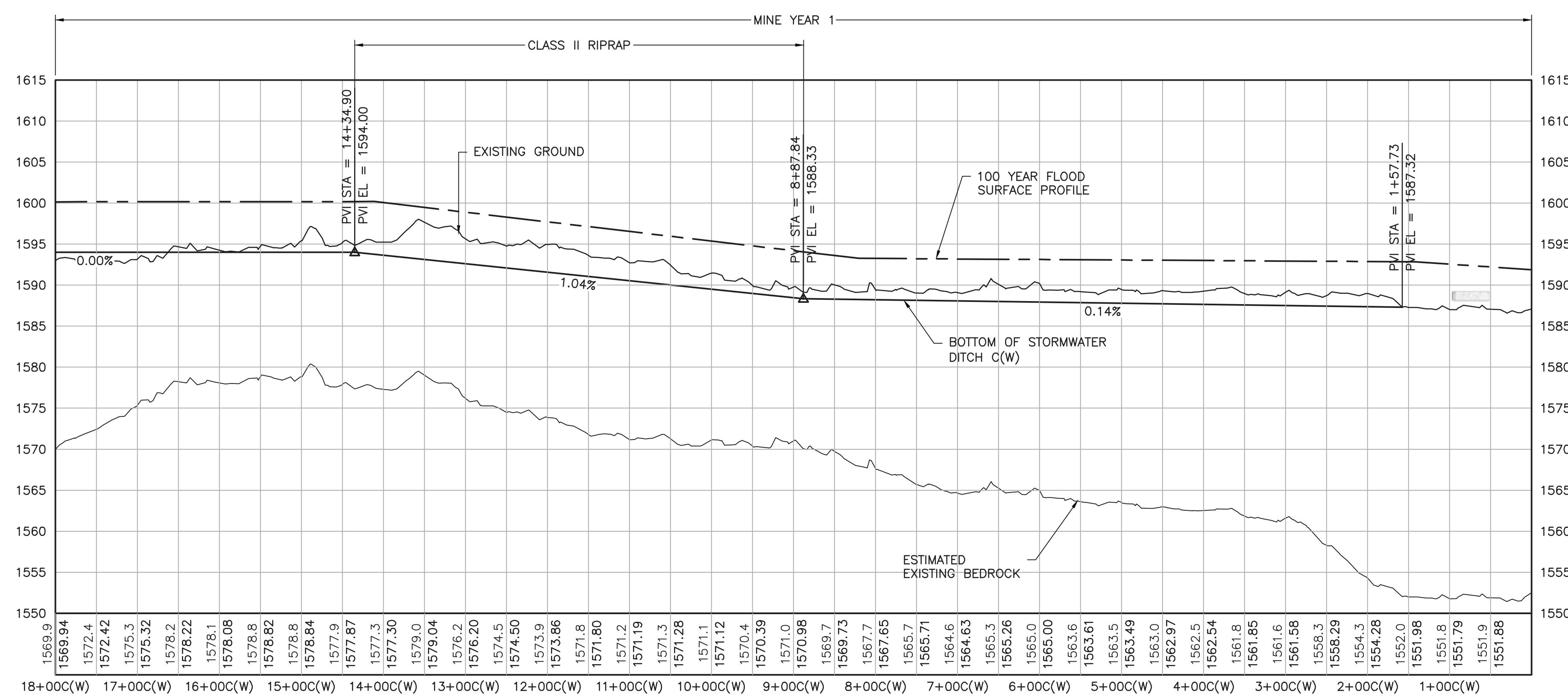
CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-05-SW-023.DWG PLOT SCALE: 1:2 PLOT DATE: 6/1/2017 7:51 AM

INCHES 1 2



1 PLAN: STORMWATER DITCH C(W)– STA. 0+00C(W)–18+00C(W)

0 100 200
SCALE IN FEET



2 PROFILE: STORMWATER DITCH C(W)– STA. 0+00C(W)–18+00C(W)

10 0 0 100
SCALE IN FEET

NOTES:

1. ALL STATIONS SHOWN ON PROFILE ARE BASED ON DITCH CENTERLINE STATIONS.
2. EXISTING GROUND PROFILE REPRESENTS GRADE AT DITCH CENTERLINE.
3. BOTTOM OF DITCH PROFILE LINE SHOWN TO PRESENT HYDRAULIC GRADE REQUIREMENTS, RESULTING "FILL" AREAS SHALL BE LEFT AS IS. DO NOT PLACE FILL TO RAISE GROUND TO DITCH PROFILE LINE.

VER NO	DATE	DESCRIPTION
1	5/26/15	ISSUED FOR INCLUSION FOR PERMIT SUBMITTAL
2	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/7/2017
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB/ATS
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE STORMWATER
DITCH C(W) PLAN AND PROFILE
STATION 0+00C(W) – 18+00C(W)

POLYMET MINING

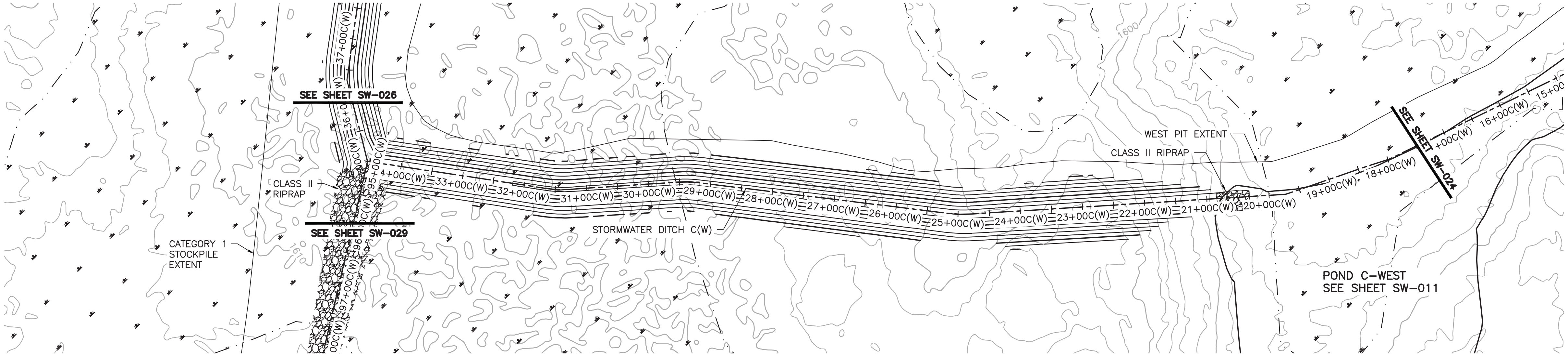
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. SW-024
REV B

CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-05-SW-024.DWG PLOT SCALE: 1:2 PLOT DATE: 6/1/2017 7:55 AM

INCHES 1 2



1 PLAN: STORMWATER DITCH C(W) – STA. 18+00C(W)–34+50C(W)

0 100 200
SCALE IN FEET

2 PROFILE: STORMWATER DITCH C(W) – STA. 18+00C(W)–34+50C(W)

10
0 100
SCALE IN FEET

NOTES:

1. ALL STATIONS SHOWN ON PROFILE ARE BASED ON DITCH CENTERLINE STATIONS.
2. EXISTING GROUND PROFILE REPRESENTS GRADE AT DITCH CENTERLINE.
3. BOTTOM OF DITCH PROFILE LINE SHOWN TO PRESENT HYDRAULIC GRADE REQUIREMENTS, RESULTING "FILL" AREAS SHALL BE LEFT AS IS. DO NOT PLACE FILL TO RAISE GROUND TO DITCH PROFILE LINE.

VER NO	DATE	DESCRIPTION
1	5/26/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
2	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/7/2017
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB/ATS
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE STORMWATER
DITCH C(W) PLAN AND PROFILE
STATION 18+00C(W) – 34+50C(W)

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

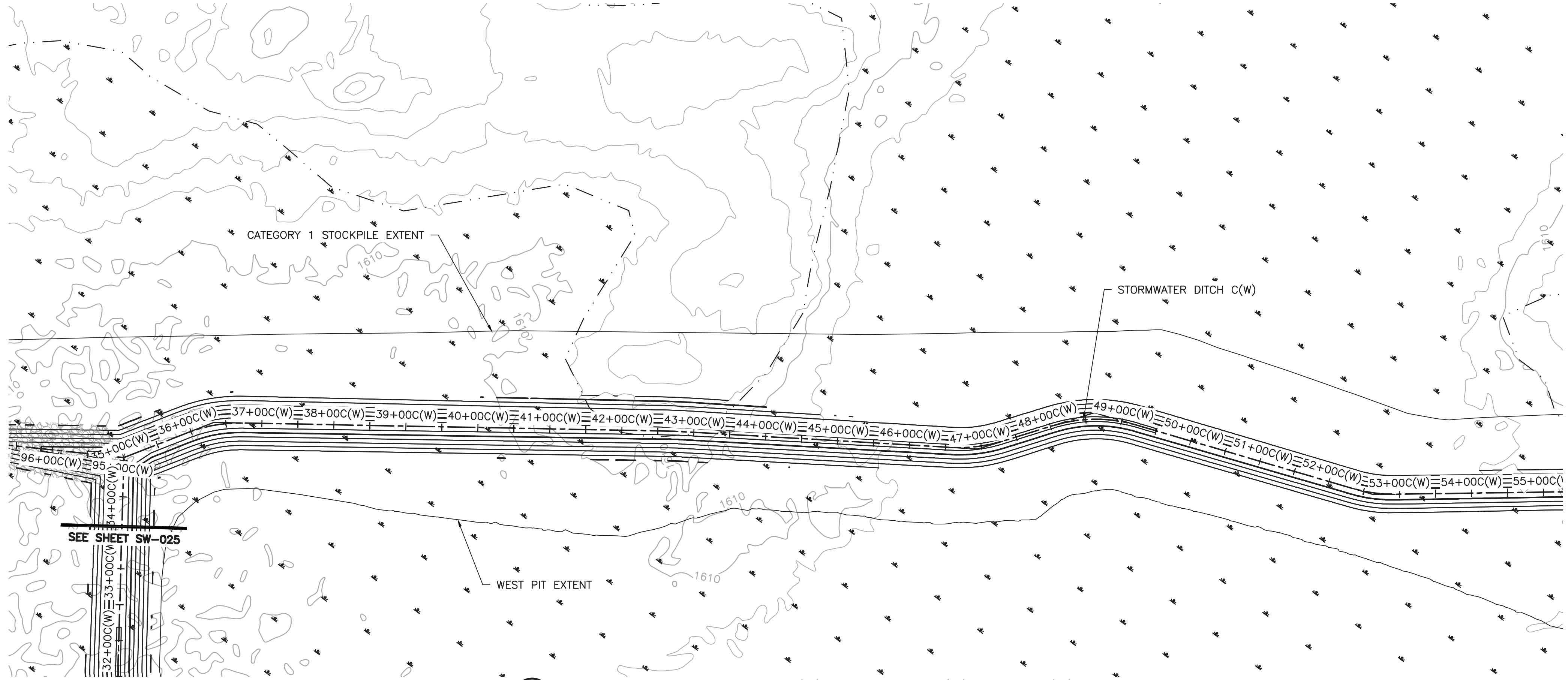
BARR

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. SW-025
REV B

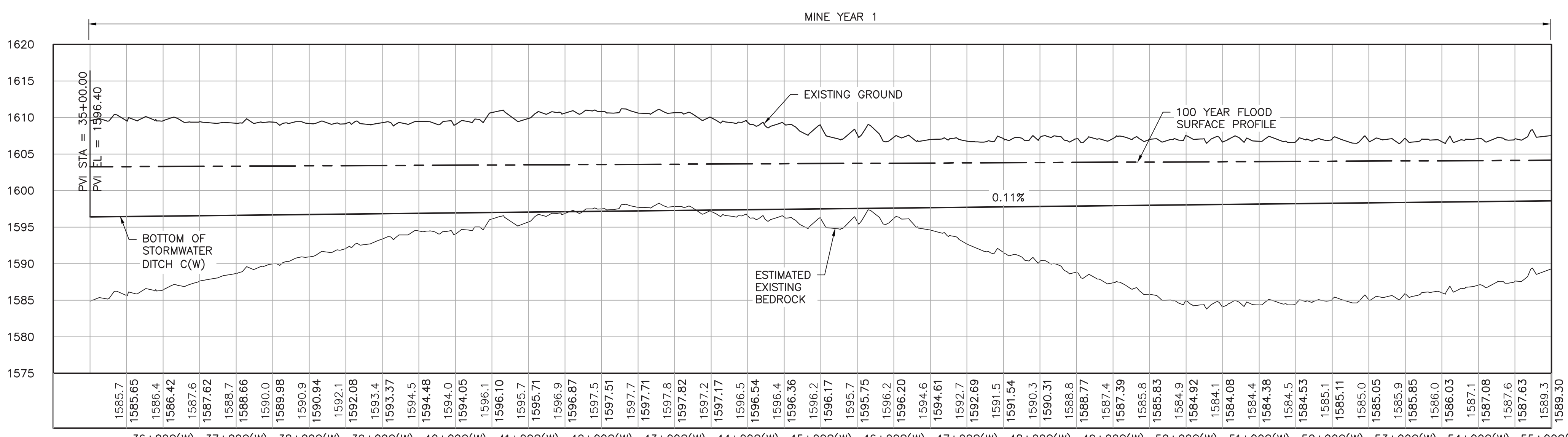
CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-05-SW-025.DWG PLOT SCALE: 1:2 PLOT DATE: 6/1/2017 7:53 AM

INCHES 1 2



1 PLAN: STORMWATER DITCH C(W) STA. 34+50C(W)–55+00C(W)

0 100 200
SCALE IN FEET



2 PROFILE: STORMWATER DITCH C(W) STA. 34+50C(W)–55+00C(W)

10
0 100
SCALE IN FEET

NOTES:

1. ALL STATIONS SHOWN ON PROFILE ARE BASED ON DITCH CENTERLINE STATIONS.
2. EXISTING GROUND PROFILE REPRESENTS GRADE AT DITCH CENTERLINE.

VER NO	DATE	DESCRIPTION
1	5/26/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
2	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/7/2017
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB/ATS
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE STORMWATER
DITCH C(W) PLAN AND PROFILE
STATION 34+50C(W) – 55+00C(W)

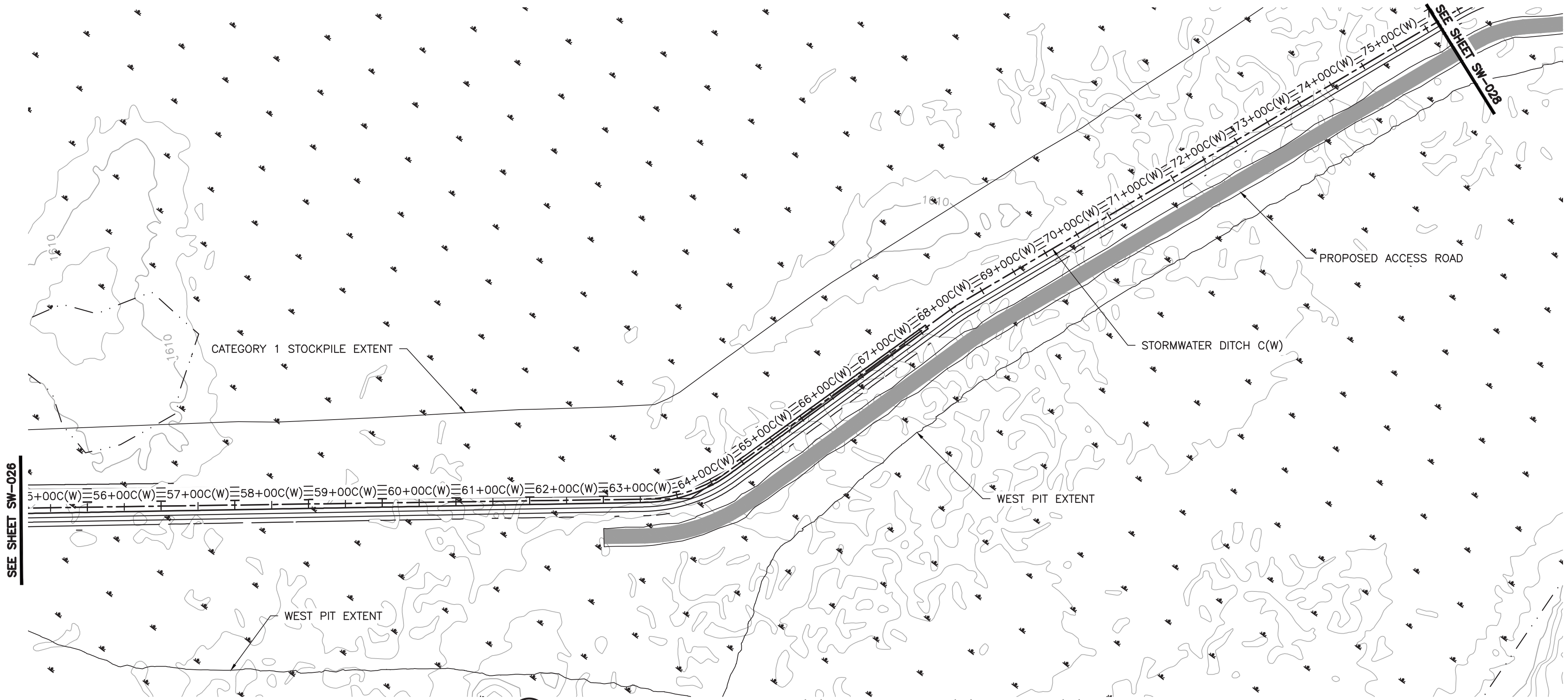
POLYMET MINING
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. SW-026
REV B

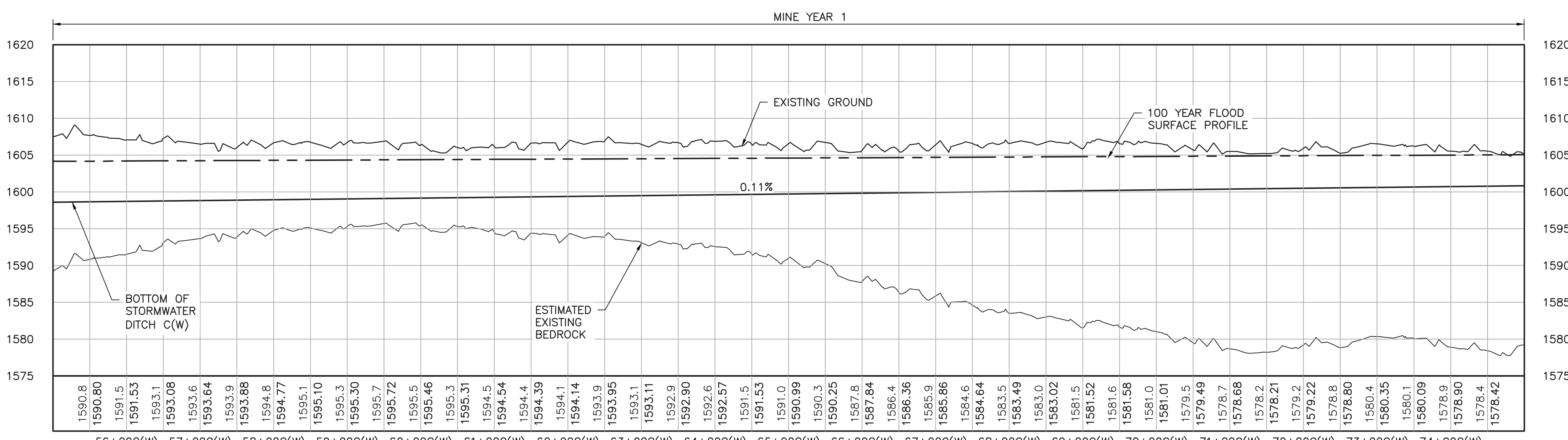
CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-05-SW-026.DWG PLOT SCALE: 1:2 PLOT DATE: 6/1/2017 7:22 AM

INCHES 1 2



1 PLAN: STORMWATER DITCH C(W) STA. 55+00C(W)–75+00C(W)

0 100 200
SCALE IN FEET



2 PROFILE: STORMWATER DITCH C(W) STA. 55+00C(W)–75+00C(W)

10
0 100
SCALE IN FEET

NOTES:

1. ALL STATIONS SHOWN ON PROFILE ARE BASED ON DITCH CENTERLINE STATIONS.
2. EXISTING GROUND PROFILE REPRESENTS GRADE AT DITCH CENTERLINE.

VER NO	DATE	DESCRIPTION
1	5/26/15	ISSUED FOR INCLUSION IN PERMET APPLICATION
2	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/7/2017
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB/ATS
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE STORMWATER
DITCH C(W) PLAN AND PROFILE
STATION 55+00C(W) – 75+00C(W)

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

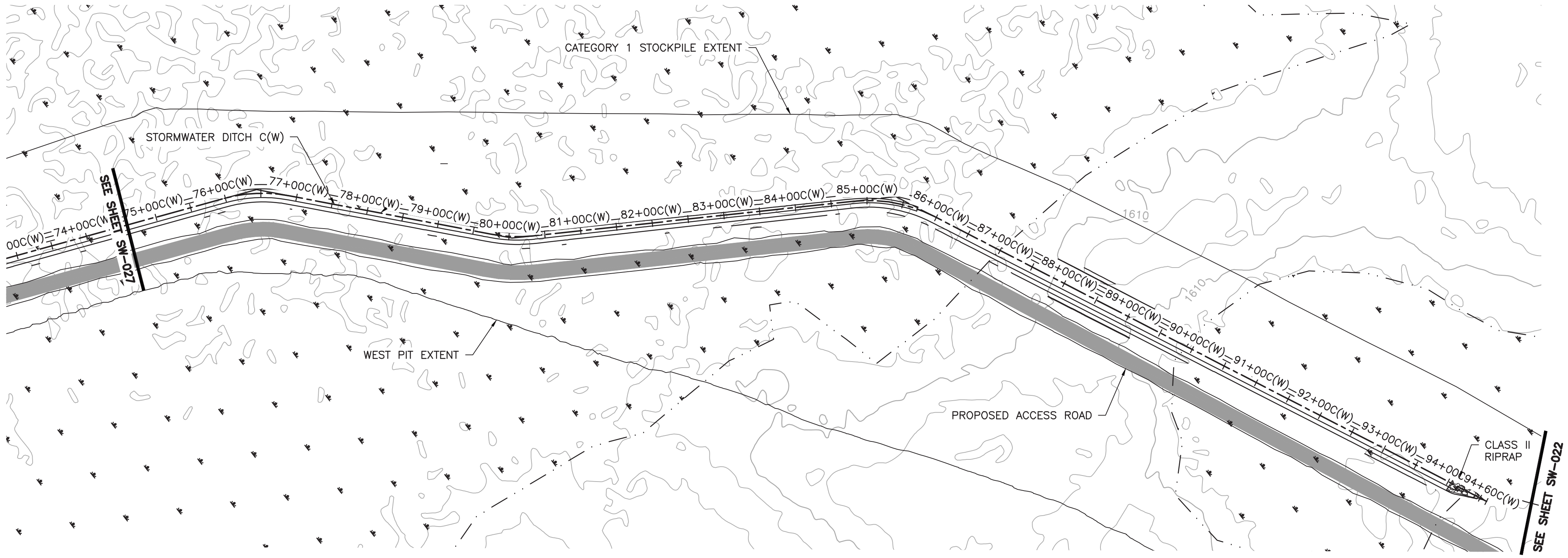
BARR

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. SW-027
REV B

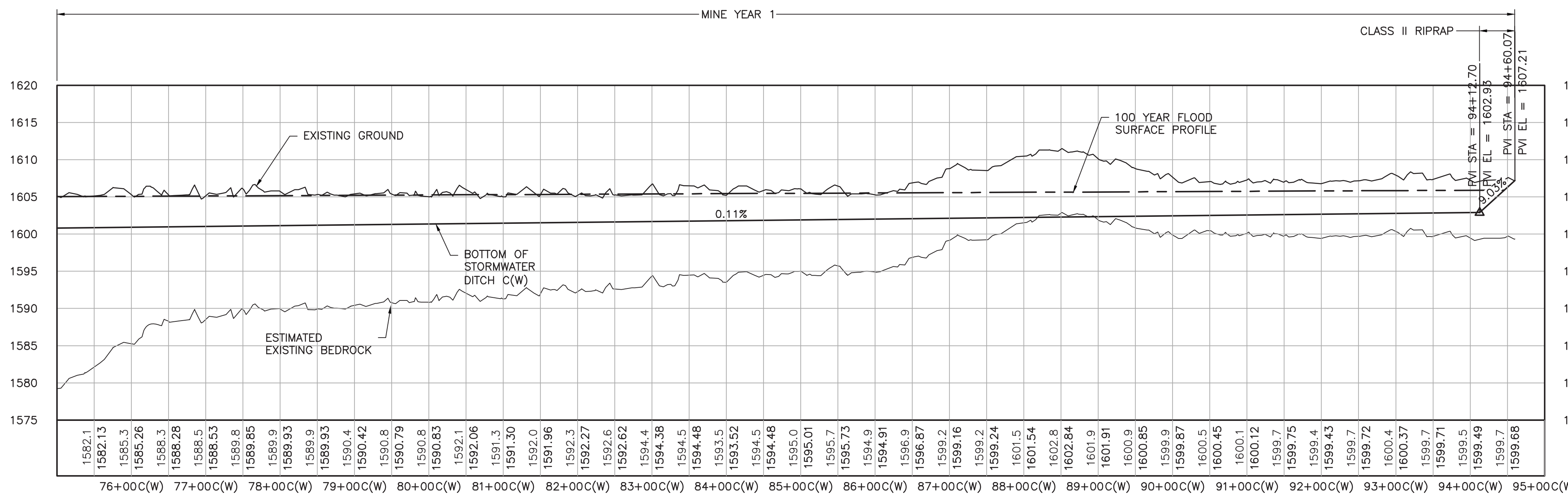
CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-05-SW-027.DWG PLOT SCALE: 1:2 PLOT DATE: 6/1/2017 7:24 AM

INCHES 1 2



1 PLAN: STORMWATER DITCH C(W) STA. 75+00C(W)–94+60C(W)

0 100 200
SCALE IN FEET



2 PROFILE: STORMWATER DITCH C(W) STA. 75+00C(W)–94+60C(W)

10
0 0 100
SCALE IN FEET

NOTES:

1. ALL STATIONS SHOWN ON PROFILE ARE BASED ON DITCH CENTERLINE STATIONS.
2. EXISTING GROUND PROFILE REPRESENTS GRADE AT DITCH CENTERLINE.

VER NO	DATE	DESCRIPTION
1	5/26/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
2	6/7/2017	PERMIT APPLICATION UPDATES

ISSUED	VERSION	DATE
FOR PERMITTING	2	6/7/2017
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB/ATS
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE STORMWATER
DITCH C(W) PLAN AND PROFILE
STATION 75+00C(W) – 94+60C(W)

POLYMET MINING

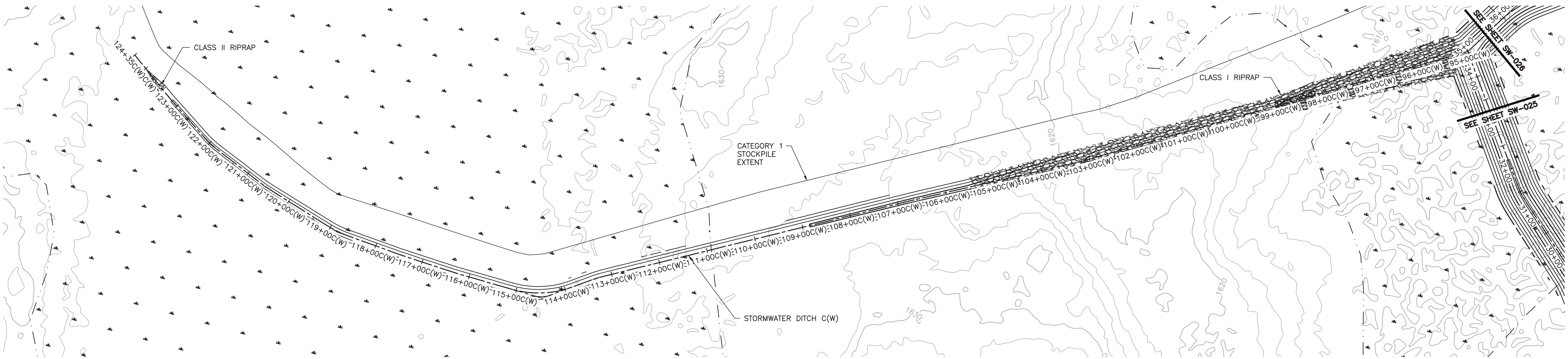
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. SW-028
REV B

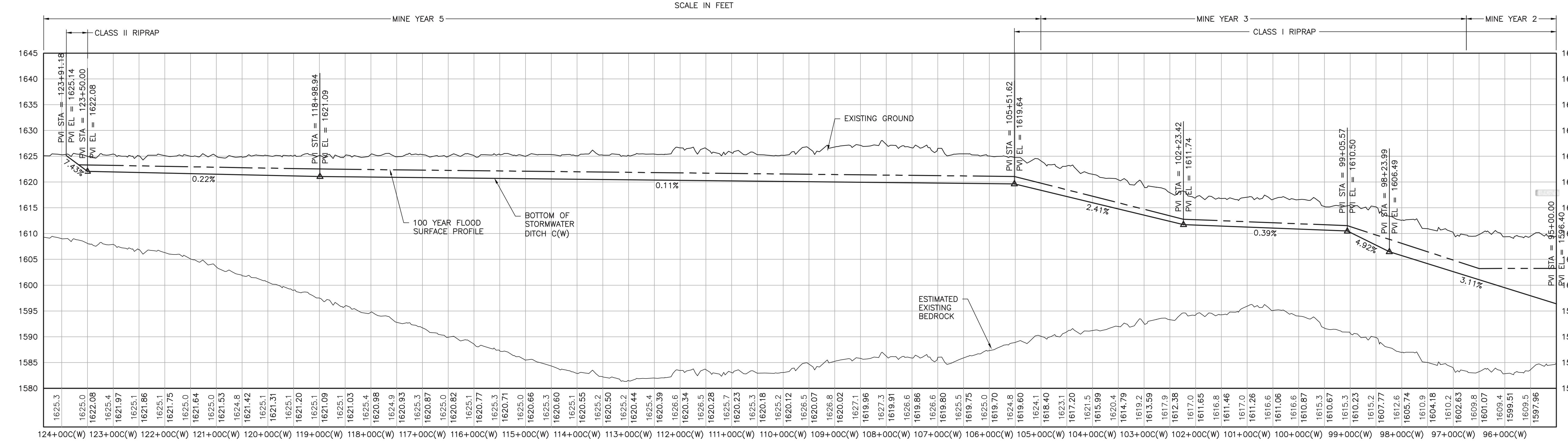
CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-05-SW-028.DWG PLOT SCALE: 1:2 PLOT DATE: 6/1/2017 7:20 AM

INCHES 1 2



1 PLAN: STORMWATER DITCH C(W) STA. 95+00C(W)–124+35C(W)

0 100 200
SCALE IN FEET



2 PROFILE: STORMWATER DITCH STA. 95+00C(W)–124+35C(W)

0 100
SCALE IN FEET

NOTES:

1. ALL STATIONS SHOWN ON PROFILE ARE BASED ON DITCH CENTERLINE STATIONS.
2. EXISTING GROUND PROFILE REPRESENTS GRADE AT DITCH CENTERLINE.

VER NO	DATE	DESCRIPTION
1	5/26/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
2	6/7/2017	PERMIT APPLICATION UPDATES

ISSUED	VERSION	DATE
FOR PERMITTING	2	6/7/2017
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB/ATS
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

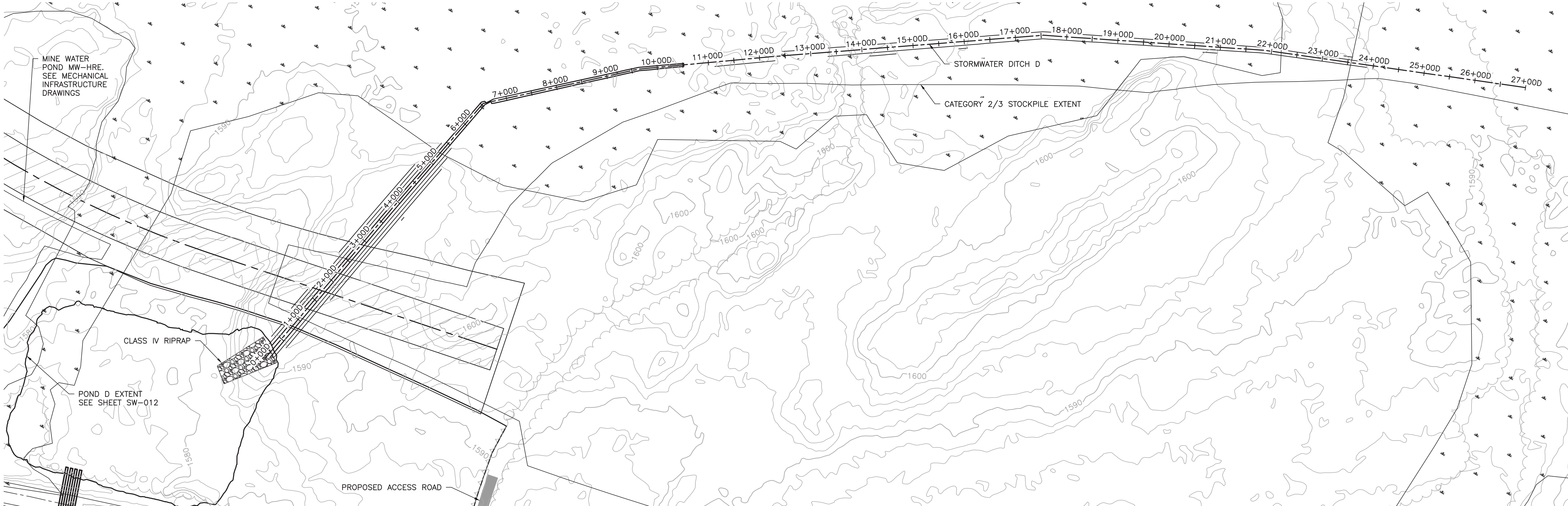
MINE SITE STORMWATER
DITCH C(W) PLAN AND PROFILE
STATION 95+00C(W) – 124+35C(W)

POLYMET MINING
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

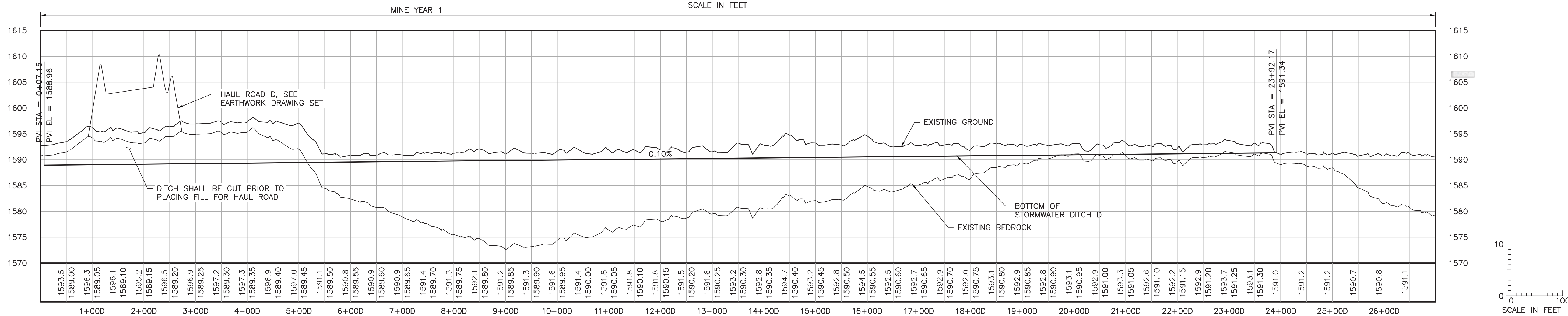
BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. SW-029
REV B

CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-05-SW-029.DWG PLOT SCALE: 1:2 PLOT DATE: 6/1/2017 7:21 AM



1 PLAN: STORMWATER DITCH D STA. 0+00D-27+00D



2 PROFILE: STORMWATER DITCH D STA. 0+00D-27+00D

NOTES:

1. ALL STATIONS SHOWN ON PROFILE ARE BASED ON DITCH CENTERLINE STATIONS.
2. EXISTING GROUND PROFILE REPRESENTS GRADE AT DITCH CENTERLINE.

VER NO	DATE	DESCRIPTION
1	5/26/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
2	6/7/2017	PERMIT APPLICATION UPDATES

ISSUED	VERSION	DATE
FOR PERMITTING	2	6/7/2017
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB/ATS
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE STORMWATER
DITCH D PLAN AND PROFILE
STATION 0+00D - 27+00D

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

POLYMET MINING

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

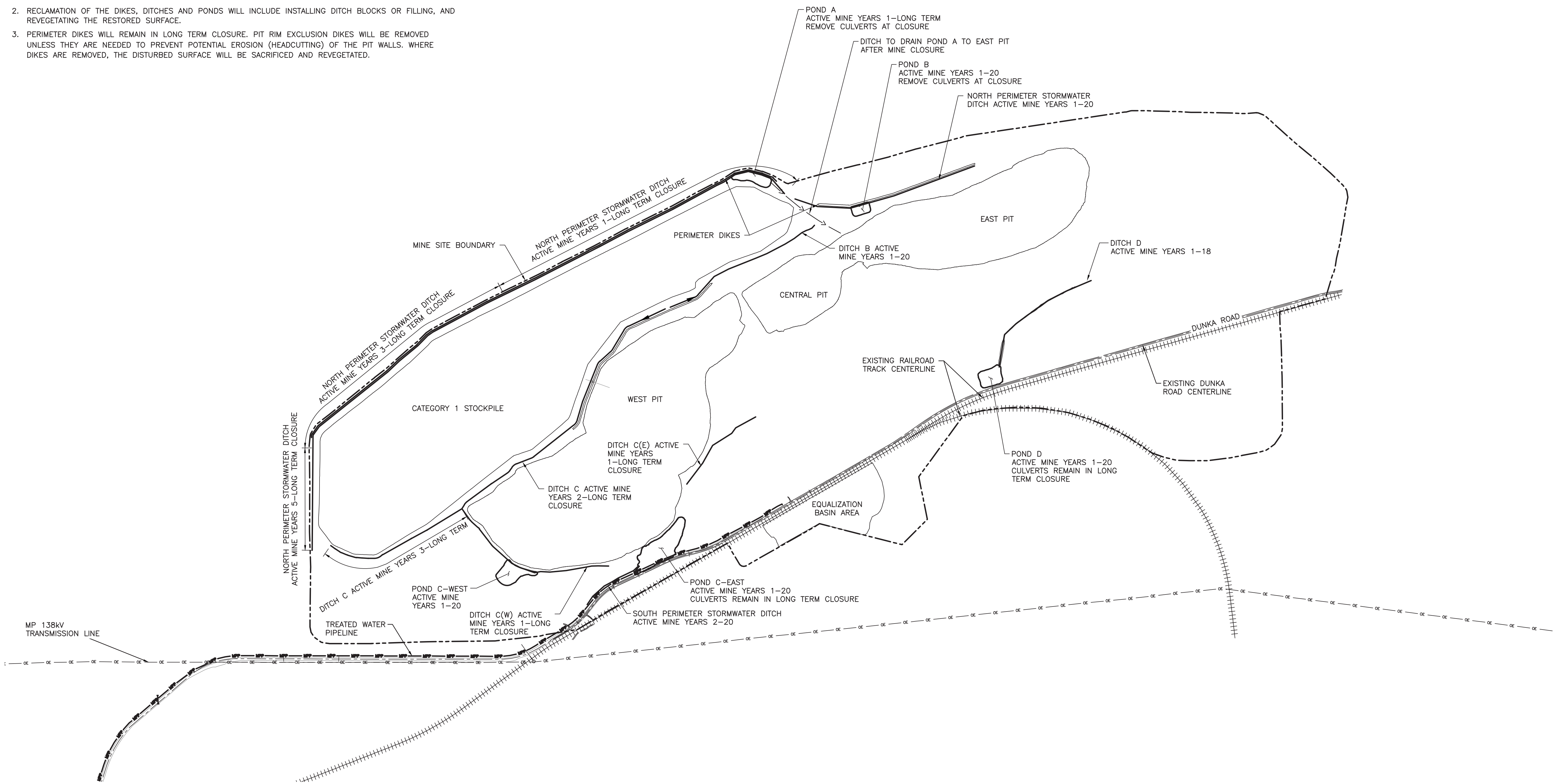
DWG. NO. SW-030
REV B

CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-05-SW-030.DWG PLOT SCALE: 1:2 PLOT DATE: 6/1/2017 7:25 AM

INCHES 1 2

NOTES:

1. ALL FEATURES SHOWN WILL REMAIN IN LONG-TERM CLOSURE UNLESS OTHERWISE NOTED.
2. RECLAMATION OF THE DIKES, DITCHES AND PONDS WILL INCLUDE INSTALLING DITCH BLOCKS OR FILLING, AND REVEGETATING THE RESTORED SURFACE.
3. PERIMETER DIKES WILL REMAIN IN LONG TERM CLOSURE. PIT RIM EXCLUSION DIKES WILL BE REMOVED UNLESS THEY ARE NEEDED TO PREVENT POTENTIAL EROSION (HEADCUTTING) OF THE PIT WALLS. WHERE DIKES ARE REMOVED, THE DISTURBED SURFACE WILL BE SACRIFICED AND REVEGETATED.



1 PLAN: STORMWATER DIKES, DITCHES, AND PONDS RECLAMATION PLAN

N

0 1000 2000
SCALE IN FEET

VER NO	DATE	DESCRIPTION
1	5/26/15	ISSUED FOR INCLUSION IN PERMIT APPLICATION
2	6/7/2017	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/7/2017
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME PAUL T. SWENSON
SIGNATURE
DATE 5/26/17 LICENSE# 20533

DRAWN: KKB/ATS
CHECKED: ATS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE SITE STORMWATER
DIKES, DITCHES, AND PONDS
RECLAMATION PLAN

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. SW-031

REV B

CADD USER: Kate K. Brown FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-05-SW-031.DWG PLOT SCALE: 1:2 PLOT DATE: 6/9/2017 7:28 AM

INCHES 1 2

Mechanical Infrastructure
Permit Application Support Drawings

Errata Sheet

Poly Met Mining, Inc. NorthMet Project

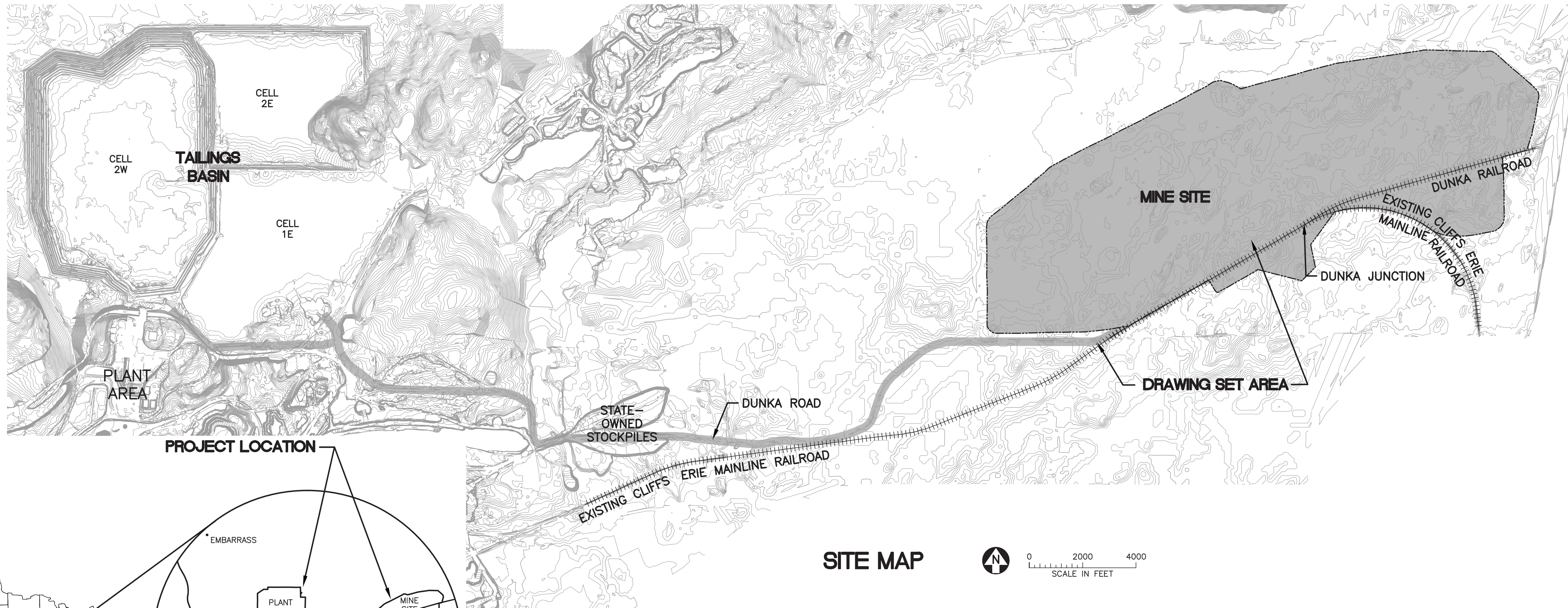
Permit Application Support Drawings: Mechanical Infrastructure

August 2017 (version 3)

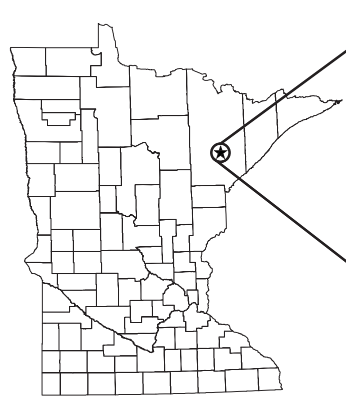
Engineering design is currently in progress. The table below lists changes that have been identified to-date and have not yet been incorporated in the attached permit application support drawings within this set. Final design will incorporate these changes along with additional site-specific information (e.g., supplementary geotechnical data); therefore, additional adjustments may be made during final design that will be incorporated into the final design drawing set.

Drawing Sheet(s)	Change
Global change to all sheets, as needed	The terminology "mine drainage" as noted in these drawings will be changed to "mine water".
MPP-009	The berm over the MPP will be revised to match the contours of the road where it crosses the proposed access road near the Equalization Basin Area.
MPP-010	The option of 1" minus rock as the top berm surface was eliminated to minimize additional impervious surfaces. Remove "or 1" minus rock" text on Sections 1, 2, 4, & 5.
MW-001	An access road will be added adjacent to a Mine Water pipe for construction and maintenance purposes. This access road will follow the Mine Water pipe that connects the Category 1 Stockpile and Haul Road F (in a general north-south orientation).
MW-003	The grading for the access road from the Mine Site Fueling and Maintenance Facility (MSFMF) to Pond MW-SOSP & Sump SOSP will be revised to optimize drainage.
ME-002, MPP-001, MPP-007, MPP-008, MPP-009, MW-001, MW-002, MW-007, MW-008, MW-016	The "Mine Site Boundary" will be replaced by the "Mining Area Boundary" as shown on figures included in the Permit to Mine Application.

POLY MET MINING, INC. NORTHMET PROJECT
PERMIT APPLICATION SUPPORT DRAWINGS
MECHANICAL INFRASTRUCTURE
HOYT LAKES, MINNESOTA

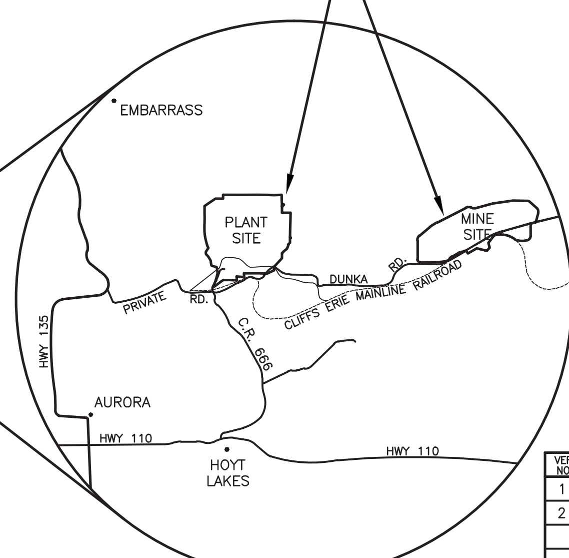


SITE MAP



LOCATION MAP

NOT TO SCALE



VICINITY MAP

NOT TO SCALE

VER NO	DATE	DESCRIPTION
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

ISSUE STATUS	ISSUED	VERSION	DATE
	FOR PERMITTING	2	6/07/17
	FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MECHANICAL INFRASTRUCTURE GENERAL DWGS
LOCATION MAP AND SITE MAP

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. ME-001
REV B

CADD USER: Veronica Wourms FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-50-TS-001.DWG PLOT SCALE: 1:2 PLOT DATE: 6/2/2017 8:38 AM

INCHES 1 2

SHEET INDEX

MECHANICAL INFRASTRUCTURE LEGEND

GENERAL

- 1000 — EXISTING CONTOUR – MAJOR
- EXISTING CONTOUR – MINOR
- 1000 — PROPOSED CONTOUR – MAJOR
- PROPOSED CONTOUR – MINOR
- 1000 — OTHER FACILITY PROPOSED CONTOUR – MAJOR
- OTHER FACILITY PROPOSED CONTOUR – MINOR
- PROPOSED RAILROAD
- EXISTING RAILROAD
- PROPOSED ACCESS ROADS
- EXISTING ROAD
- MINE SITE BOUNDARY
- WETLAND BOUNDARY
- HAUL ROAD

MINE TO PLANT PIPELINES DRAWINGS

- EXISTING POWER POLE
- EXISTING TRAIL
- EXISTING UNIMPROVED TRAIL
- R/W — RIGHT OF WAY
- EXISTING STRUCTURES
- TREE LINE
- OE — EXISTING OVERHEAD ELECTRIC
- UE — EXISTING UNDERGROUND ELECTRIC
- MPP — PROPOSED MINE TO PLANT PIPELINES
- PROPOSED CULVERT (NON–MINE WATER)
- PROPOSED MINE WATER PIPE

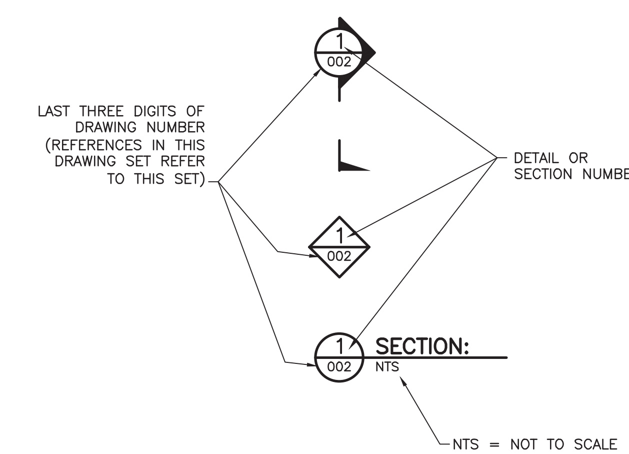
MINE WATER DRAWINGS

- PROPOSED MINE WATER PIPE
- TOP OF DIKE BENCH
- PROPOSED MINE WATER CULVERT
- PROPOSED SUMP MANHOLE
- MPP — PROPOSED MINE TO PLANT PIPELINES
- << — PROPOSED HAUL ROAD MINE WATER DITCH
- PROPOSED STOCKPILE LINER OUTLET PIPE
- PROPOSED MINE WATER WATERSHED

NOTES

1. COORDINATE SYSTEM IS MINNESOTA STATE PLANE NORTH ZONE, NAD83.
2. ELEVATIONS ARE MEAN SEA LEVEL (MSL), NAVD88.
3. EXISTING TOPOGRAPHIC INFORMATION SHOWN ON THE DRAWINGS WAS PREPARED BY AEROMETRIC, INC. FROM LIDAR DATA COLLECTED ON MARCH 17, 2010.

DRAWING NUMBERING



ABBREVIATIONS

AC–FT	–	ACRE–FEET
AVE	–	AVERAGE
CAT	–	CATEGORY
℄	–	CENTERLINE
CMP	–	CORRUGATED METAL PIPE
CPS	–	CENTRAL PUMPING STATION
DIP	–	DUCTILE IRON PIPE
DV	–	DRAIN VALVE
DWG	–	DRAWING
EL.	–	ELEVATION
GAL	–	GALLONS
GCL	–	GEOSYNTHETIC CLAY LINER
GPM	–	GALLONS PER MINUTE
HDPE	–	HIGH–DENSITY POLYETHYLENE
HRC	–	HAUL ROAD CENTRAL
HRE	–	HAUL ROAD EAST
HRN	–	HAUL ROAD NORTH
HRW	–	HAUL ROAD WEST
INV	–	INVERT
LF	–	LINEAR FEET
MG	–	MILLION GALLONS
MH	–	MANHOLE
MIL	–	MEASUREMENT OF LINER THICKNESS; A MIL IS A THOUSANDTH OF AN INCH
MIN	–	MINIMUM
MnDOT	–	MINNESOTA DEPARTMENT OF TRANSPORTATION
MPP	–	MINE TO PLANT PIPELINES
MW	–	MINE WATER
OSLA	–	OVERBURDEN STORAGE AND LAYDOWN AREA
OSP	–	ORE SURGE PILE
PL	–	PIPELINE
PSI	–	POUNDS PER SQUARE INCH
RTH	–	RAIL TRANSFER HOPPER
SDR	–	STANDARD DIMENSION RATIO
STA	–	STATION
STOCKPILE	–	WASTE ROCK STOCKPILE
TDH	–	TOTAL DESIGN HEAD
TYP	–	TYPICAL
V/A	–	VACUUM/AIR RELIEF
WWTS	–	WASTE WATER TREATMENT SYSTEM

VER NO	DATE	DESCRIPTION
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/07/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69–0C29
SCALE: AS SHOWN

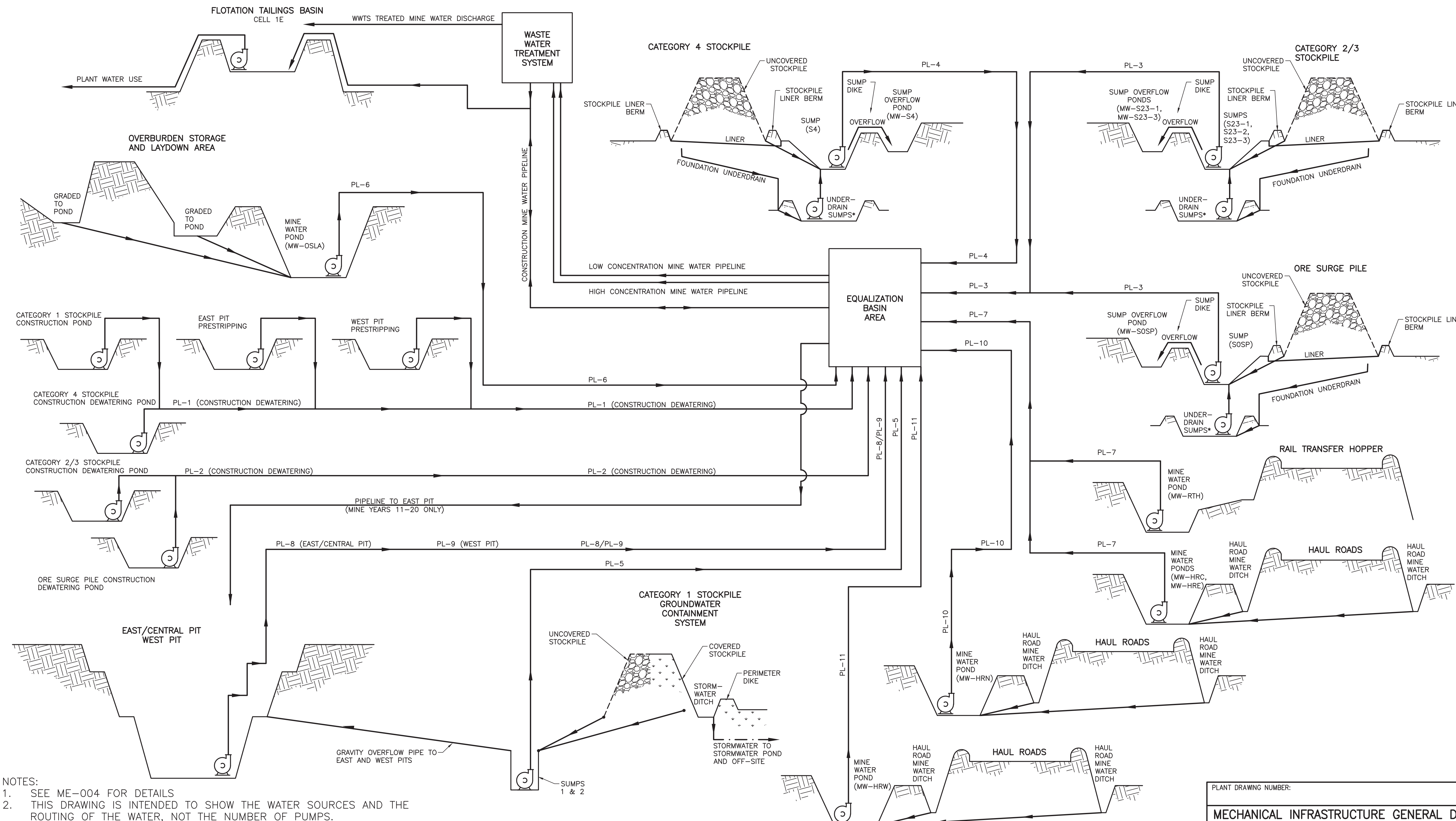
PLANT DRAWING NUMBER:

MECHANICAL INFRASTRUCTURE GENERAL DWGS
LEGEND AND SHEET INDEX

POLYMET MINING
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1–800–632–2277

DWG. NO. ME–002
REV B



NOTES:
1. SEE ME-004 FOR DETAILS
2. THIS DRAWING IS INTENDED TO SHOW THE WATER SOURCES AND THE ROUTING OF THE WATER, NOT THE NUMBER OF PUMPS.

* ROUTING OF THIS WATER WILL BE TO THE WWTS OR CPS DEPENDING ON WATER QUALITY TESTING RESULTS.

LEGEND

- STORMWATER FLOW
- SITE MINE WATER FLOW
- COVERED STOCKPILE/GRASS
- UNCOVERED STOCKPILE
- UNCOVERED EARTHWORK
- PUMP

VER NO	DATE	DESCRIPTION	ISSUE STATUS		
			ISSUED	VERSION	DATE
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS	FOR PERMITTING	2	6/07/17
2	6/07/17	PERMIT APPLICATION UPDATES			
			FOR CONSTRUCTION		
			NOT APPROVED FOR CONSTRUCTION		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MECHANICAL INFRASTRUCTURE GENERAL DWGS
MINE SITE
MINE WATER FLOW DIAGRAM

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. ME-003
REV B

CADD USER: Veronica Wourms FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-50-MF-500.DWG PLOT SCALE: 1:2 PLOT DATE: 6/2/2017 9:07 AM

INCHES 1 2

SUMPS – TEMPORARY

ID	DESCRIPTION	OBJECTIVES	MINE YEARS	DESIGN VOLUME* (GAL)	APPROXIMATE PUMP CAPACITY		LINER TYPE	ACTUAL VOLUME* (GAL)	OVERFLOWS TO	SHOWN ON SHEET #
					GPM	TDH (FT)				
S23–1	CATEGORY 2/3 STOCKPILE SUMP	PROVIDE RUNOFF STORAGE FOR THE 10 YEAR 24 HOUR EVENT	1–19	4,855,000	190	210	MINE WATER SUMP LINER	4,855,000	MW–S23–1	MW–005
S23–2	CATEGORY 2/3 STOCKPILE SUMP	PROVIDE RUNOFF STORAGE FOR THE 10 YEAR 24 HOUR EVENT	3–17	3,878,000	150	230	MINE WATER SUMP LINER	3,910,000	MW–S23–1	MW–006
S23–3	CATEGORY 2/3 STOCKPILE SUMP	PROVIDE RUNOFF STORAGE FOR THE 10 YEAR 24 HOUR EVENT	6–16	2,151,000	90	270	MINE WATER SUMP LINER	2,151,000	MW–S23–3	MW–007
S4	CATEGORY 4 STOCKPILE SUMP	PROVIDE RUNOFF STORAGE FOR THE 10 YEAR 24 HOUR EVENT	1–11	3,291,000	130	50	MINE WATER SUMP LINER	4,073,000	MW–S4	MW–004
SOSP	ORE SURGE PILE SUMP	PROVIDE RUNOFF STORAGE FOR THE 10 YEAR 24 HOUR EVENT	1–20	2,770,000	80	90	MINE WATER SUMP LINER	2,835,000	MW–SOSP	MW–003

* DESIGN VOLUME REFLECTS THE VOLUME REQUIRED BASED ON THE DESIGN NEEDS; WHEREAS ACTUAL VOLUME REFLECTS THE VOLUME SHOWN IN THE ATTACHED DRAWING SET. ACTUAL VOLUME DOES NOT INCLUDE ADDITIONAL VOLUME FROM 3 FEET OF FREEBOARD

MINE PIT SUMPS

ID	DESCRIPTION	OBJECTIVES	MINE YEARS	INITIAL SUMP CAPACITY (AC–FT)	MAXIMUM SUMP CAPACITY (AC–FT)	APPROXIMATE PUMP CAPACITY – INITIAL YEAR AND MAXIMUM YEAR		OVERFLOWS TO
						GPM	TDH (FT)	
WP–W	WEST PIT – WEST SUMP	*COLLECTION IN PIT	2–20	6.6	14.0	YEAR 2: 820 YEAR 20: 1,590	YEAR 2: 120 YEAR 20: 740	NONE
WP–E	WEST PIT – EAST SUMP	*COLLECTION IN PIT	10–20	4.7	9.4	YEAR 10: 530 YEAR 20: 1,050	YEAR 10: 110 YEAR 20: 350	NONE
EP	EAST PIT	*COLLECTION IN PIT	1–20	11.6	19.5	YEAR 1: 1,520 YEAR 11: 2,340	YEAR 1: 120 YEAR 11: 750	NONE
CP	CENTRAL PIT	*COLLECTION IN PIT	11–20	3.8	3.8	YEAR 11: 440 YEAR 16: 440	YEAR 1: 60 YEAR 16: 390	NONE

* PIT COLLECTION IS BASED ON 40% OF THE AVERAGE ANNUAL SNOW MELT OCCURRING WITHIN ONE DAY AND THE PUMP CAPACITY DESIGNED TO REMOVE THAT SNOW MELT EVENT WITHIN 3 DAYS

SUMPS – PERMANENT

ID	DESCRIPTION	OBJECTIVES	MINE YEARS	MINIMUM CAPACITY (GAL)	APPROXIMATE PUMP CAPACITY		LINER TYPE	OVERFLOWS TO	SHOWN ON SHEET #
					GPM	TDH (FT)			
SUMP 1	CATEGORY 1 STOCKPILE SUMP – EAST	COLLECTION FOR GROUNDWATER CONTAINMENT SYSTEM	1–20+	NA – MANHOLE	7,200	50	NA – MANHOLE	EAST PIT	SEE CATEGORY 1 STOCKPILE CONTAINMENT SYSTEM DRAWING SET
SUMP 2	CATEGORY 1 STOCKPILE SUMP – WEST	COLLECTION FOR GROUNDWATER CONTAINMENT SYSTEM	1–20+	NA – MANHOLE	7,200	50	NA – MANHOLE	WEST PIT	

NOTES:

1. ACTUAL PUMP, PIPE, AND POND SIZES WILL BE OPTIMIZED IN FINAL DESIGN
2. STANDARDIZED PUMP SIZE TO BE DETERMINED DURING FINAL DESIGN
3. MINE WATER SUMP LINER IS SHOWN IN DETAIL 1 ON SHEET MW–014
4. MINE WATER POND LINER IS SHOWN IN DETAIL 2 ON SHEET MW–014
5. ALL PUMP CAPACITY FLOWS AND TDH VALUES HAVE BEEN ROUNDED

MINE WATER PONDS

ID	DESCRIPTION	OBJECTIVES	MINE YEARS	DESIGN VOLUME* (GAL)	APPROXIMATE PUMP CAPACITY		LINER TYPE	ACTUAL VOLUME* (GAL)	OVERFLOWS TO	SHOWN ON SHEET #
					GPM	TDH (FT)				
MW–S23–1	CATEGORY 2/3 STOCKPILE SUMP OVERFLOW POND	PROVIDE SUMP OVERFLOW STORAGE UP TO THE 100 YEAR 24 HOUR EVENT	1–19	6,973,000	NA	NA	MINE WATER POND LINER	7,006,000	NONE	MW–005/ MW–006
MW–S23–3	CATEGORY 2/3 STOCKPILE SUMP OVERFLOW POND	PROVIDE SUMP OVERFLOW STORAGE UP TO THE 100 YEAR 24 HOUR EVENT	6–16	1,727,000	NA	NA	MINE WATER POND LINER	1,727,000	NONE	MW–007
MW–S4	CATEGORY 4 STOCKPILE SUMP OVERFLOW POND	PROVIDE SUMP OVERFLOW STORAGE UP TO THE 100 YEAR 24 HOUR EVENT	1–11	2,639,000	NA	NA	MINE WATER POND LINER	3,226,000	NONE	MW–004
MW–SOSP	ORE SURGE PILE SUMP OVERFLOW POND	PROVIDE SUMP OVERFLOW STORAGE UP TO THE 100 YEAR 24 HOUR EVENT	1–20	1,564,000	NA	NA	MINE WATER POND LINER	1,727,000	NONE	MW–003
MW–HRC	HAUL ROAD RUNOFF POND	PROVIDE FLOOD STORAGE UP TO THE 100 YEAR 24 HOUR EVENT AND REDUCE TSS	1–20	1,988,000	40	80	MINE WATER POND LINER	2,248,000	NONE	MW–011
MW–HRE	HAUL ROAD RUNOFF POND	PROVIDE FLOOD STORAGE UP TO THE 100 YEAR 24 HOUR EVENT AND REDUCE TSS	1–20	3,487,000	70	110	MINE WATER POND LINER	3,487,000	NONE	MW–010
MW–HRW	HAUL ROAD RUNOFF POND	PROVIDE FLOOD STORAGE UP TO THE 100 YEAR 24 HOUR EVENT AND REDUCE TSS	2–20	1,206,000	30	70	MINE WATER POND LINER	1,303,000	NONE	MW–012
MW–HRN	HAUL ROAD RUNOFF POND	PROVIDE FLOOD STORAGE UP TO THE 100 YEAR 24 HOUR EVENT AND REDUCE TSS	2–20	1,434,000	30	110	MINE WATER POND LINER	1,499,000	NONE	MW–013
MW–RTH	RAIL TRANSFER HOPPER RUNOFF POND	PROVIDE FLOOD STORAGE UP TO THE 100 YEAR 24 HOUR EVENT AND REDUCE TSS	1–20	228,000	200	60	MINE WATER SUMP LINER	228,000	NONE	MW–009
MW–OSLA	OVERBURDEN STORAGE & LAYDOWN AREA RUNOFF POND	PROVIDE FLOOD STORAGE UP TO THE 25 YEAR 24 HOUR EVENT AND REDUCE TSS	1–20	3,487,000	100	90	NONE	4,725,000	NONE	MW–008
TEMP (VARIOUS)	STOCKPILE CONSTRUCTION RUNOFF PONDS AND PIT STRIPPING	TEMPORARY POND TO COLLECT RUNOFF DURING CONSTRUCTION	VARIES	VARIES	VARIES	VARIES	NONE	VARIES	NONE	NONE

*DESIGN VOLUME REFLECTS THE VOLUME REQUIRED BASED ON THE DESIGN NEEDS; WHEREAS ACTUAL VOLUME REFLECTS THE VOLUME SHOWN IN THE ATTACHED DRAWING SET. ACTUAL VOLUME DOES NOT INCLUDE ADDITIONAL VOLUME FROM 3 FEET OF FREEBOARD (1 FOOT FOR MW–RTH)

PIPING

ID	DESCRIPTION	OBJECTIVES	WATER SOURCE	NOMINAL PIPE SIZES* (IN)
MPP	MINE TO PLANT PIPELINES	TRANSPORT WATER FROM THE CPS TO FLOTATION TAILINGS BASIN	CPS	20
PL–1	PIPELINE NUMBER 1	TRANSPORT CONSTRUCTION WATER TO THE WWTS	TEMP – CAT 1, CAT 4, EAST PIT & WEST PIT	2 TO 8
PL–2	PIPELINE NUMBER 2	TRANSPORT CONSTRUCTION WATER TO THE WWTS	TEMP – CAT 2/3 + OSP	2 TO 8
PL–3	PIPELINE NUMBER 3	TRANSPORT MINE WATER TO THE WWTS	CAT 2/3 & OSP	3 TO 8
PL–4	PIPELINE NUMBER 4	TRANSPORT MINE WATER TO THE WWTS	CAT 4	4
PL–5	PIPELINE NUMBER 5	TRANSPORT MINE WATER TO THE WWTS	CAT 1	28 TO 42
PL–6	PIPELINE NUMBER 6	TRANSPORT MINE WATER TO THE CPS	OSLA	3
PL–7	PIPELINE NUMBER 7	TRANSPORT MINE WATER TO THE WWTS	RTH, MW–HRE & MW–HRC	2 TO 6
PL–8	PIPELINE NUMBER 8	TRANSPORT MINE WATER TO THE WWTS	EAST PIT & CENTRAL PIT	12 TO 20
PL–9	PIPELINE NUMBER 9	TRANSPORT MINE WATER TO THE WWTS	WEST PIT	10 TO 22
PL–10	PIPELINE NUMBER 10	TRANSPORT MINE WATER TO THE WWTS	MW–HRN	2
PL–11	PIPELINE NUMBER 11	TRANSPORT MINE WATER TO THE WWTS	MW–HRW	2

*ALL PIPES ARE SIZED BASED ON THE USE OF HDPE SDR 11 PIPE

VER NO	DATE	DESCRIPTION
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/07/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69–0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MECHANICAL INFRASTRUCTURE GENERAL DWGS
MINE SITE
SUMP, POND AND PIPE DETAIL TABLES

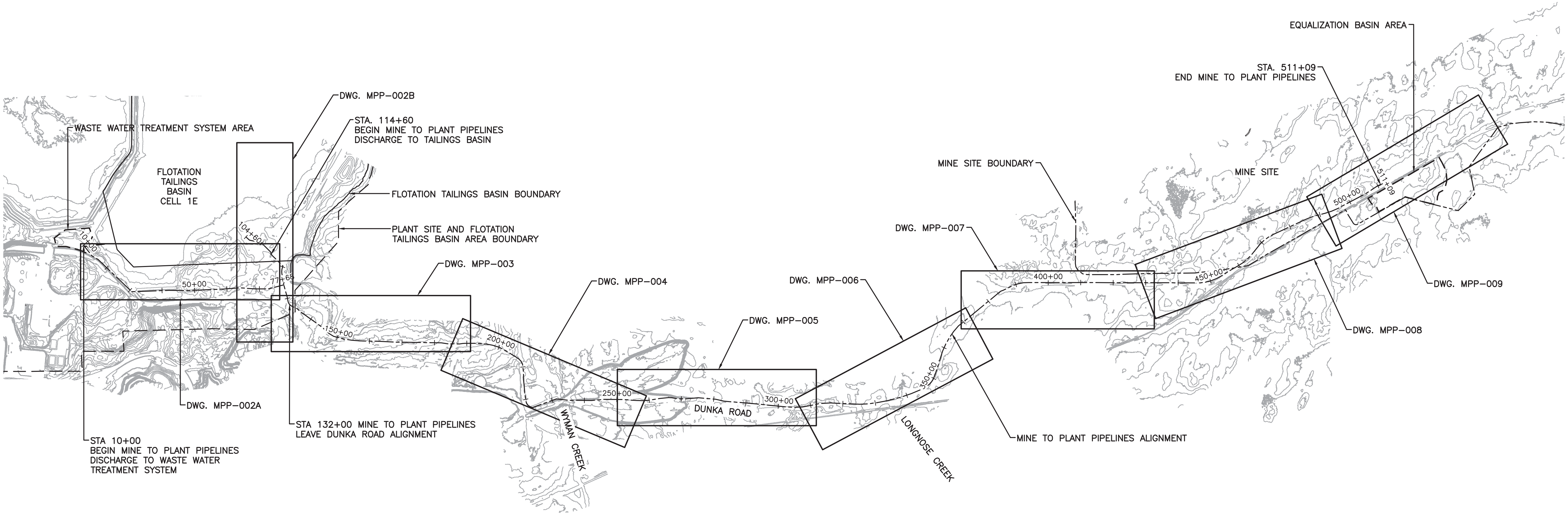
POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1–800–632–2277

DWG. NO. ME–004
REV B

INCHES 1 2



1 PLAN: SHEET INDEX

N

0 1500 3000
SCALE IN FEET

VER NO	DATE	DESCRIPTION
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/07/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE TO PLANT PIPELINES
GENERAL LAYOUT AND SHEET INDEX

POLYMET MINING

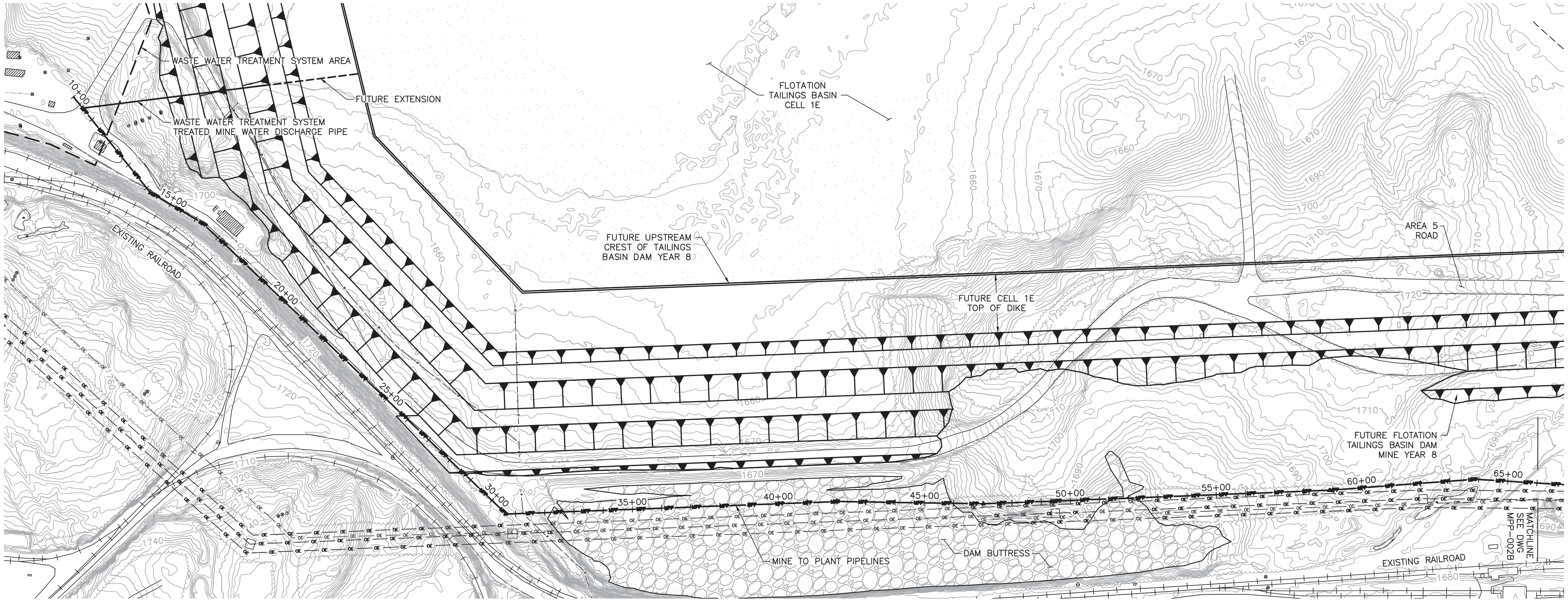
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. MPP-001
REV B

INCHES 1 2



PLAN 0 200 400 SCALE IN FEET

PROFILES TO BE DEVELOPED ONCE ROUTE IS FINALIZED DURING FINAL DESIGN.

NOTES:
1. PIPELINE SHALL BE CONSTRUCTED PER 1/MPP-010, NORMAL PIPELINE CONSTRUCTION, UNLESS NOTED OTHERWISE.

VER NO	DATE	DESCRIPTION
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/07/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE TO PLANT PIPELINES
PLAN
STATION 10+00 TO 66+00

POLYMET MINING

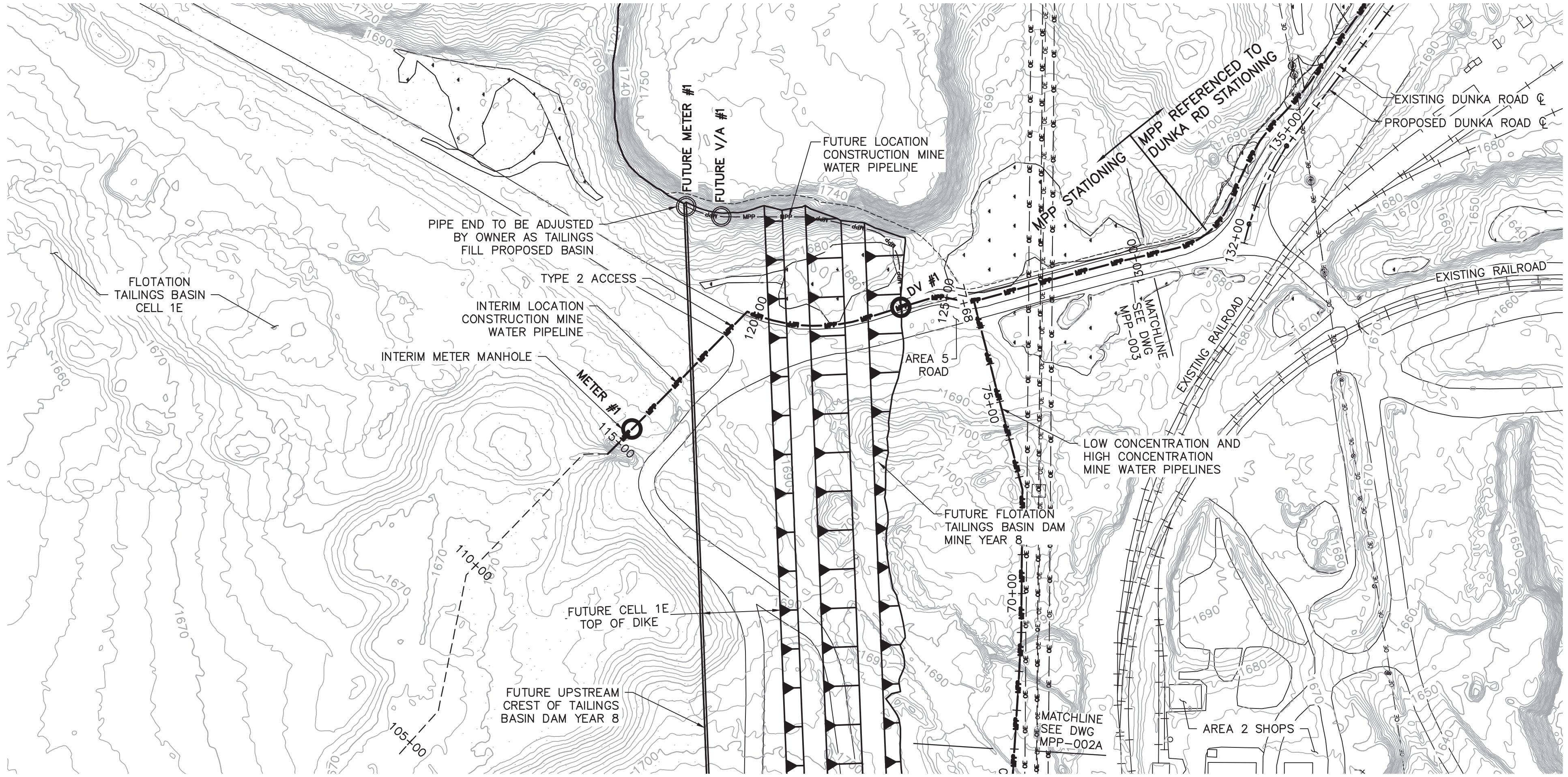
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR

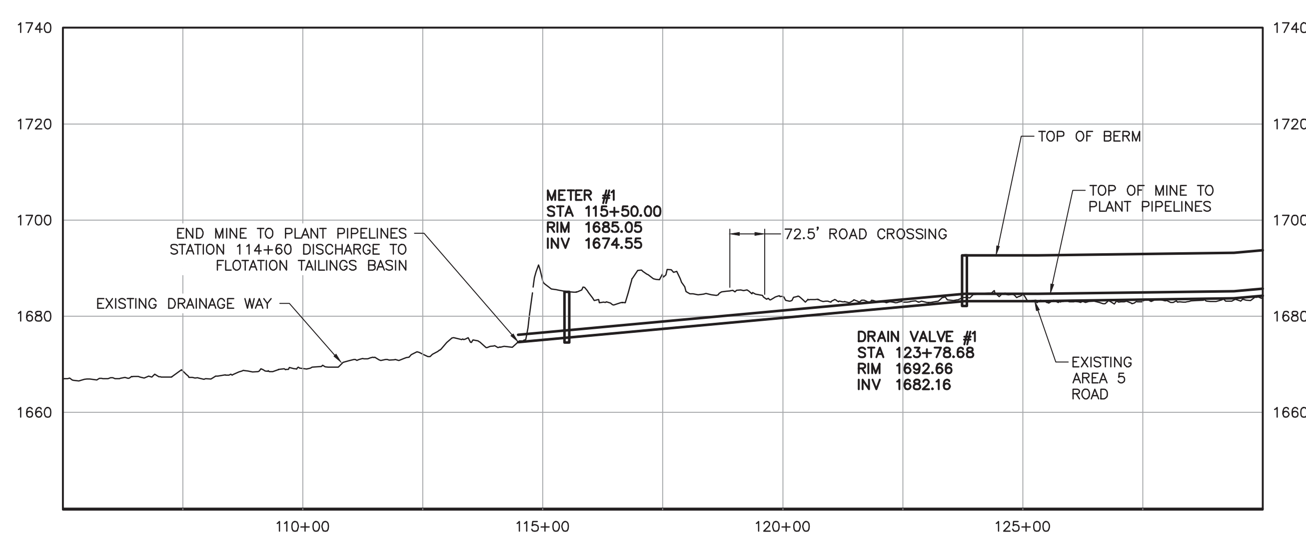
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. MPP-002A
REV B

INCHES 1 2



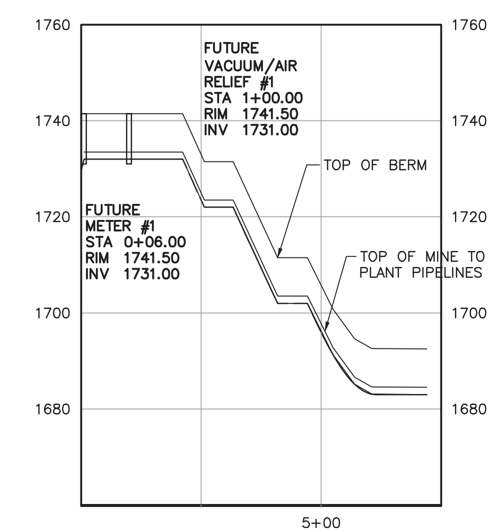
PLAN 0 200 400 SCALE IN FEET



VERTICAL SCALE: 0 20 40 SCALE IN FEET

PROFILE: INTERIM

HORIZONTAL SCALE: 0 200 400 SCALE IN FEET



VERTICAL SCALE: 0 20 40 SCALE IN FEET

PROFILE: FUTURE

HORIZONTAL SCALE: 0 200 400 SCALE IN FEET

NOTES:
1. PIPELINE SHALL BE CONSTRUCTED PER 1/MPP-010, NORMAL PIPELINE CONSTRUCTION, UNLESS NOTED OTHERWISE.

VER NO	DATE	DESCRIPTION
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/07/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE TO PLANT PIPELINES
PLAN AND PROFILE
STATION 113+70 TO 130+00

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

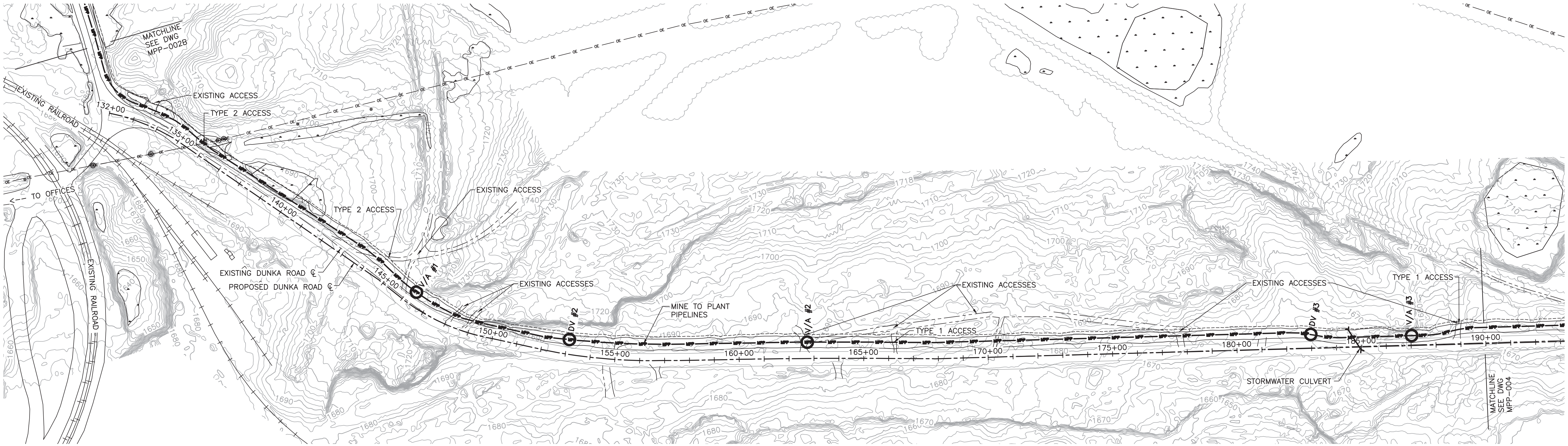
BARR

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. MPP-002B
REV B

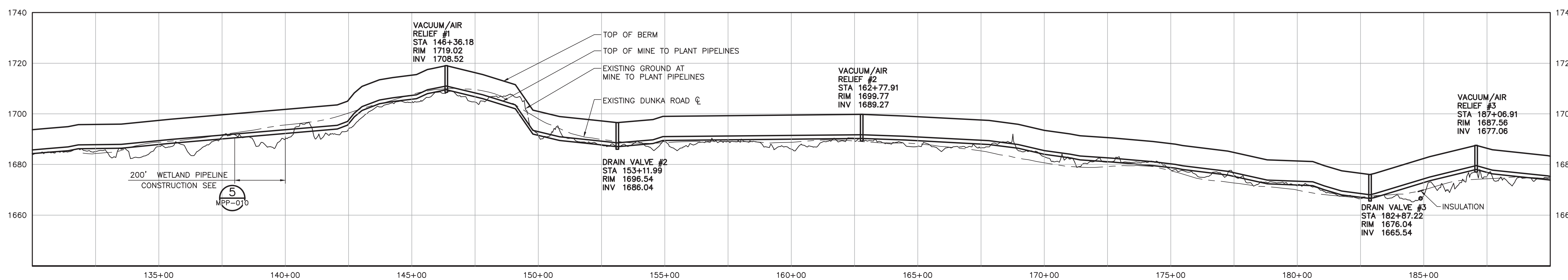
CADD USER: Veronica Wourms FILE: K:\DESIGN\23690C29.10\PERMIT_NMD-51-CU-103.DWG PLOT SCALE: 1:2 PLOT DATE: 6/2/2017 10:11 AM

INCHES 1 2



PLAN

0 200 400
SCALE IN FEET



PROFILE

VERTICAL SCALE: 0 20 40
SCALE IN FEET

HORIZONTAL SCALE: 0 200 400
SCALE IN FEET

NOTES:
1. PIPELINE SHALL BE CONSTRUCTED PER 1/MPP-010, NORMAL PIPELINE CONSTRUCTION, UNLESS NOTED OTHERWISE.

VER NO	DATE	DESCRIPTION
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/07/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE TO PLANT PIPELINES
PLAN AND PROFILE
STATION 130+00 TO 190+00

POLYMET MINING

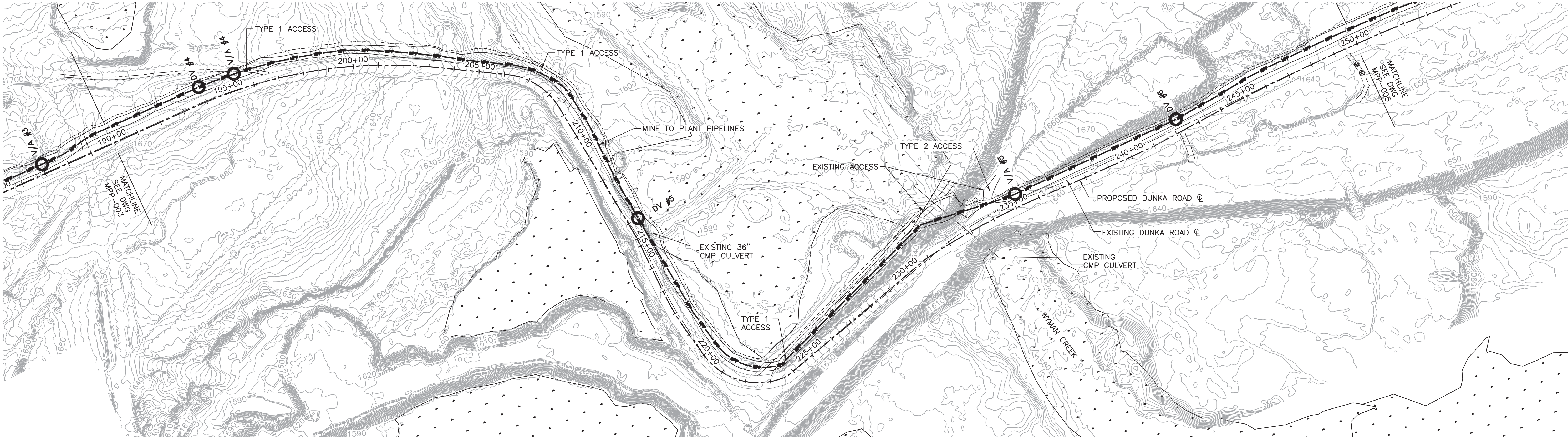
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. MPP-003
REV B

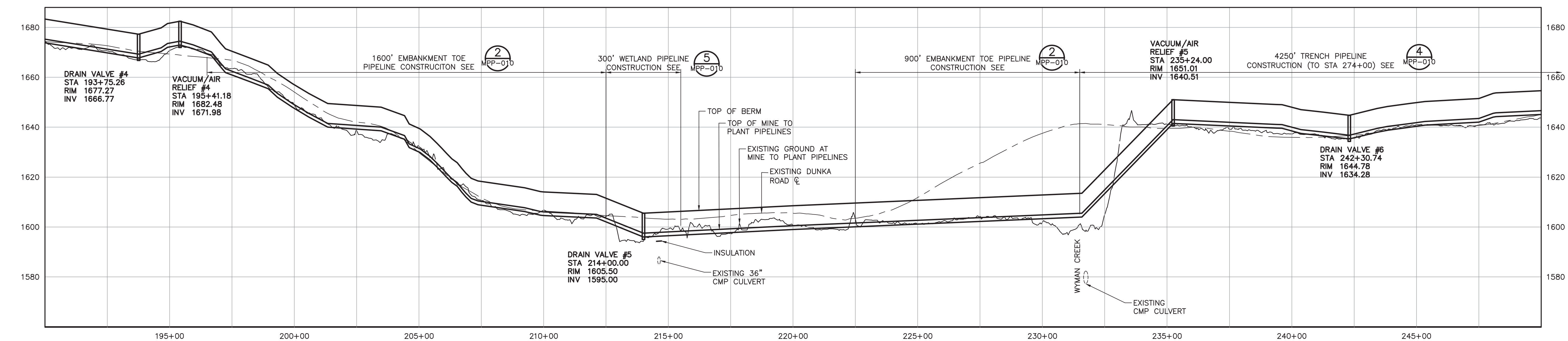
CADD USER: Veronica Wourms FILE: K:\DESIGN\23690C29.10\PERMIT_NMD-51-CU-104.DWG PLOT SCALE: 1:2 PLOT DATE: 6/2/2017 10:19 AM

INCHES 1 2



PLAN

0 200 400
SCALE IN FEET



VERTICAL SCALE: 0 20 40 SCALE IN FEET

PROFILE

HORIZONTAL SCALE: 0 200 400 SCALE IN FEET

NOTES:
1. PIPELINE SHALL BE CONSTRUCTED PER 1 MPP-010, NORMAL PIPELINE CONSTRUCTION, UNLESS NOTED OTHERWISE.

VER NO	DATE	DESCRIPTION
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/07/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

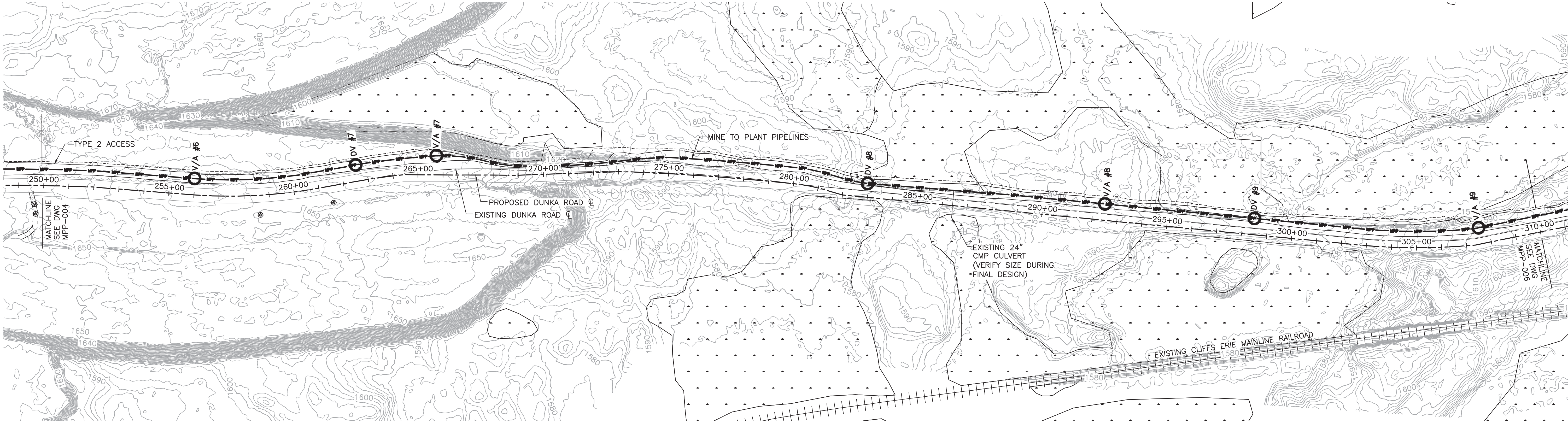
MINE TO PLANT PIPELINES
PLAN AND PROFILE
STATION 190+00 TO 250+00

POLYMET MINING
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

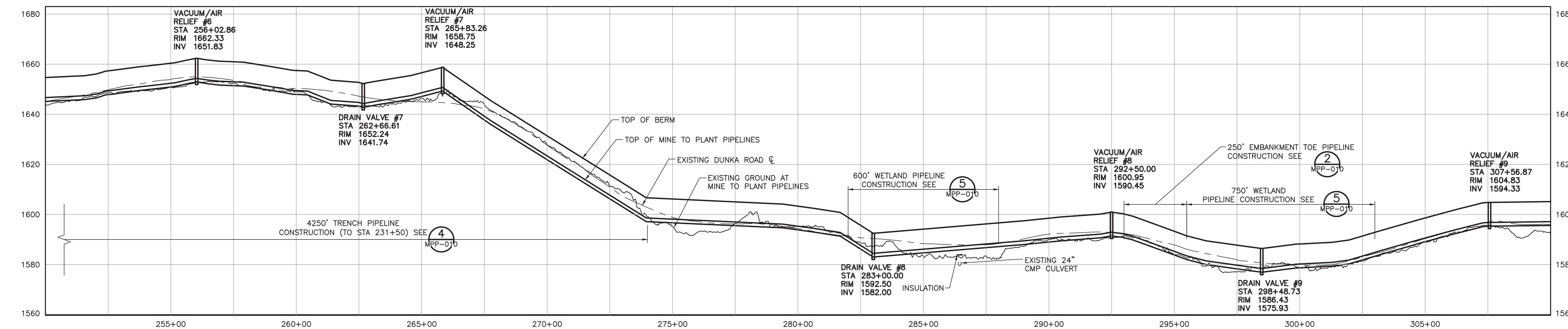
DWG. NO. MPP-004
REV B

INCHES 1 2



PLAN

0 200 400
SCALE IN FEET



VERTICAL SCALE: 0 20 40 SCALE IN FEET

HORIZONTAL SCALE: 0 200 400 SCALE IN FEET

NOTES:
1. PIPELINE SHALL BE CONSTRUCTED PER 1 MPP-010, NORMAL PIPELINE CONSTRUCTION, UNLESS NOTED OTHERWISE.

VER NO	DATE	DESCRIPTION
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/07/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE TO PLANT PIPELINES
PLAN AND PROFILE
STATION 250+00 TO 310+00

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

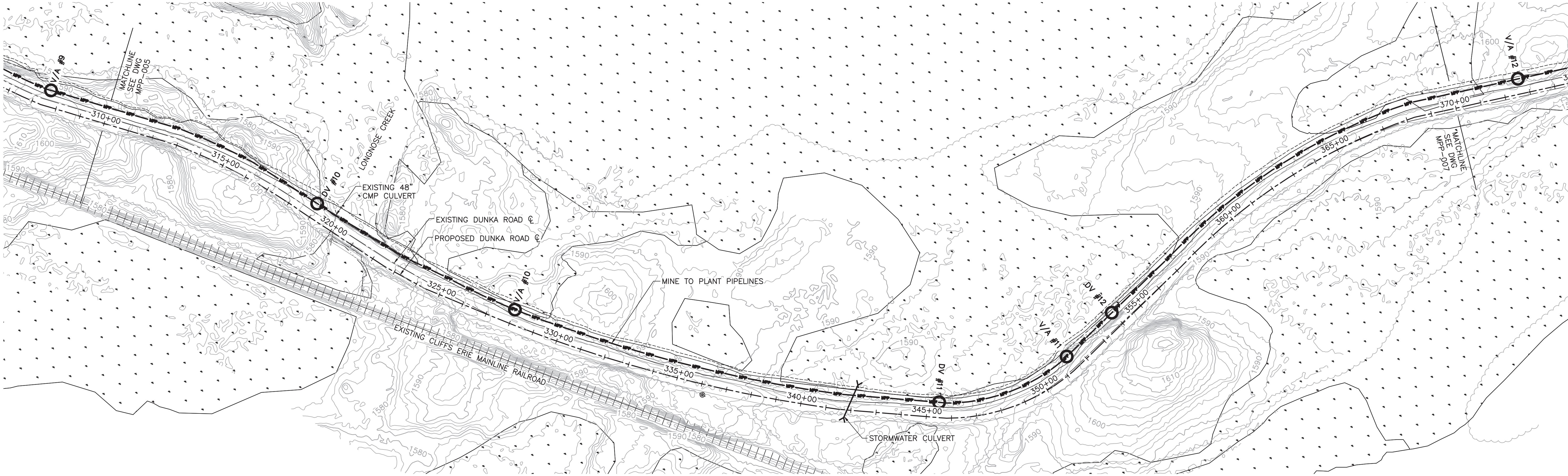
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. MPP-005

REV B

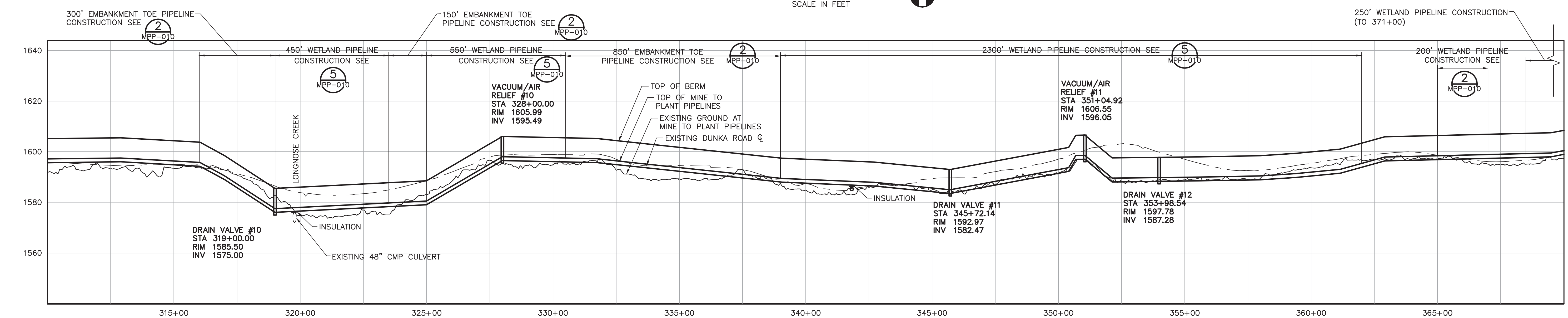
CADD USER: Veronica Wourms FILE: K:\DESIGN\23690C29.10\PERMIT_NMD-51-CU-106.DWG PLOT SCALE: 1:2 PLOT DATE: 6/2/2017 10:40 AM

INCHES 1 2



PLAN

0 200 400
SCALE IN FEET



PROFILE

VERTICAL SCALE: 0 20 40 SCALE IN FEET

HORIZONTAL SCALE: 0 200 400 SCALE IN FEET

NOTES:
1. PIPELINE SHALL BE CONSTRUCTED PER 1 MPP-010, NORMAL PIPELINE CONSTRUCTION, UNLESS NOTED OTHERWISE.

CADD USER: Veronica Wourms FILE: K:\DESIGN\23690C29.10\PERMIT_NMD-51-CU-107.DWG PLOT SCALE: 1:2 PLOT DATE: 6/2/2017 10:52 AM

INCHES 1 2

VER NO	DATE	DESCRIPTION
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/07/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE TO PLANT PIPELINES
PLAN AND PROFILE
STATION 310+00 TO 370+00

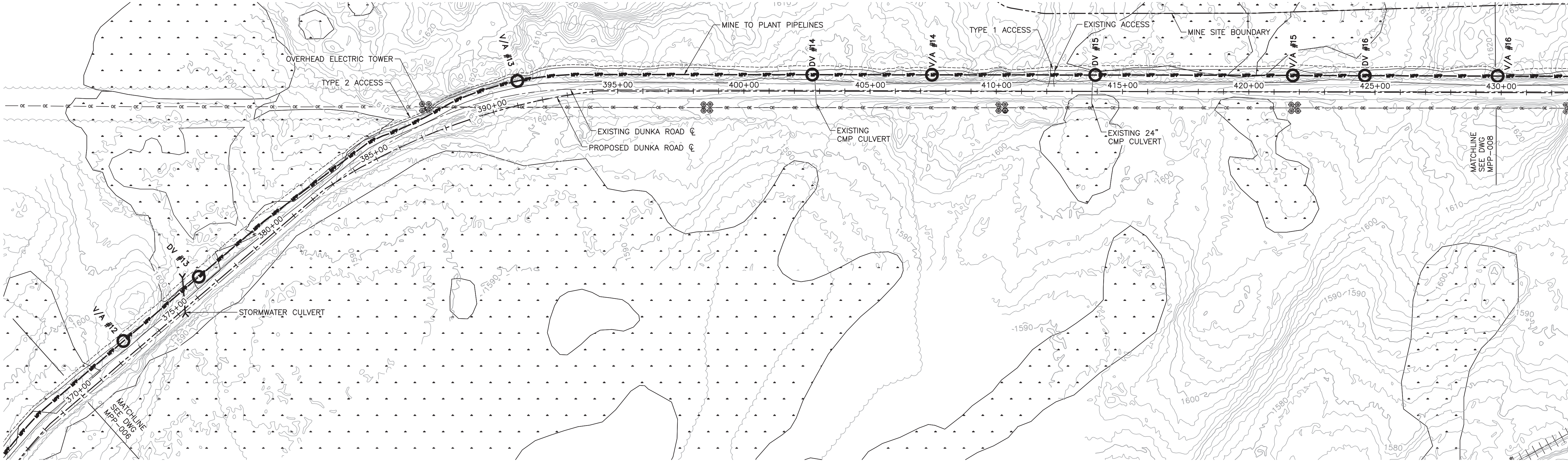
POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

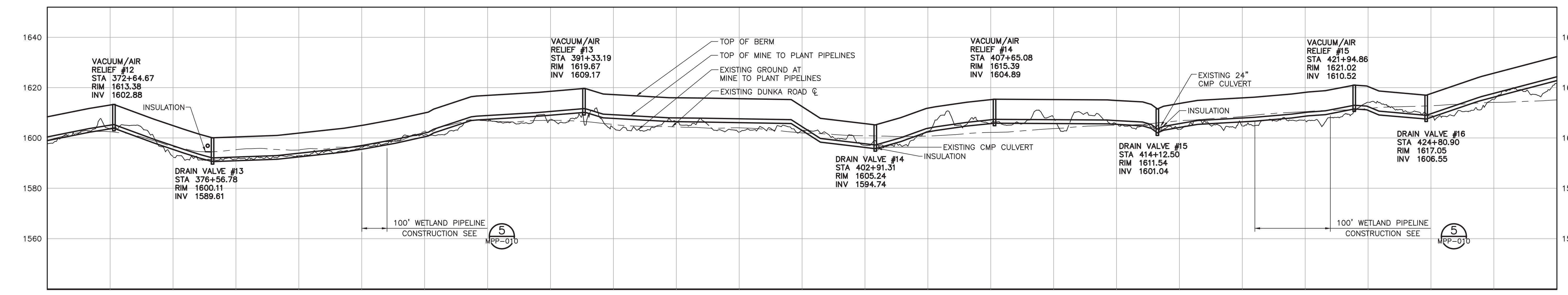
DWG. NO. MPP-006

REV B



PLAN

0 200 400
SCALE IN FEET



PROFILE

VERTICAL SCALE: 0 20 40 SCALE IN FEET

HORIZONTAL SCALE: 0 200 400 SCALE IN FEET

NOTES:
1. PIPELINE SHALL BE CONSTRUCTED PER 1 MPP-010, NORMAL PIPELINE CONSTRUCTION, UNLESS NOTED OTHERWISE.

VER NO	DATE	DESCRIPTION
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/07/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

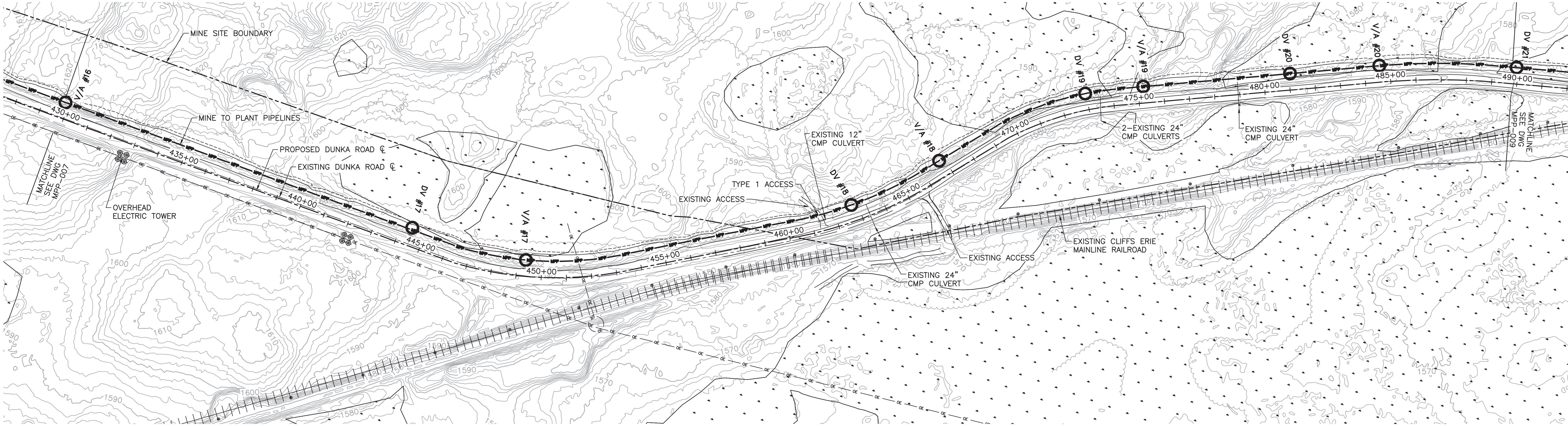
MINE TO PLANT PIPELINES
PLAN AND PROFILE
STATION 370+00 TO 430+00

POLYMET MINING
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

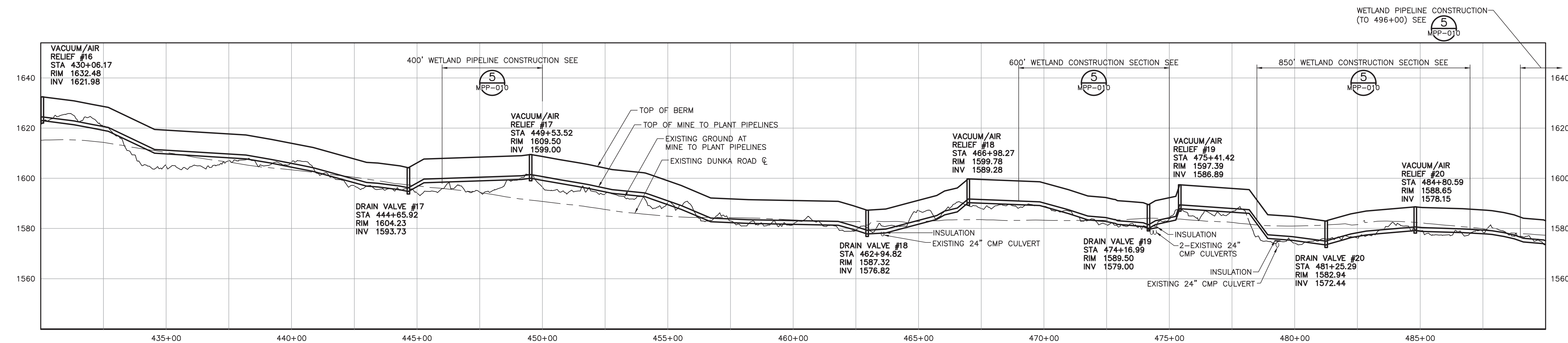
BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. MPP-007
REV B

INCHES 1 2



PLAN 0 200 400 SCALE IN FEET



PROFILE

VERTICAL SCALE: 0 20 40 SCALE IN FEET

HORIZONTAL SCALE: 0 200 400 SCALE IN FEET

NOTES:
1. PIPELINE SHALL BE CONSTRUCTED PER 1 MPP-010, NORMAL PIPELINE CONSTRUCTION, UNLESS NOTED OTHERWISE.

VER NO	DATE	DESCRIPTION
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/07/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE TO PLANT PIPELINES
PLAN AND PROFILE
STATION 430+00 TO 490+00

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

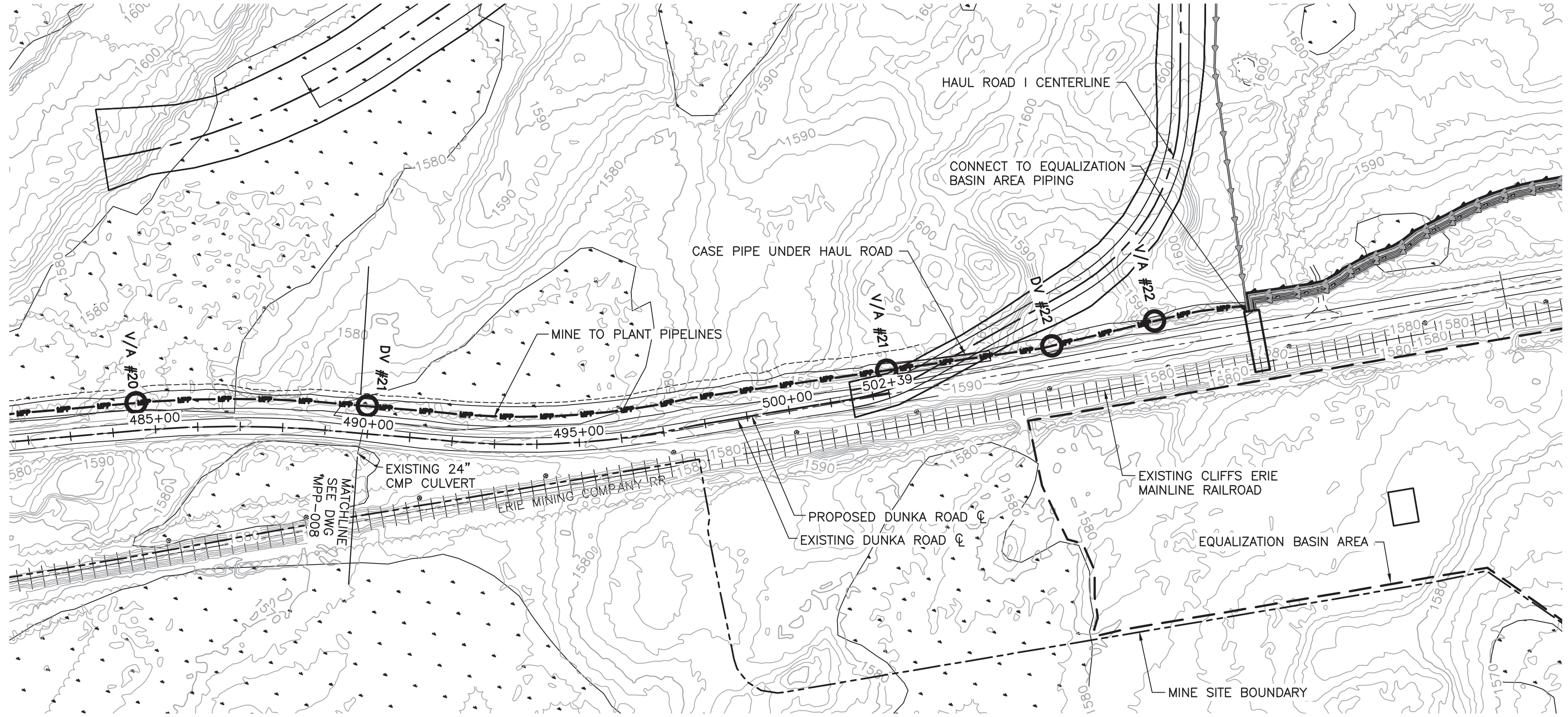
BARR

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. MPP-008 REV B

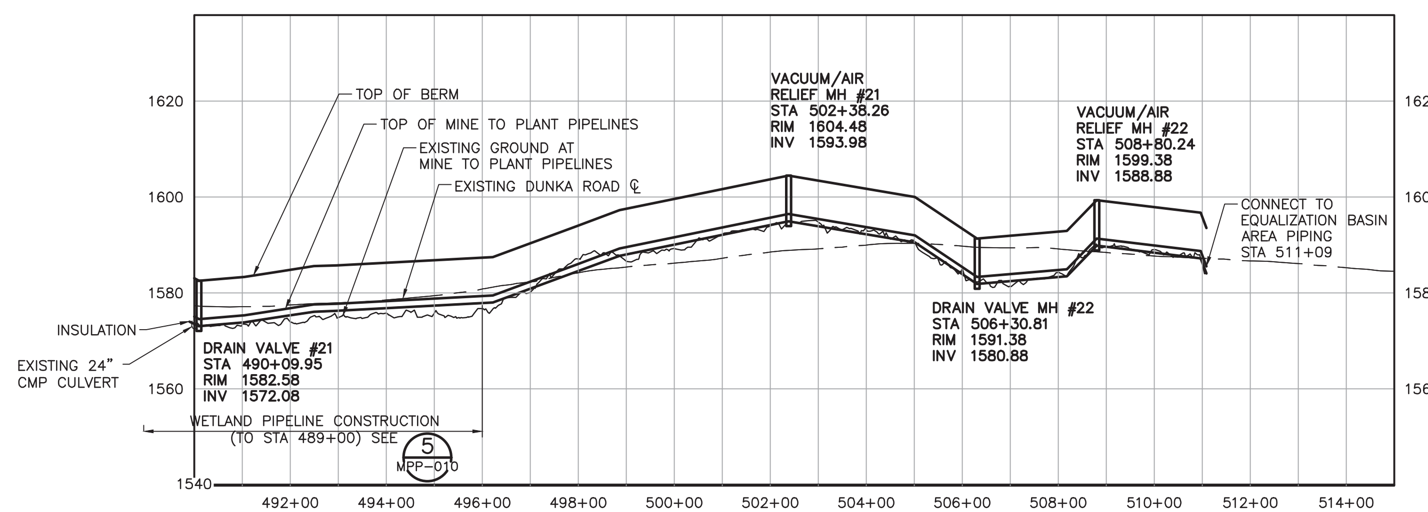
CADD USER: Veronica Wourms FILE: K:\DESIGN\23690C29.10\PERMIT_NMD-51-CU-109.DWG PLOT SCALE: 1:2 PLOT DATE: 6/2/2017 11:14 AM

INCHES 1 2



PLAN

0 200 400 SCALE IN FEET



PROFILE

VERTICAL SCALE: 0 20 40 SCALE IN FEET

HORIZONTAL SCALE: 0 200 400 SCALE IN FEET

NOTES:
1. PIPELINE SHALL BE CONSTRUCTED PER 1 MPP-010, NORMAL PIPELINE CONSTRUCTION, UNLESS NOTED OTHERWISE.

VER NO	DATE	DESCRIPTION
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/07/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE TO PLANT PIPELINES
PLAN AND PROFILE
STATION 490+00 TO 511+09

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

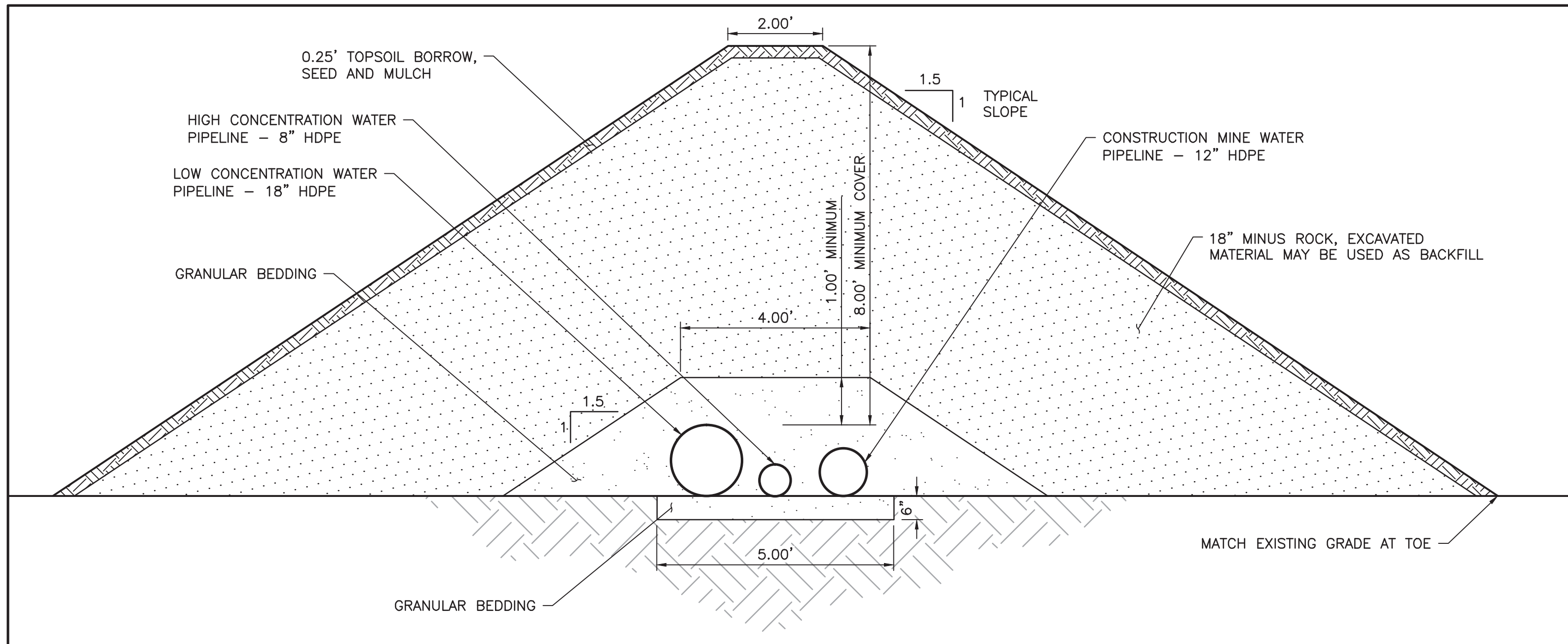
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. MPP-009

REV B

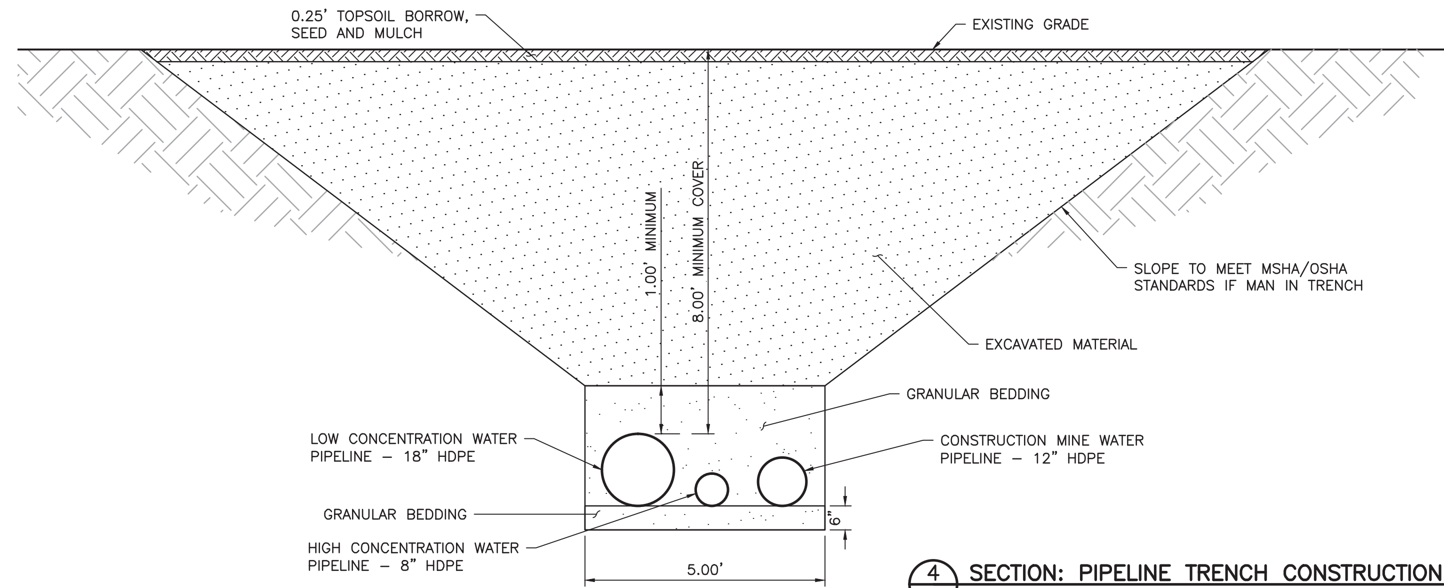
CADD USER: Veronica Wourms FILE: K:\DESIGN\23690C29.10\PERMIT_NMD-51-CU-110.DWG PLOT SCALE: 1:2 PLOT DATE: 6/2/2017 11:20 AM

INCHES 1 2



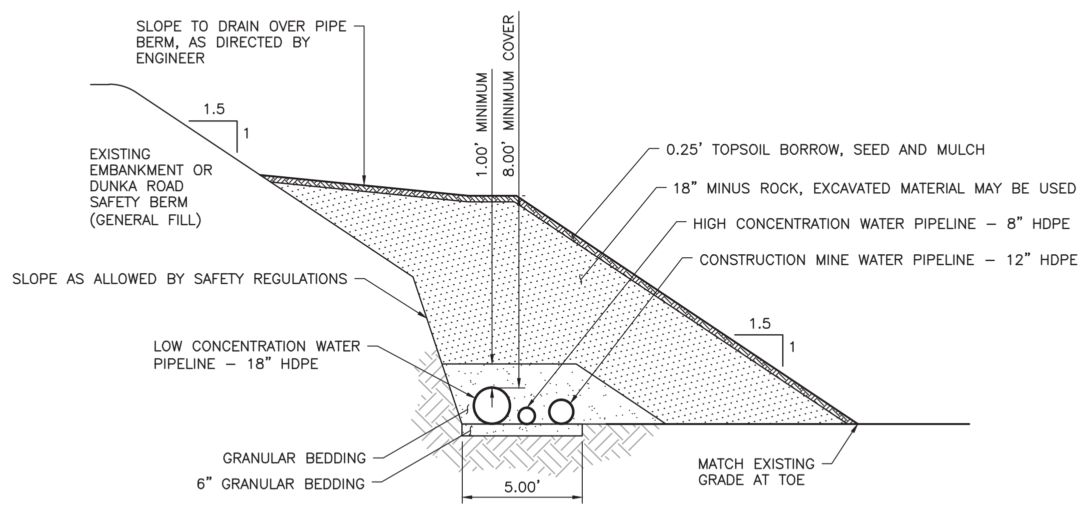
1 SECTION: NORMAL PIPELINE CONSTRUCTION

0 1 2 3 4 SCALE IN FEET



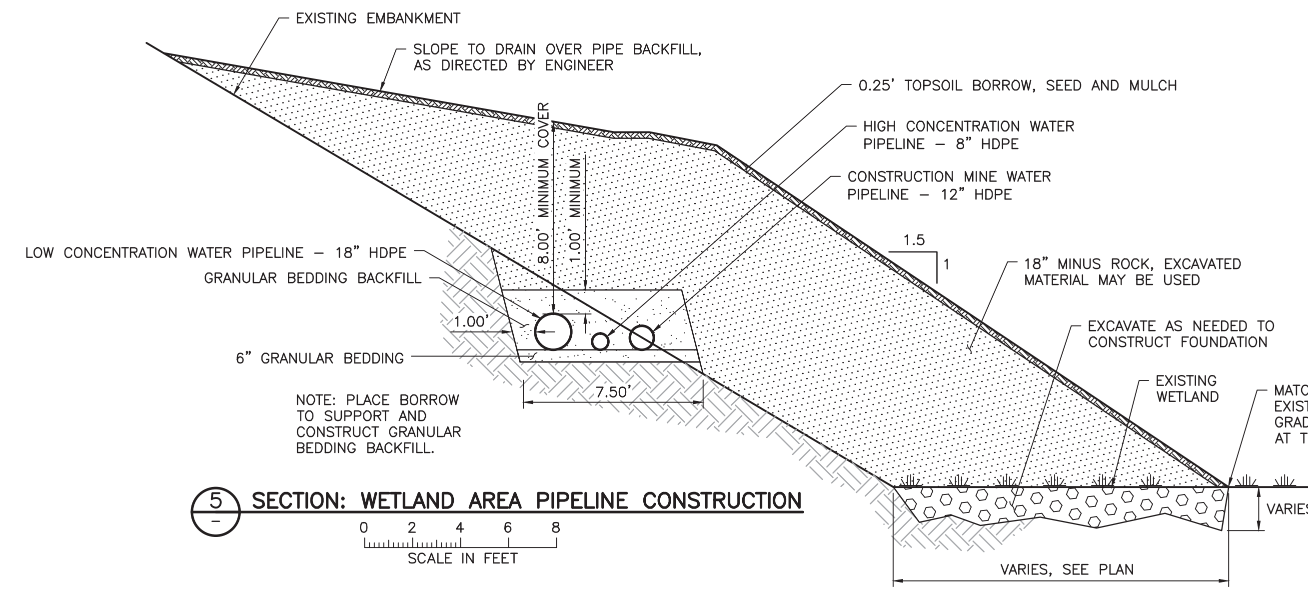
4 SECTION: PIPELINE TRENCH CONSTRUCTION

0 1 2 3 4 SCALE IN FEET



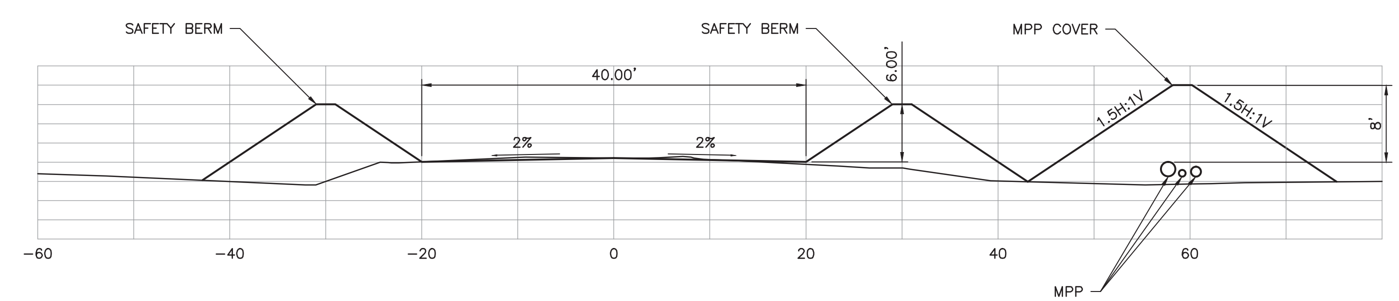
2 SECTION: EMBANKMENT TOE PIPELINE CONSTRUCTION

0 2 4 6 8 SCALE IN FEET



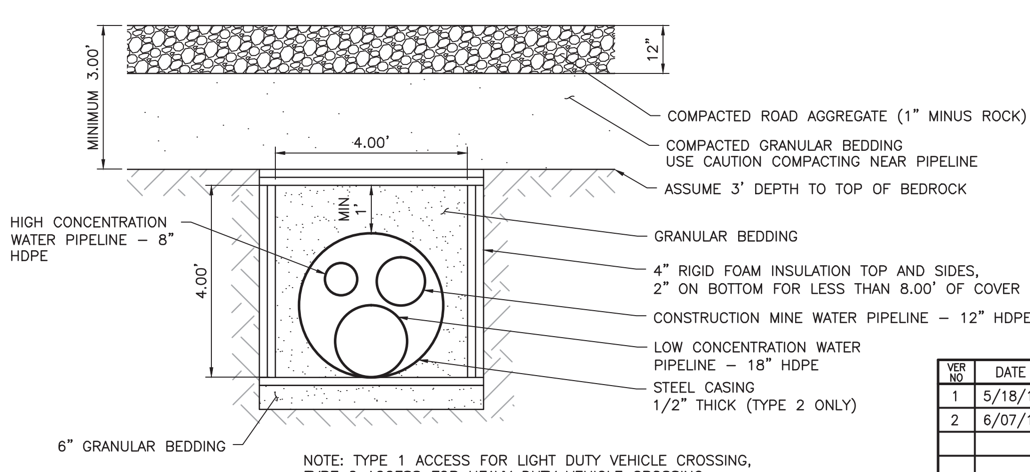
5 SECTION: WETLAND AREA PIPELINE CONSTRUCTION

0 2 4 6 8 SCALE IN FEET



6 SECTION: DUNKA ROAD/MPP TYPICAL SECTION
MPP–003

0 10 20 SCALE IN FEET



NOTE: TYPE 1 ACCESS FOR LIGHT DUTY VEHICLE CROSSING, TYPE 2 ACCESS FOR HEAVY DUTY VEHICLE CROSSING.

3 SECTION: ACCESS ROAD CROSSING – TYPE 1 OR 2

0 1 2 3 4 SCALE IN FEET

VER NO	DATE	DESCRIPTION
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/07/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69–0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE TO PLANT PIPELINES
PIPELINE INSTALLATION TYPICAL SECTIONS

POLYMET MINING

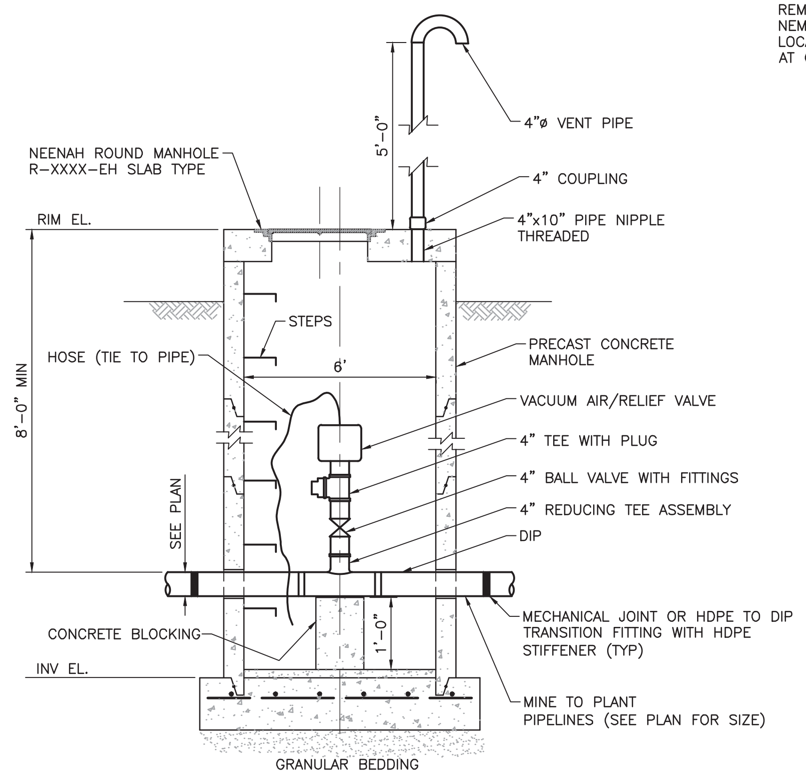
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1–800–632–2277

DWG. NO. MPP–010

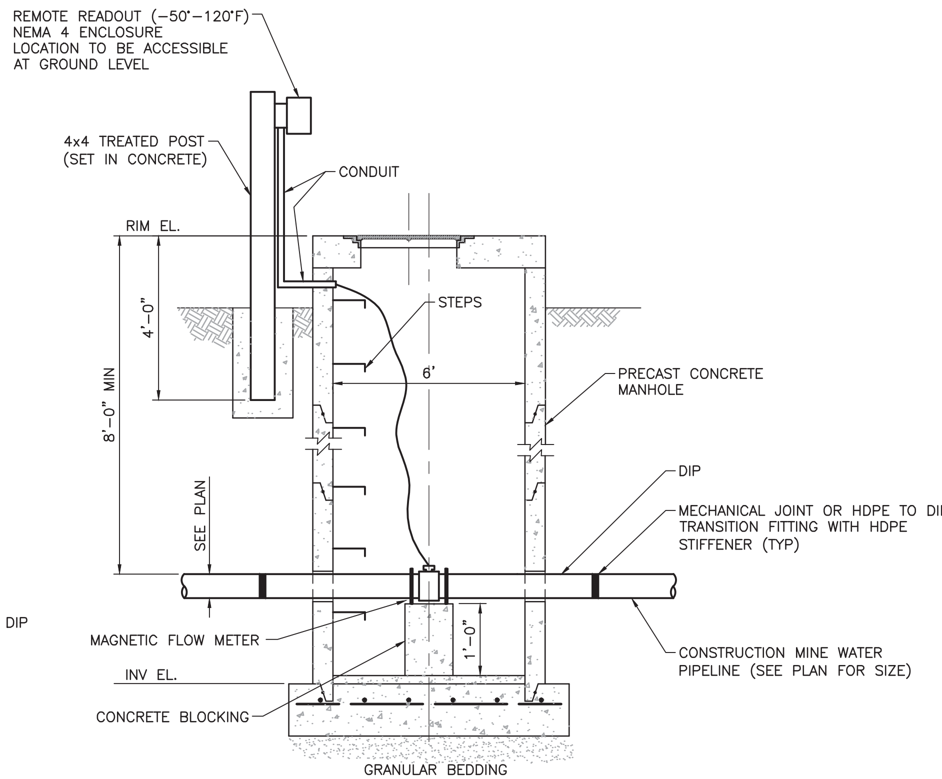
REV B

INCHES 1 2



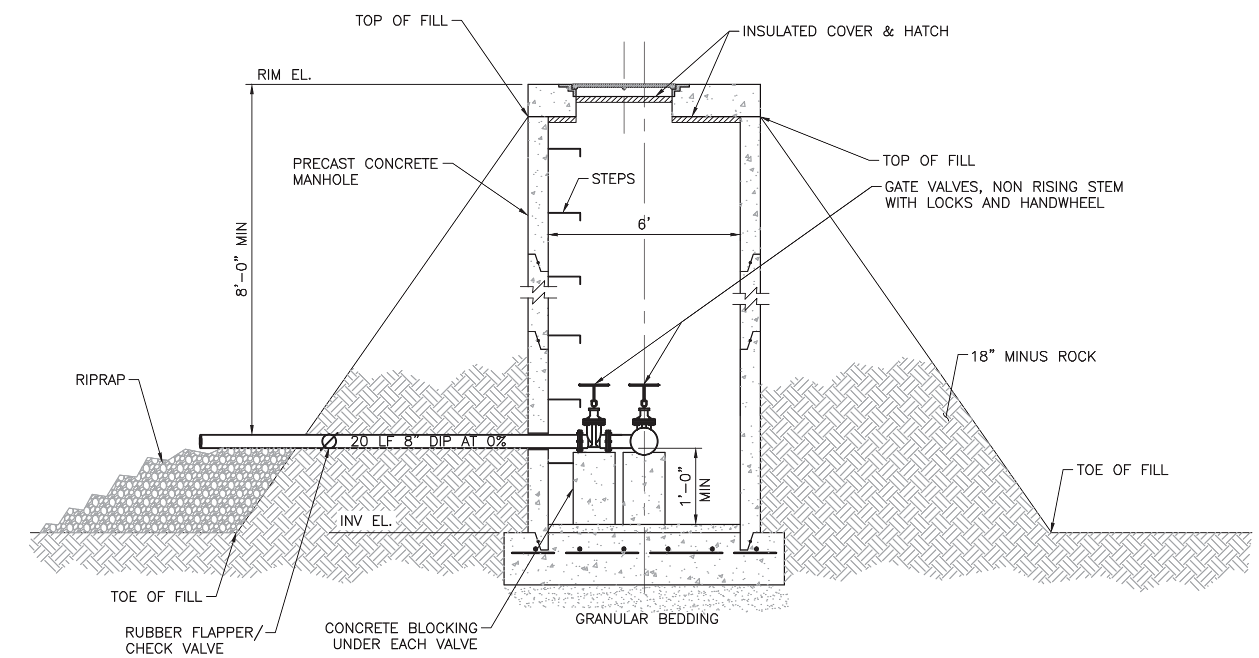
NOTE: SEAL MANHOLE OPENINGS AND JOINTS TO PROVIDE LEAK PROTECTION FOR MANHOLES TO ACT AS SECONDARY CONTAINMENT.

1 – ELEVATION: ALTERNATE VACUUM/AIR RELIEF MANHOLE
NOT TO SCALE



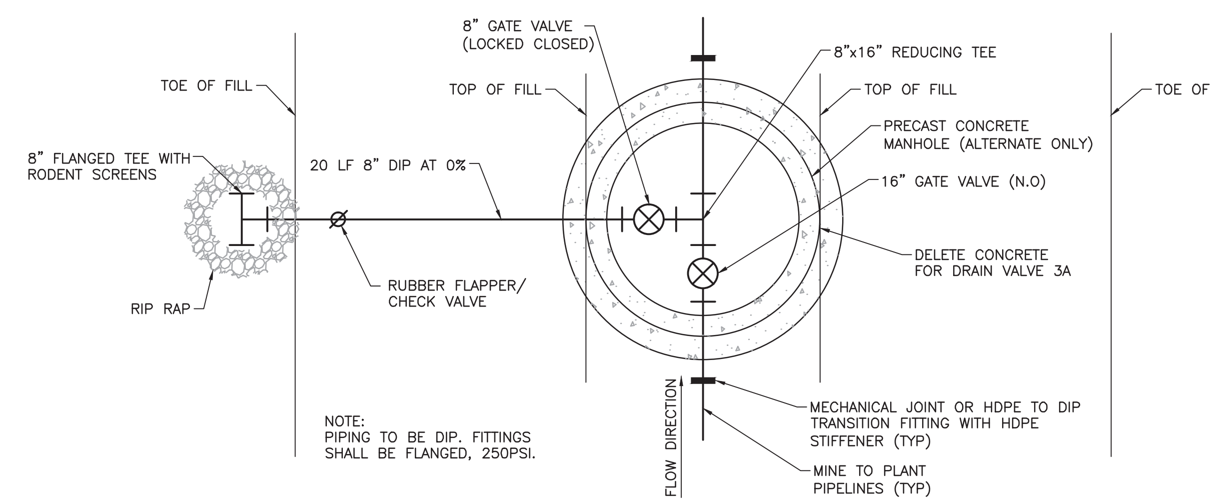
NOTE: SEAL MANHOLE OPENINGS AND JOINTS TO PROVIDE LEAK PROTECTION FOR MANHOLES TO ACT AS SECONDARY CONTAINMENT.

2 – ELEVATION: METER MANHOLE
NOT TO SCALE



NOTE: SEAL MANHOLE OPENINGS AND JOINTS TO PROVIDE LEAK PROTECTION FOR MANHOLES TO ACT AS SECONDARY CONTAINMENT.

3 – ELEVATION: ALTERNATE DRAIN VALVE MANHOLE
NOT TO SCALE



NOTE:
PIPING TO BE DIP. FITTINGS SHALL BE FLANGED, 250PSI.

4 – PLAN: DRAIN VALVE
NOT TO SCALE

CADD USER: Veronica Wourms FILE: K:\DESIGN\23690C29.10\PERMIT_NMD-51-CU-304.DWG PLOT SCALE: 1:2 PLOT DATE: 6/2/2017 11:50 AM

INCHES 1 2

VER NO	DATE	DESCRIPTION
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/07/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE TO PLANT PIPELINES
DETAILS

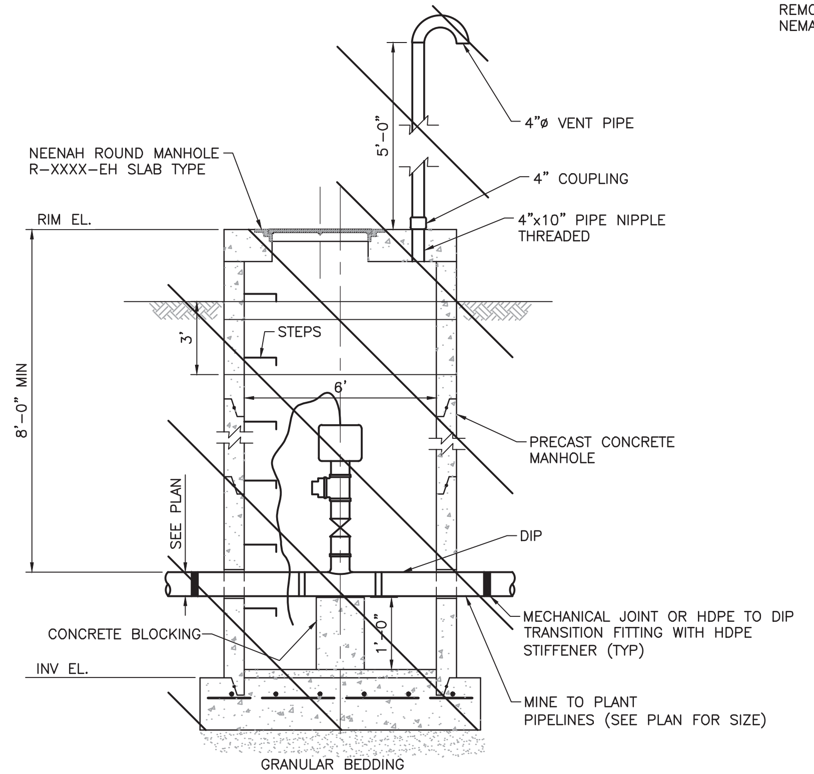
POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

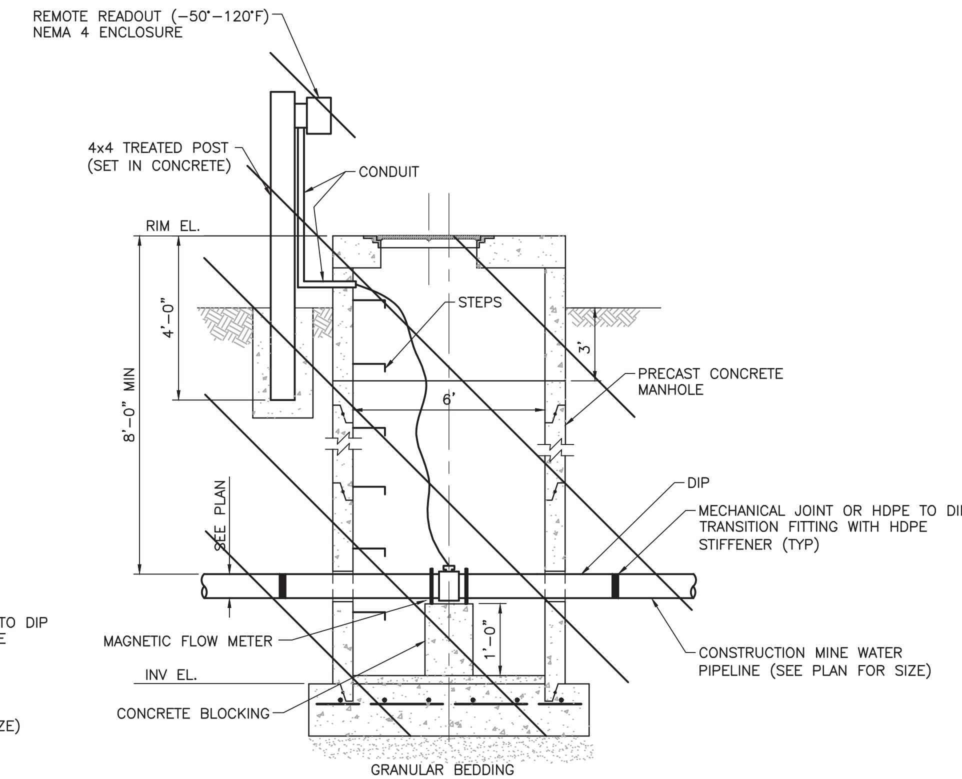
DWG. NO. MPP-011
REV B



NOTE: STRUCTURE AND PIPING WITHIN CROSS HATCH TO BE REMOVED AFTER TRANSITION TO NON-MECHANICAL TREATMENT.

1 ELEVATION: ALTERNATE VACUUM/AIR RELIEF MANHOLE IN CLOSURE

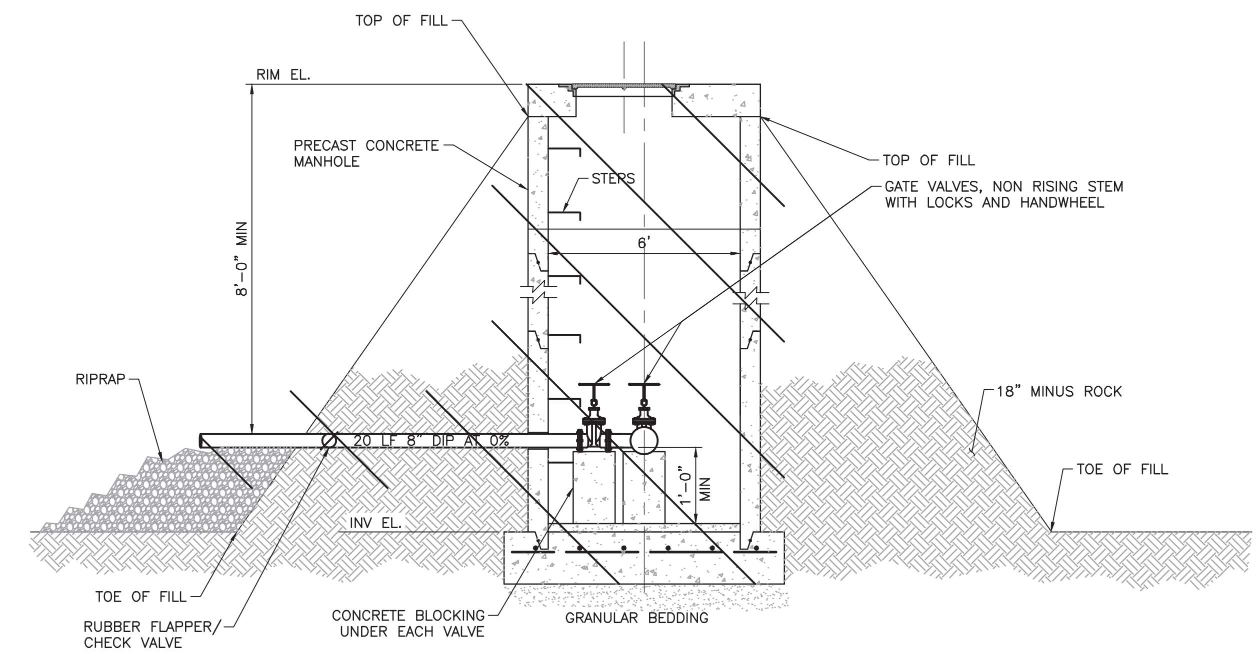
NOT TO SCALE



NOTE: STRUCTURE AND PIPING WITHIN CROSS HATCH TO BE REMOVED AFTER TRANSITION TO NON-MECHANICAL TREATMENT.

2 ELEVATION: METER MANHOLE IN CLOSURE

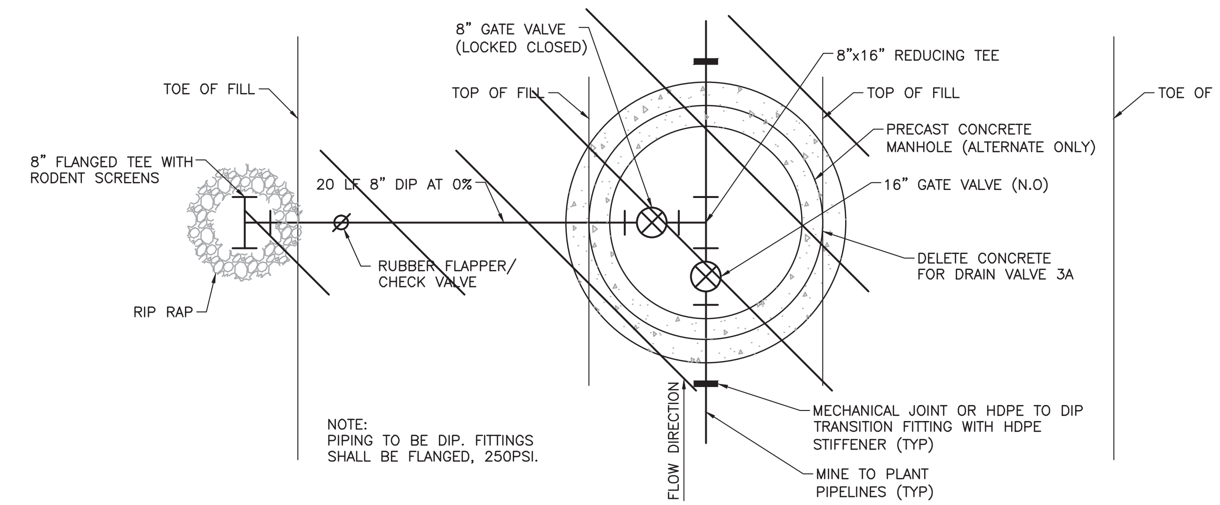
NOT TO SCALE



NOTE: STRUCTURE AND PIPING WITHIN CROSS HATCH TO BE REMOVED AFTER TRANSITION TO NON-MECHANICAL TREATMENT.

3 ELEVATION: ALTERNATE DRAIN VALVE MANHOLE IN CLOSURE

NOT TO SCALE



NOTE:
PIPING TO BE DIP. FITTINGS SHALL BE FLANGED, 250PSI.

4 PLAN: DRAIN VALVE IN CLOSURE

NOT TO SCALE

VER NO	DATE	DESCRIPTION
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/07/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE TO PLANT PIPELINES
DETAILS IN CLOSURE

POLYMET MINING

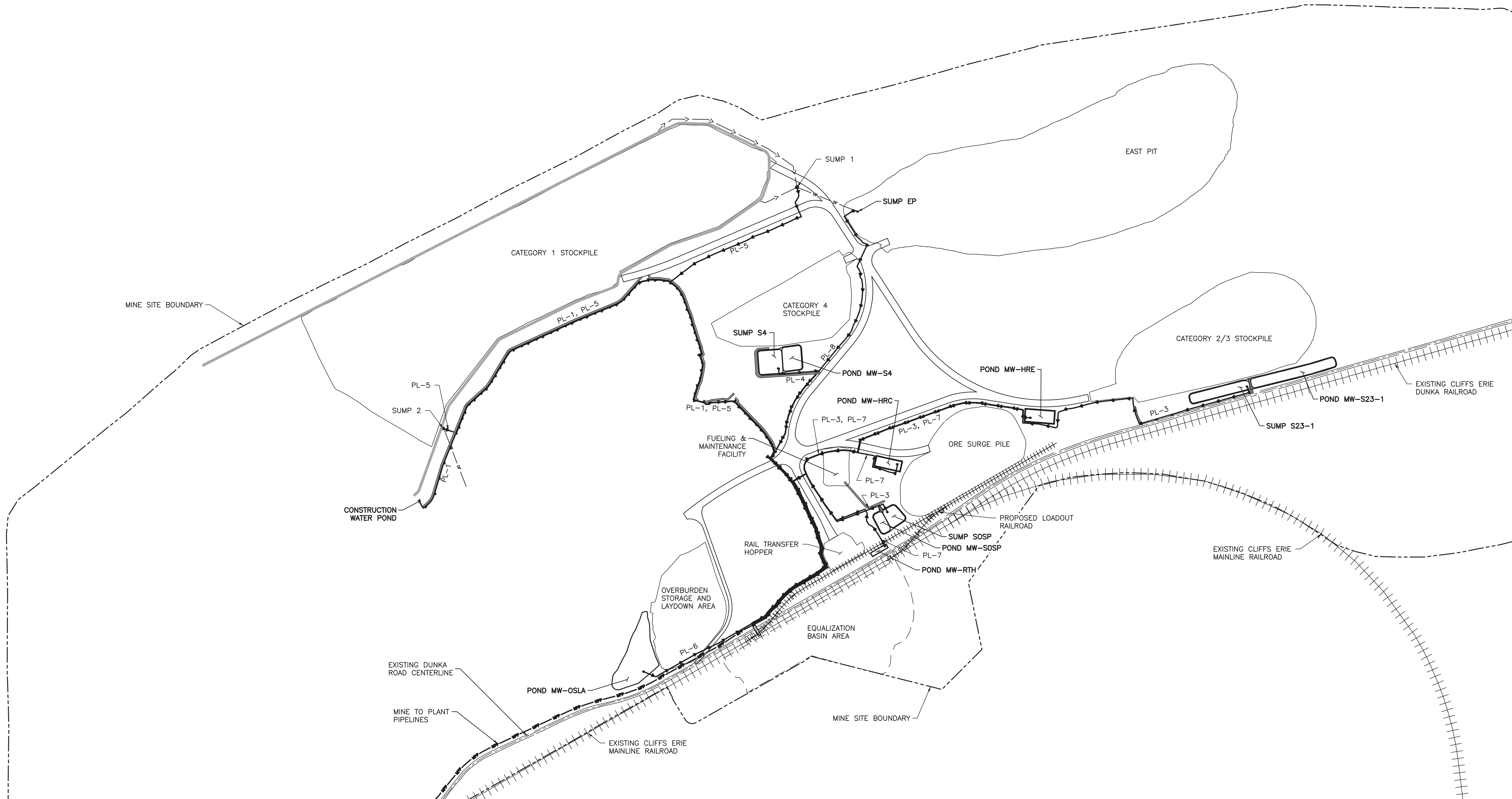
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. MPP-012
REV B

INCHES 1 2



1 PLAN: GENERAL LAYOUT MINE YEAR 1

0 600 1200

SCALE IN FEET

CADD USER: Veronica Wourms FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-55-CS-100.DWG PLOT SCALE: 1:2 PLOT DATE: 6/2/2017 2:58 PM

INCHES 1 2

VER NO	DATE	DESCRIPTION
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/07/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE

SIGNATURE

DATE 6/07/17 LICENSE# 25080

DRAWN: KRM

CHECKED: JMM3

BARR PROJECT NO.: 23/69-0C29

SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE WATER INFRASTRUCTURE
MINE YEAR 1 GENERAL LAYOUT

POLYMET MINING

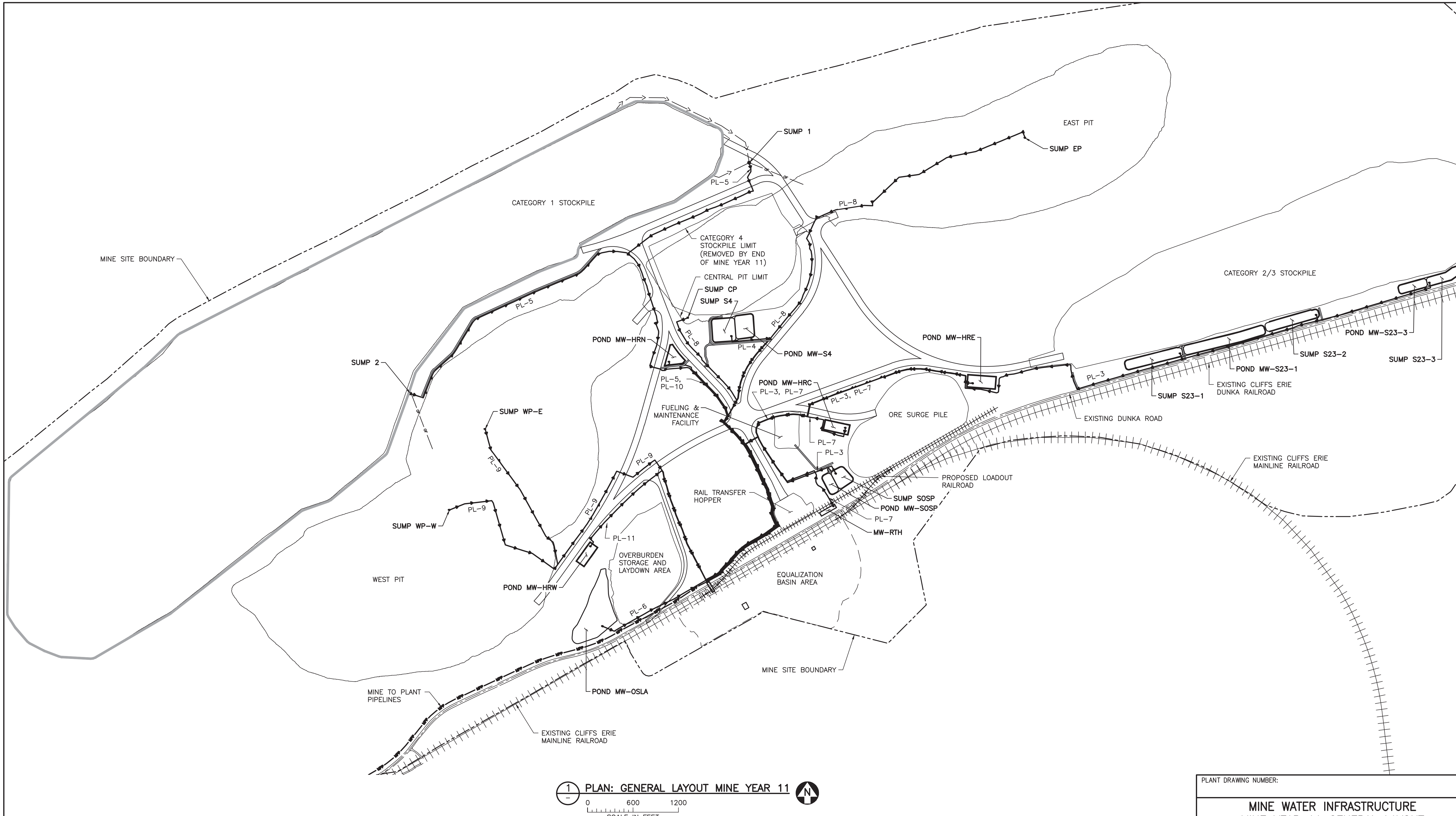
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. MW-001

REV B



CADD USER: Veronica Wourms FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-55-CS-101.DWG PLOT SCALE: 1:2 PLOT DATE: 6/2/2017 3:09 PM

PLANT DRAWING NUMBER:

MINE WATER INFRASTRUCTURE
MINE YEAR 11 GENERAL LAYOUT

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

POLYMET MINING

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

VER NO	DATE	DESCRIPTION
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/07/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION		

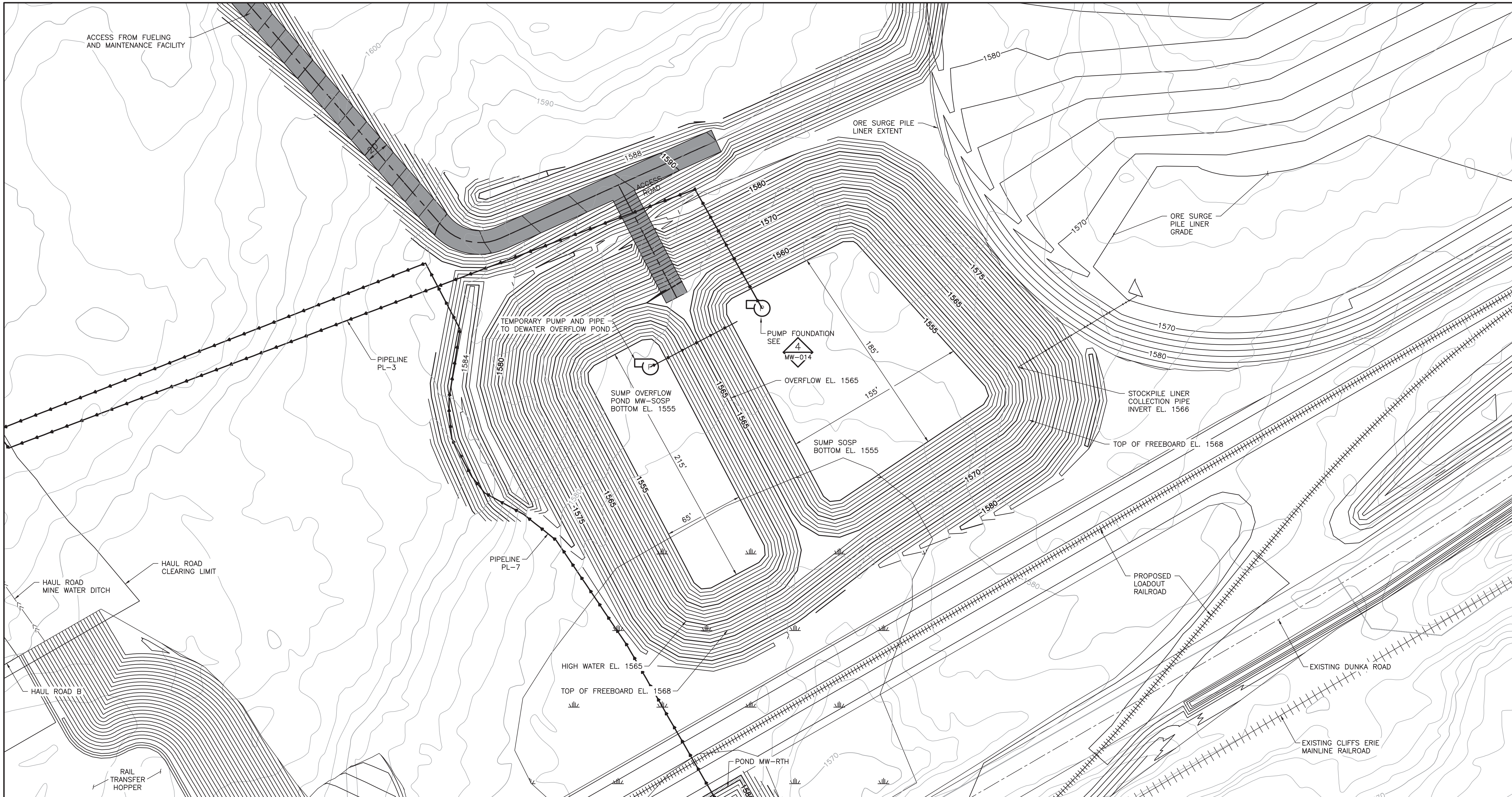
I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: KRM
CHECKED: JMM3
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

DWG. NO. MW-002
REV B

INCHES 1 2



CADD USER: Veronica Wourms FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-55-CS-125.DWG PLOT SCALE: 1:2 PLOT DATE: 6/2/2017 3:31 PM

NOTE:
1. THE SUMP SOSP OVERFLOWS TO THE SUMP OVERFLOW POND MW-SOSP IN EVENTS GREATER THAN THE 10-YEAR 24 HOUR STORM.

1 PLAN: SUMP SOSP AND MW-SOSP

0 40 80
SCALE IN FEET

VER NO	DATE	DESCRIPTION
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

ISSUE STATUS	ISSUED	VERSION	DATE
	FOR PERMITTING	2	6/07/17
	FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

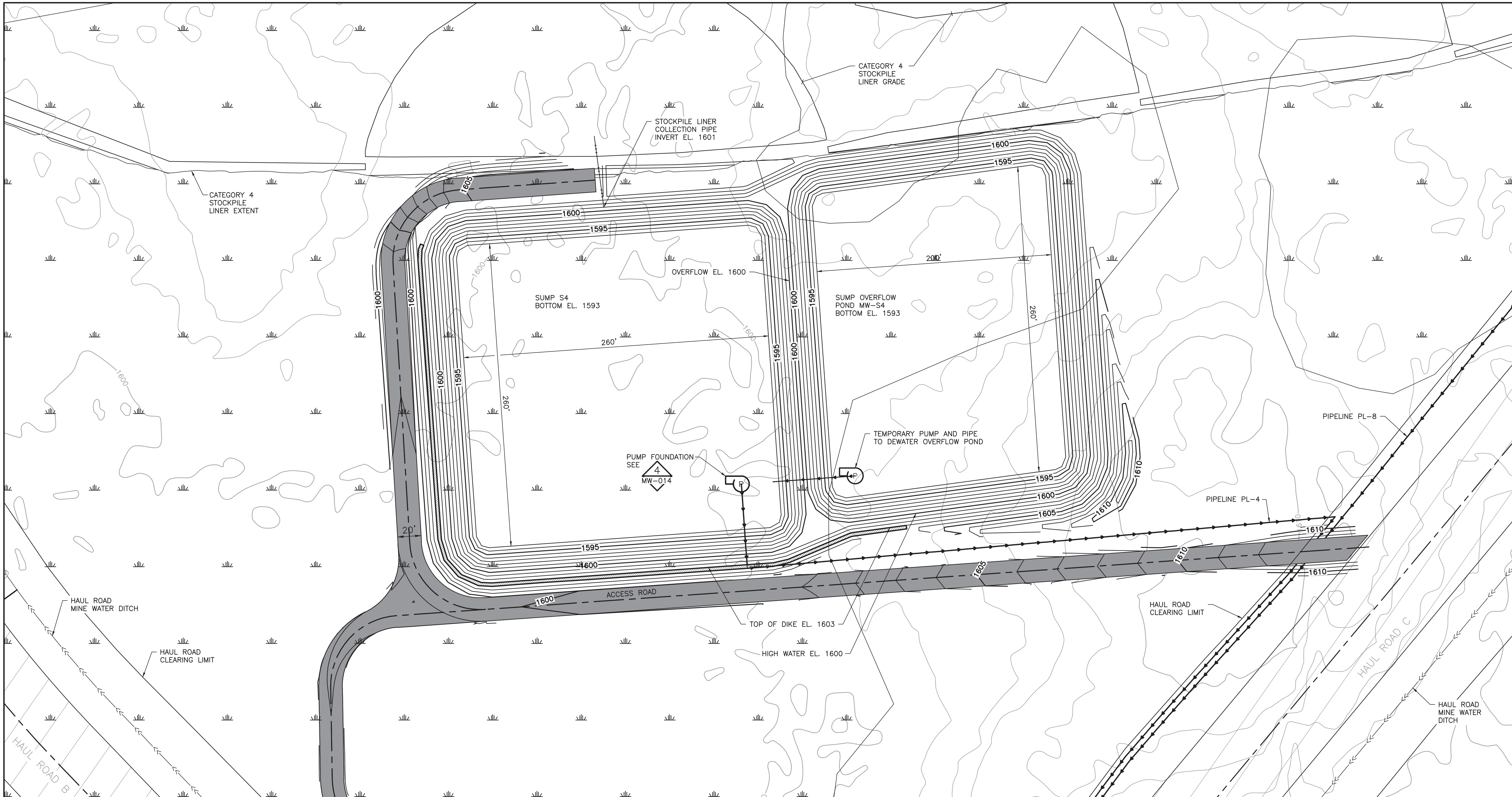
MINE WATER INFRASTRUCTURE
MINE WATER SUMP DESIGN
SUMP SOSP & MW-SOSP GRADING PLAN

POLYMET MINING
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. MW-003
REV B

INCHES 1 2



NOTE:
1. THE SUMP S4 OVERFLOWS TO THE SUMP OVERFLOW POND MW–S4 IN EVENTS GREATER THAN THE 10–YEAR 24 HOUR STORM.

1 — PLAN: SUMP S4 AND MW–S4

0 40 80
SCALE IN FEET

PLANT DRAWING NUMBER:

MINE WATER INFRASTRUCTURE
MINE WATER SUMP DESIGN
SUMP S4 AND MW–S4 GRADING PLAN

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

POLYMET MINING

VER NO	DATE	DESCRIPTION
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/07/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

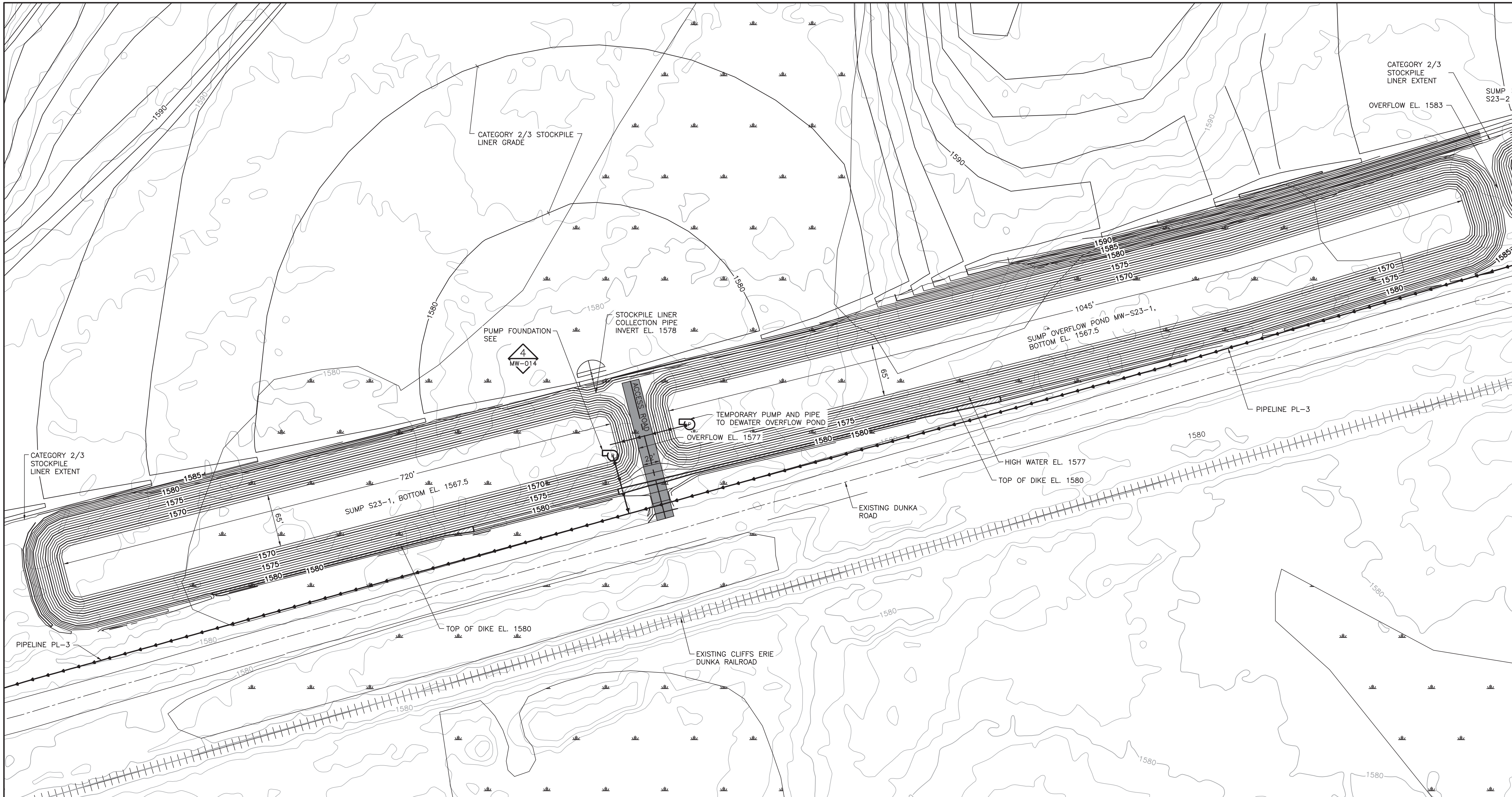
DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69–0C29
SCALE: AS SHOWN

BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1–800–632–2277

DWG. NO. MW–004
REV B

CADD USER: Veronica Wourms FILE: K:\DESIGN\23690C29.10\PERMIT_NMM–55–CS–126.DWG PLOT SCALE: 1:2 PLOT DATE: 6/2/2017 3:44 PM

INCHES 1 2



NOTE:
1. THE SUMP S23-1 OVERFLOWS TO THE SUMP OVERFLOW POND MW-S23-1 IN EVENTS GREATER THAN THE 10-YEAR 24 HOUR STORM.

1 PLAN: SUMP S23-1 AND MW-S23-1

0 60 120
SCALE IN FEET

VER NO	DATE	DESCRIPTION
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

ISSUED	VERSION	DATE
FOR PERMITTING	2	6/07/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE WATER INFRASTRUCTURE
MINE WATER SUMP DESIGN
SUMP S23-1 AND MW-S23-1 GRADING PLAN

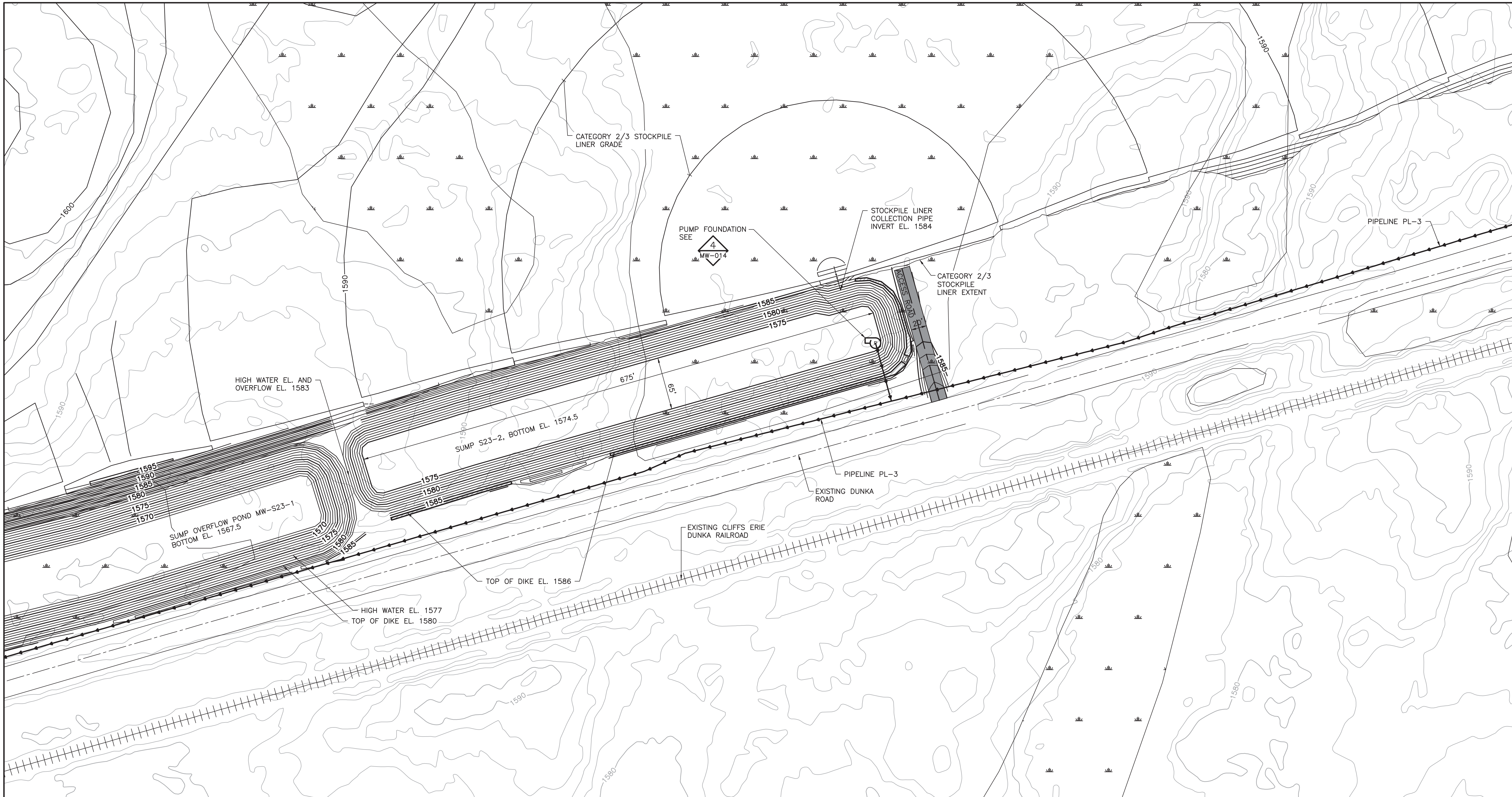
POLYMET MINING
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. MW-005
REV B

CADD USER: Veronica Wourms FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-SS-CS-127.DWG PLOT SCALE: 1:2 PLOT DATE: 6/2/2017 4:10 PM

INCHES 1 2



NOTE:
1. THE SUMP S23-2 OVERFLOWS TO THE SUMP OVERFLOW POND MW-S23-1 IN EVENTS GREATER THAN THE 10-YEAR 24 HOUR STORM.

1 PLAN: SUMP S23-2

0 60 120
SCALE IN FEET

VER NO	DATE	DESCRIPTION
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/07/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE WATER INFRASTRUCTURE
MINE WATER SUMP DESIGN
SUMP S23-2 GRADING PLAN

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

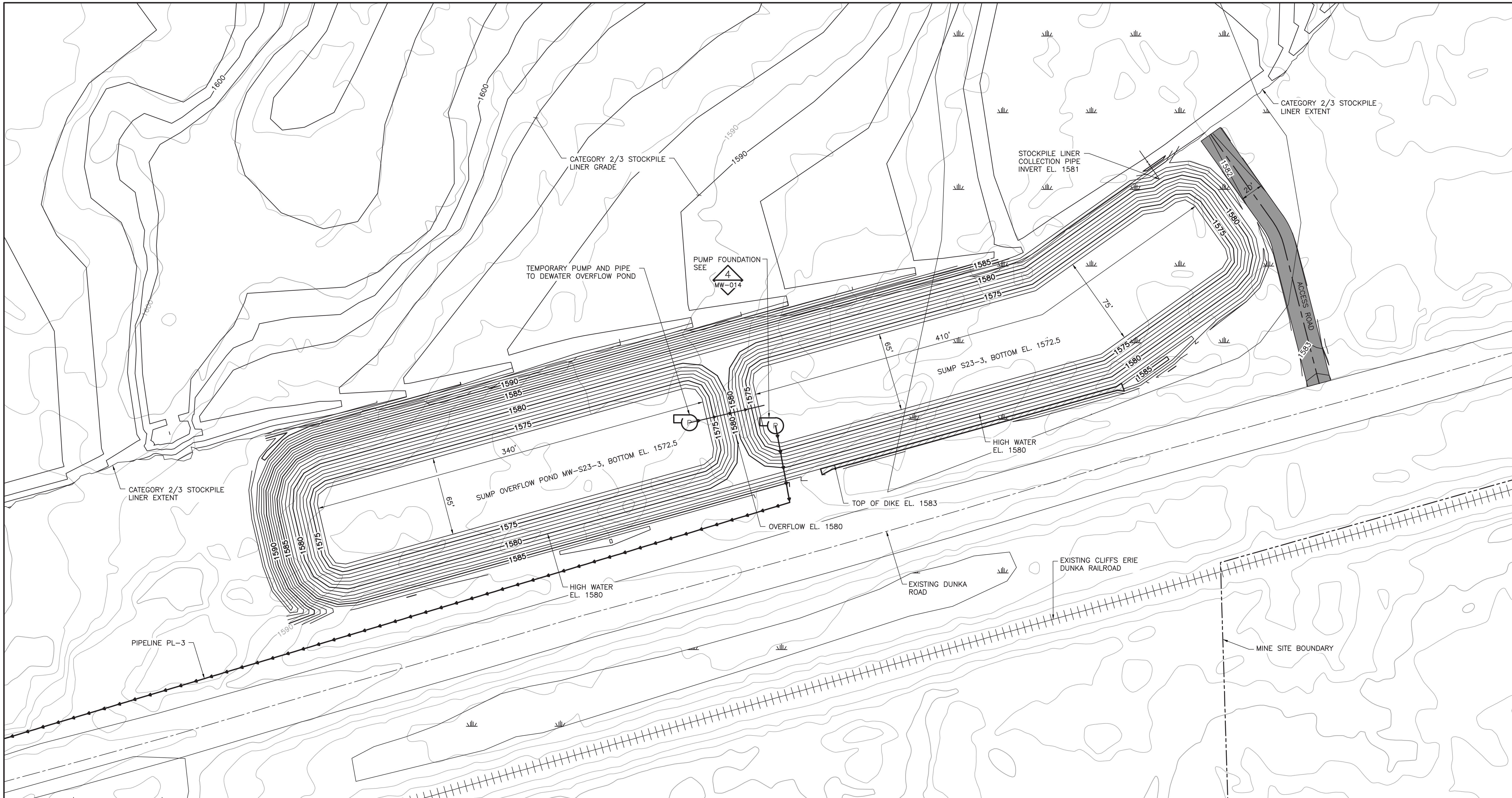
BARR

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. MW-006
REV B

CADD USER: Veronica Wourms FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-55-CS-128.DWG PLOT SCALE: 1:2 PLOT DATE: 6/2/2017 4:15 PM

INCHES 1 2



1 PLAN: SUMP S23-3 AND MW-23-3

0 40 80
SCALE IN FEET

NOTE:
1. THE SUMP S23-3 OVERFLOWS TO THE SUMP OVERFLOW POND MW-S23-3 IN EVENTS GREATER THAN THE 10-YEAR 24 HOUR STORM.

VER NO	DATE	DESCRIPTION
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/07/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE WATER INFRASTRUCTURE
MINE WATER SUMP DESIGN
SUMP S23-3 AND MW-S23-3 GRADING PLAN

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR

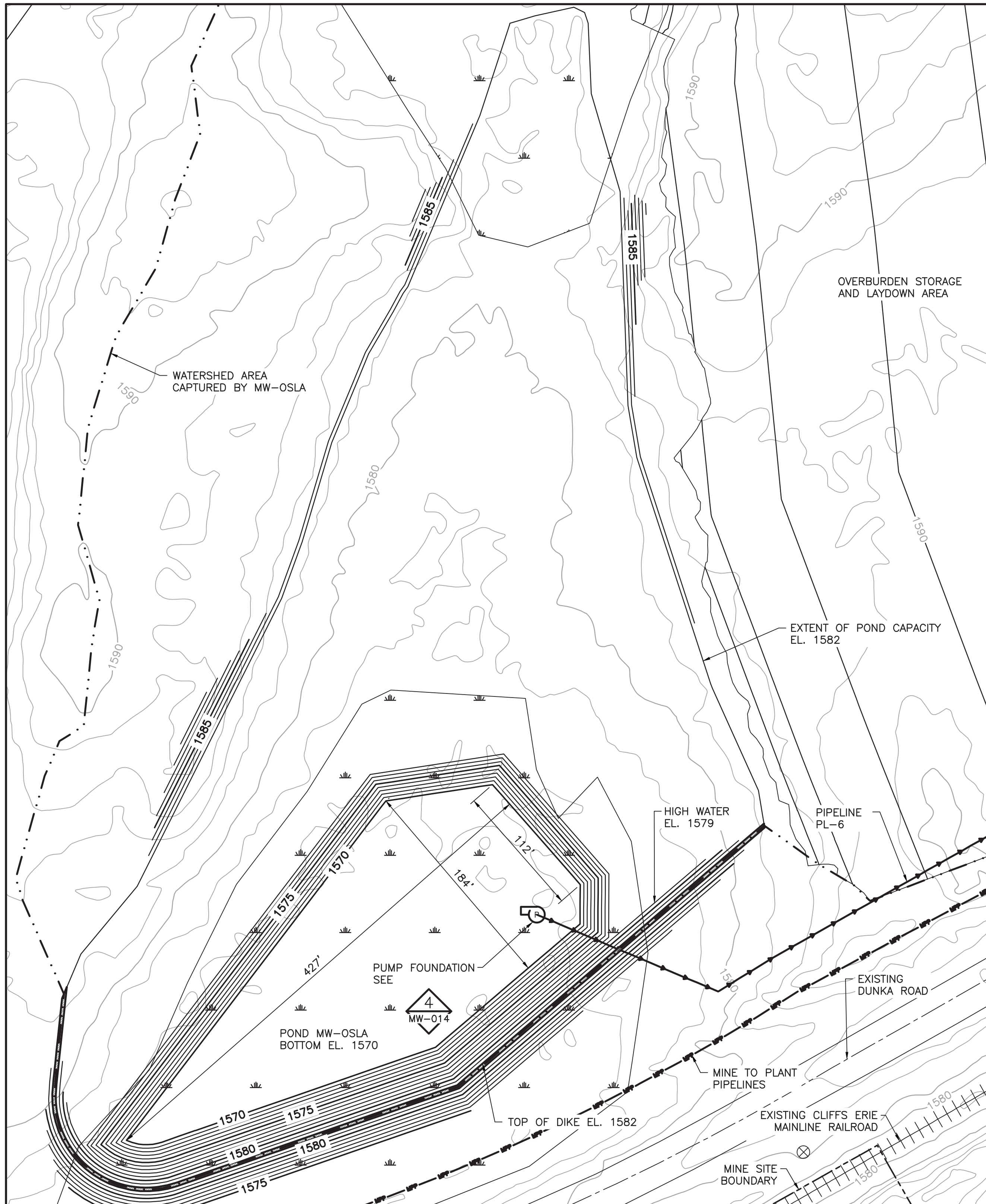
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

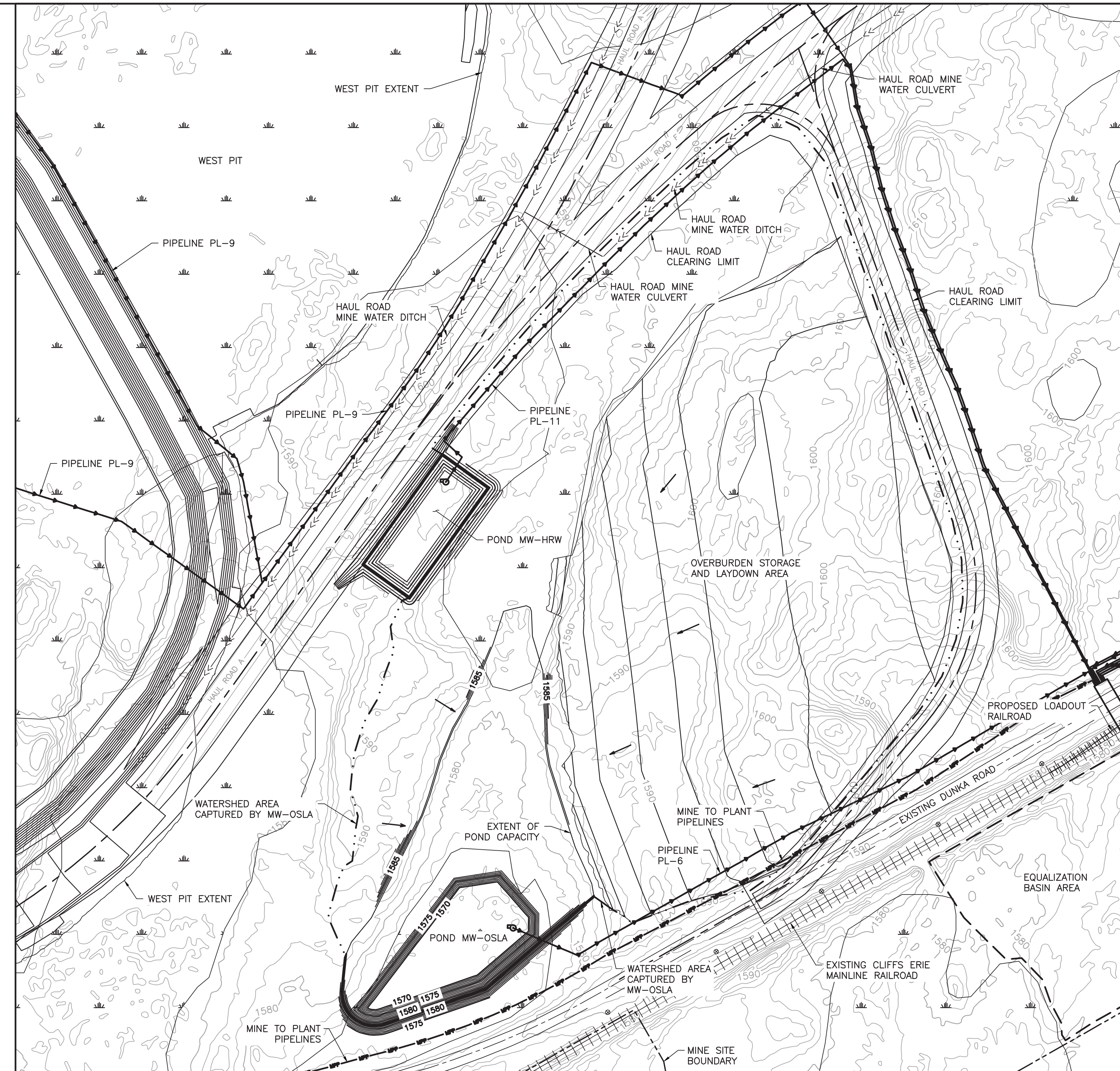
DWG. NO. MW-007

REV B

CADD USER: Veronica Wourms FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-55-CS-129.DWG PLOT SCALE: 1:2 PLOT DATE: 6/2/2017 4:46 PM

INCHES 1 2





NOTE:
1. MINE YEAR 11 CONTOURS ARE SHOWN FOR THE WEST PIT.

1 PLAN: POND MW-OSLA

0 60 120
SCALE IN FEET

2 PLAN: DRAINAGE AREA FOR MW-OSLA

0 150 300
SCALE IN FEET

PLANT DRAWING NUMBER:

MINE WATER INFRASTRUCTURE
MINE WATER POND DESIGN
POND MW-OSLA GRADING PLAN

VER NO	DATE	DESCRIPTION
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/07/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

POLYMET MINING

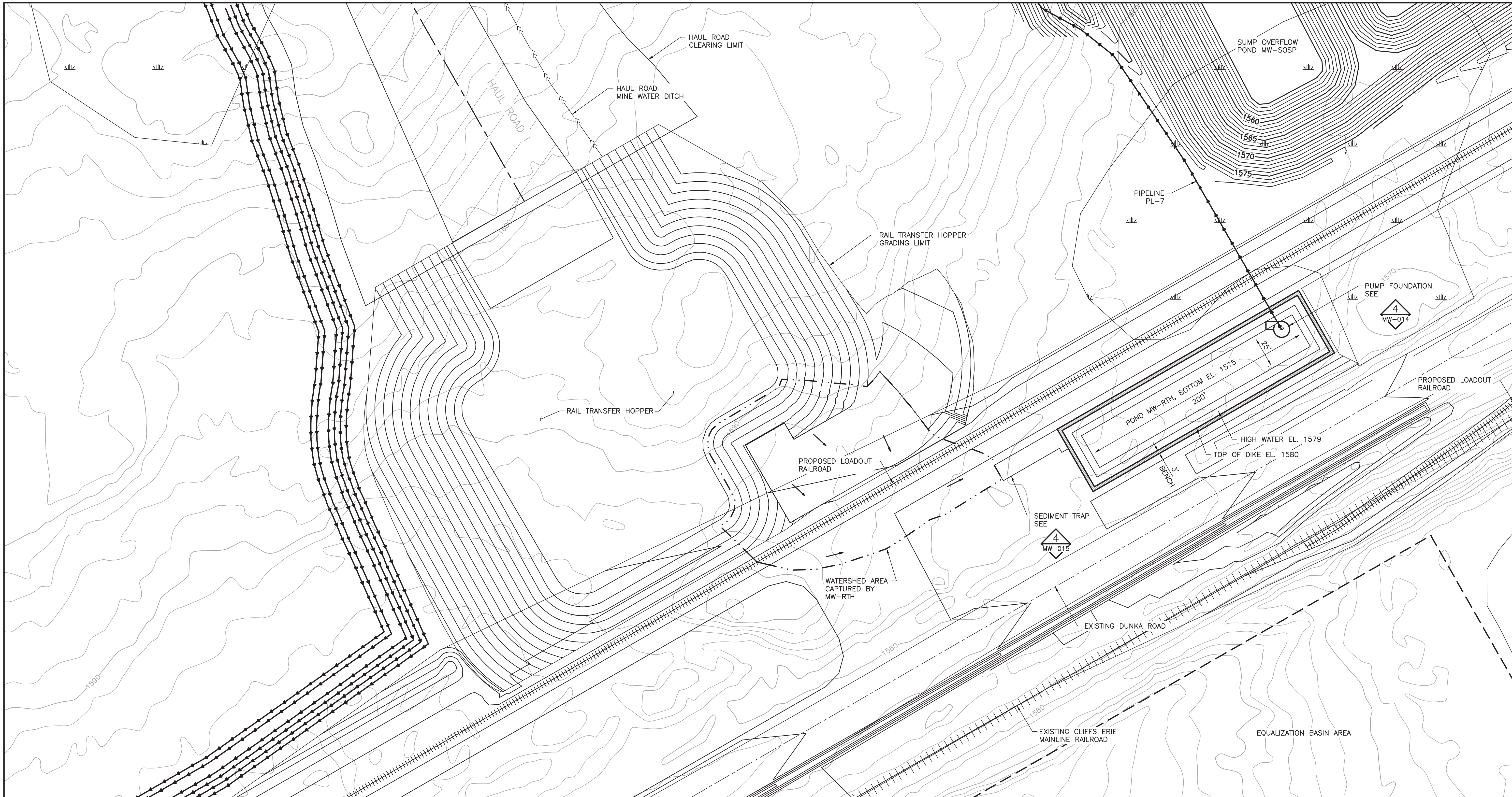
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. MW-008
REV B

CADD USER: Veronica Wourms FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-55-CS-140.DWG PLOT SCALE: 1:2 PLOT DATE: 6/2/2017 4:56 PM

INCHES 1 2



1 PLAN: POND MW-RTH

0 40 80
SCALE IN FEET

PLANT DRAWING NUMBER:

MINE WATER INFRASTRUCTURE
MINE WATER POND DESIGN
POND MW-RTH GRADING PLAN

VER NO	DATE	DESCRIPTION
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/07/17
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

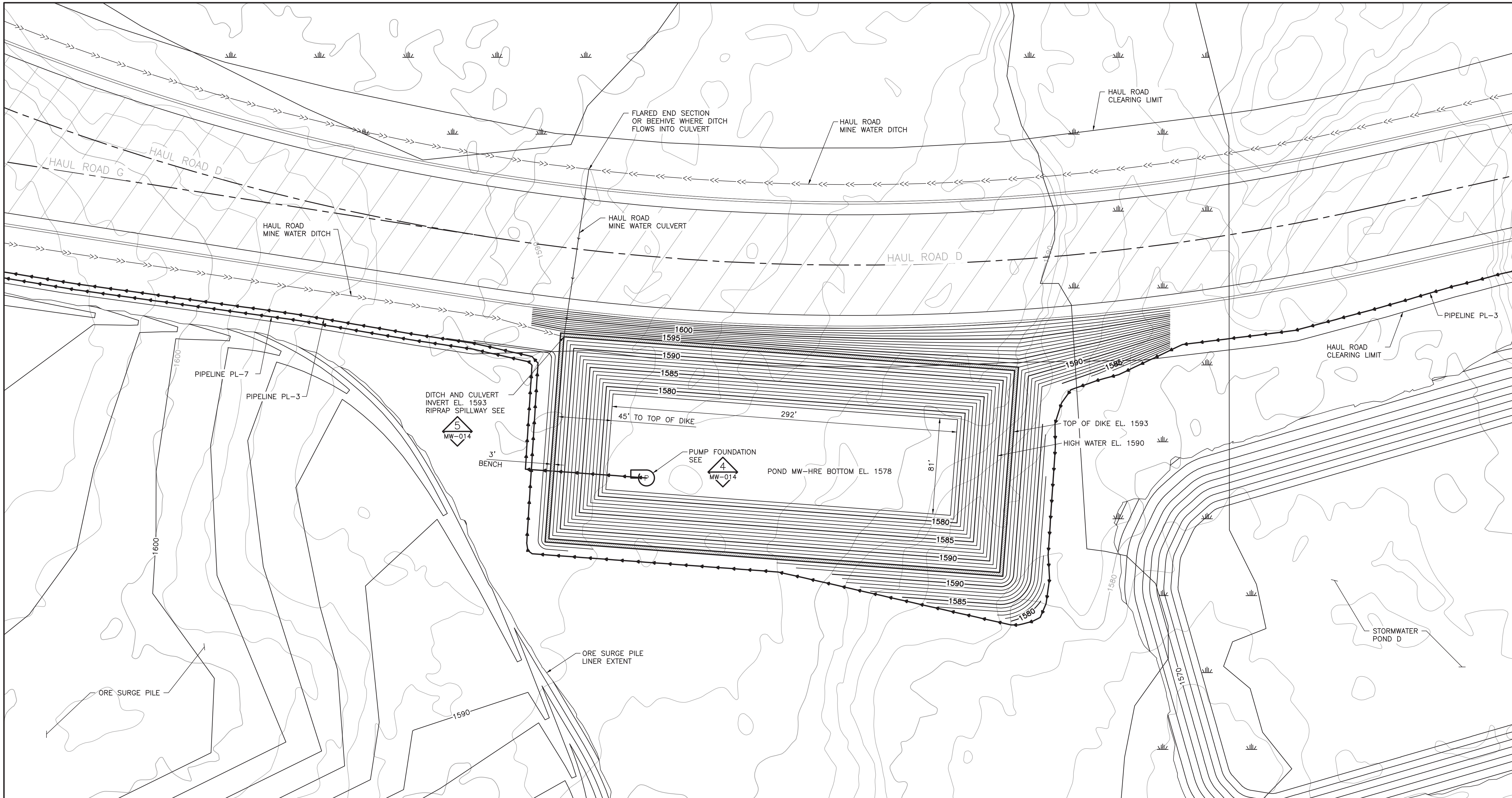
BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. MW-009
REV B

CADD USER: Veronica Wourms FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-55-CS-141.DWG PLOT SCALE: 1:2 PLOT DATE: 6/2/2017 5:02 PM

INCHES 1 2

CADD USER: Veronica Wourms FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-55-CS-142.DWG PLOT SCALE: 1:2 PLOT DATE: 6/2/2017 5:06 PM



1 PLAN: POND MW-HRE

0 40 80
SCALE IN FEET

PLANT DRAWING NUMBER:

MINE WATER INFRASTRUCTURE
MINE WATER POND DESIGN
POND MW-HRE GRADING PLAN

VER NO	DATE	DESCRIPTION
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/07/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

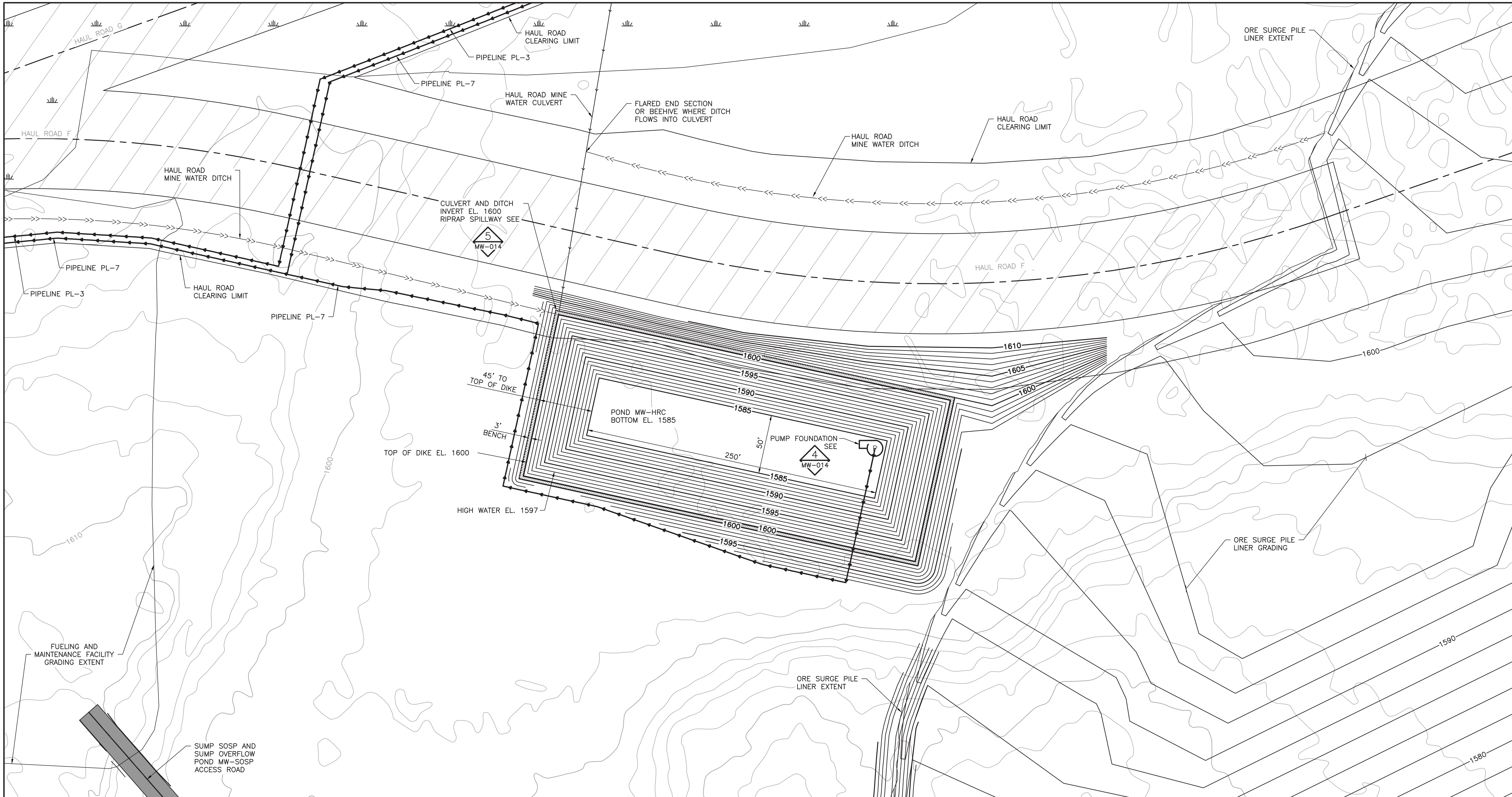
BARR

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. MW-010

REV B

INCHES 1 2



1 PLAN: POND MW-HRC

0 40 80
SCALE IN FEET

VER NO	DATE	DESCRIPTION
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/07/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE WATER INFRASTRUCTURE
MINE WATER POND DESIGN
POND MW-HRC GRADING PLAN

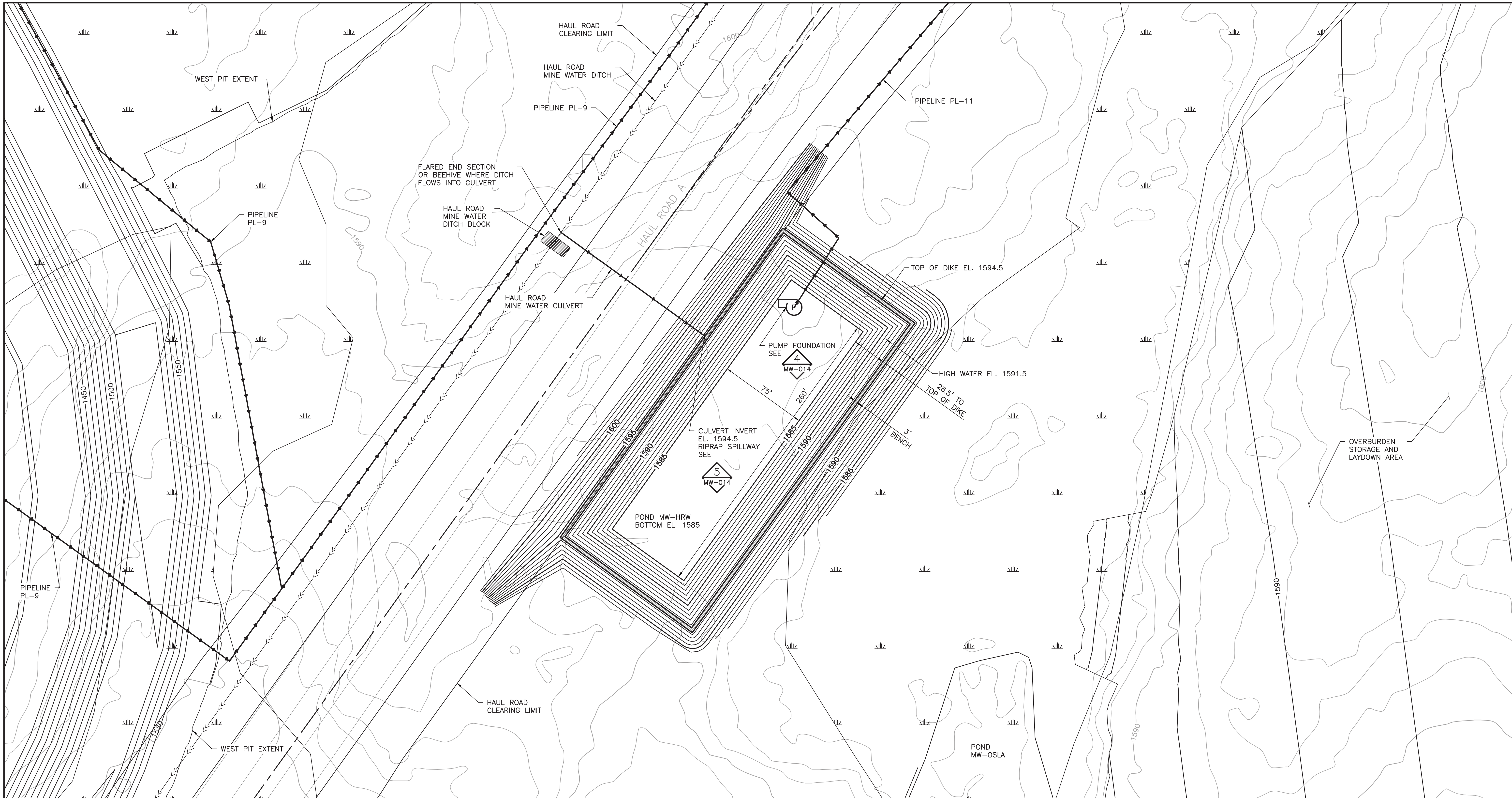
POLYMET MINING
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. MW-011
REV B

CADD USER: Veronica Wourms FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-55-CS-143.DWG PLOT SCALE: 1:2 PLOT DATE: 6/2/2017 5:16 PM

INCHES 1 2



NOTE:
1. MINE YEAR 11 CONTOURS ARE SHOWN FOR THE WEST PIT.

1 PLAN: POND MW-HRW

0 40 80
SCALE IN FEET

VER NO	DATE	DESCRIPTION
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/07/17
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE WATER INFRASTRUCTURE
MINE WATER POND DESIGN
POND MW-HRW GRADING PLAN

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. MW-012

REV B

CADD USER: Veronica Wourms FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-55-CS-144.DWG PLOT SCALE: 1:2 PLOT DATE: 6/2/2017 5:20 PM

INCHES 1 2

NOTE:
1. MINE YEAR 11 CONTOURS ARE SHOWN FOR THE WEST PIT.

1 PLAN: POND MW-HRN

0 40 80
SCALE IN FEET

VER NO	DATE	DESCRIPTION
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/07/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE WATER INFRASTRUCTURE
MINE WATER POND DESIGN
POND MW-HRN GRADING PLAN

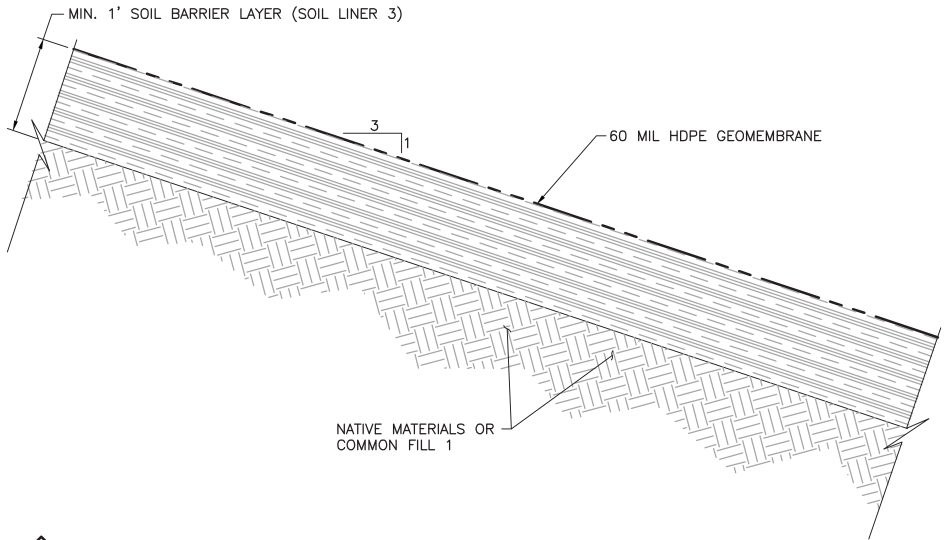
POLYMET MINING
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

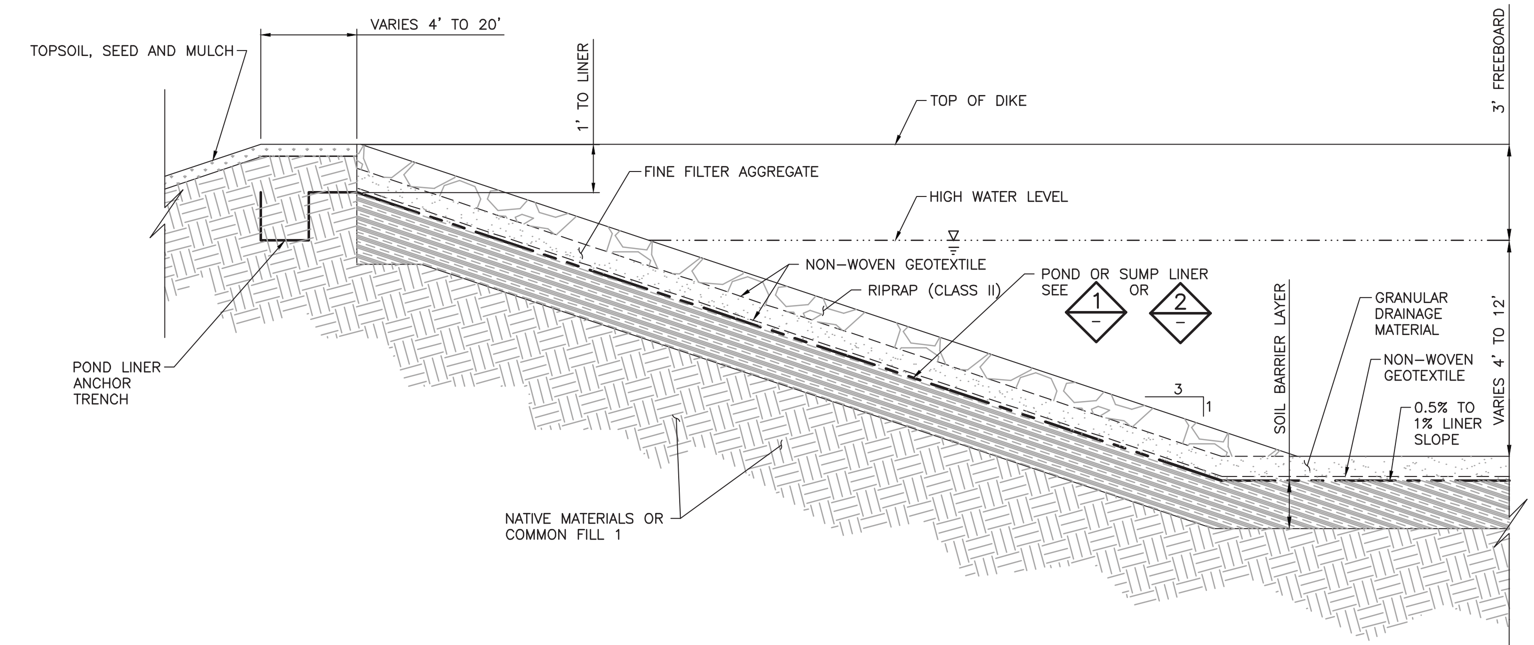
DWG. NO. MW-013
REV B

CADD USER: Veronica Wourms FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-55-CS-145.DWG PLOT SCALE: 1:2 PLOT DATE: 6/2/2017 5:27 PM

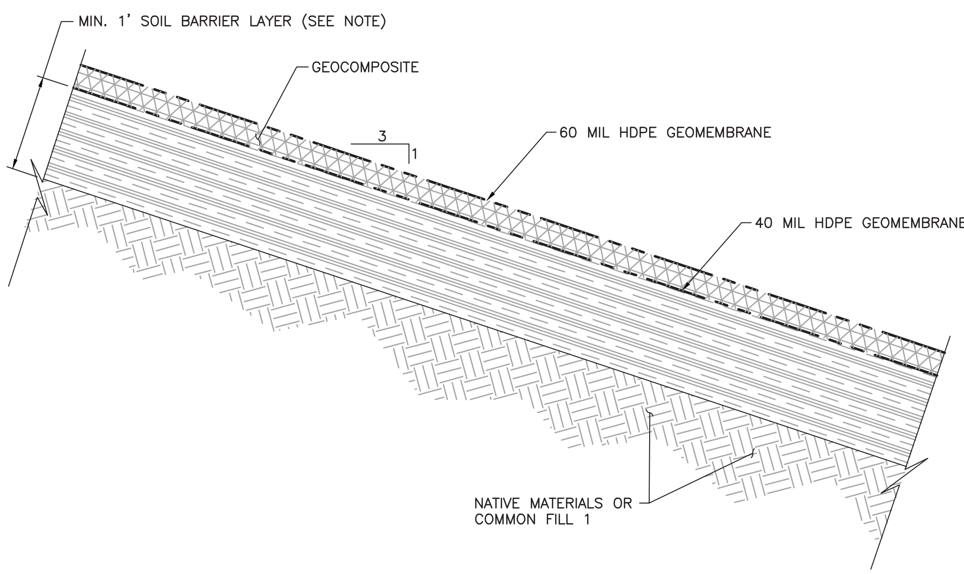
INCHES 1 2



1 DETAIL: TYPICAL MINE WATER POND AND SUMP OVERFLOW POND LINER
NOT TO SCALE

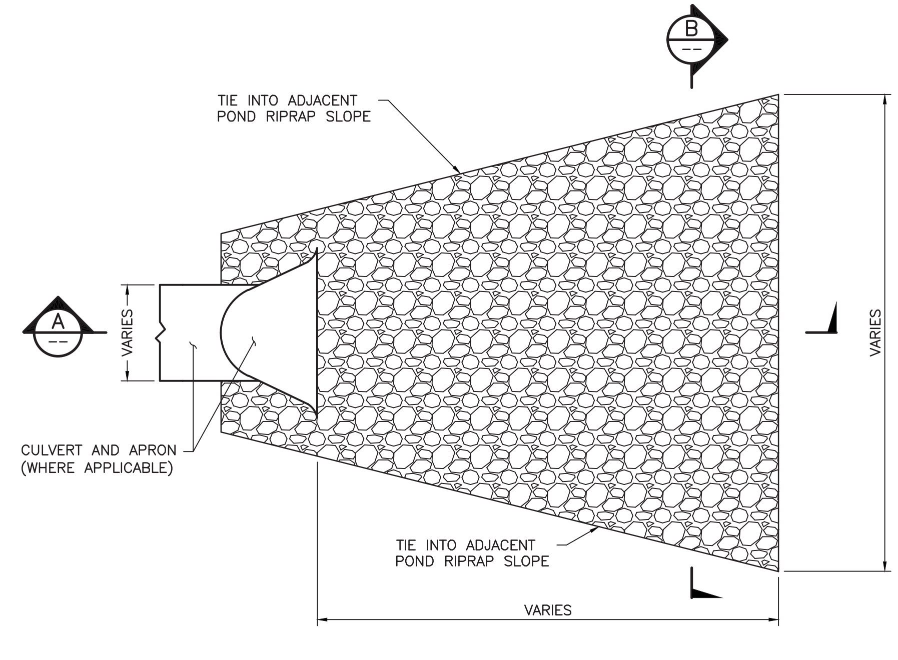


3 SECTION: TYPICAL SUMP AND POND LINER SECTION
NOT TO SCALE



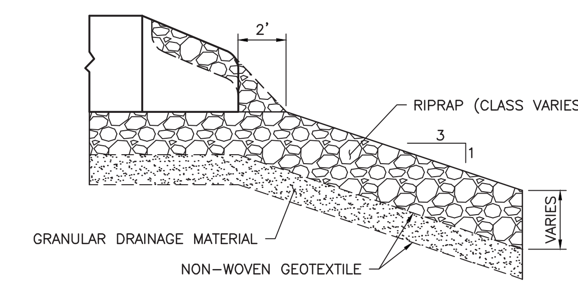
2 DETAIL: TYPICAL CATEGORY 2/3, 4 AND OSP SUMP AND MW-RTH LINER
NOT TO SCALE

NOTE: SOIL BARRIER LAYER TO MATCH THE ASSOCIATED STOCKPILE: CATEGORY 2/3 TO USE SOIL LINER 2; CATEGORY 4, OSP, AND RTH TO USE SOIL LINER 1

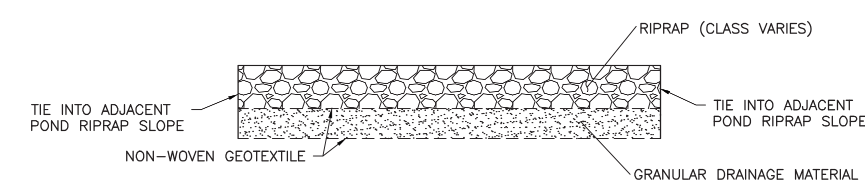


5 DETAIL: RIPRAP SLOPE
NOT TO SCALE

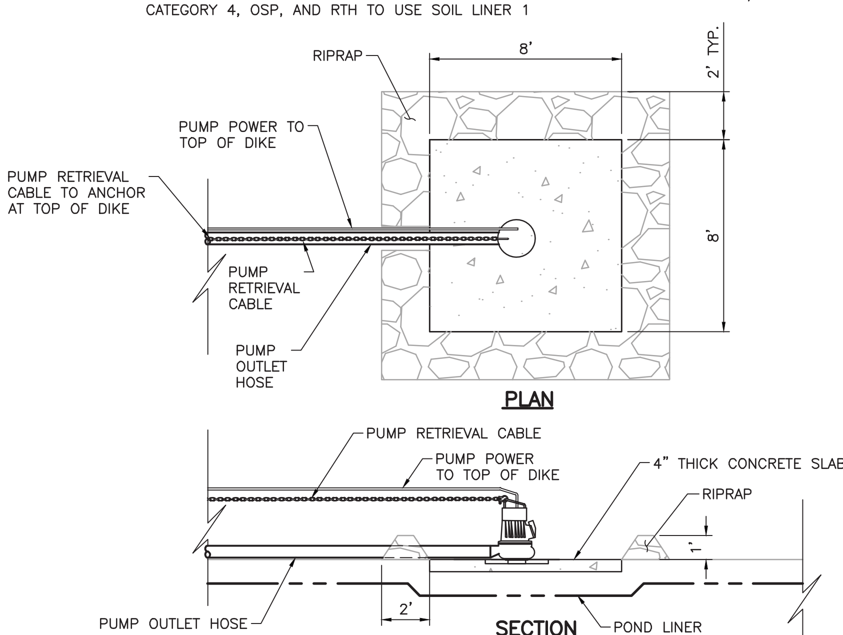
NOTES:
1. RIPRAP GRADATION BASED ON EXPECTED VELOCITIES FROM 100 YEAR 24-HOUR STORM EVENT.
2. CULVERT OUTLETS TO RIPRAP SLOPE.



A SECTION: RIPRAP SLOPE
NOT TO SCALE



B SECTION: RIPRAP SLOPE
NOT TO SCALE



4 DETAIL: TYPICAL SUMP AND POND PUMP FOUNDATION STRUCTURE
NOT TO SCALE

VER NO	DATE	DESCRIPTION
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/07/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE WATER INFRASTRUCTURE
SUMP/POND TYPICAL DETAILS

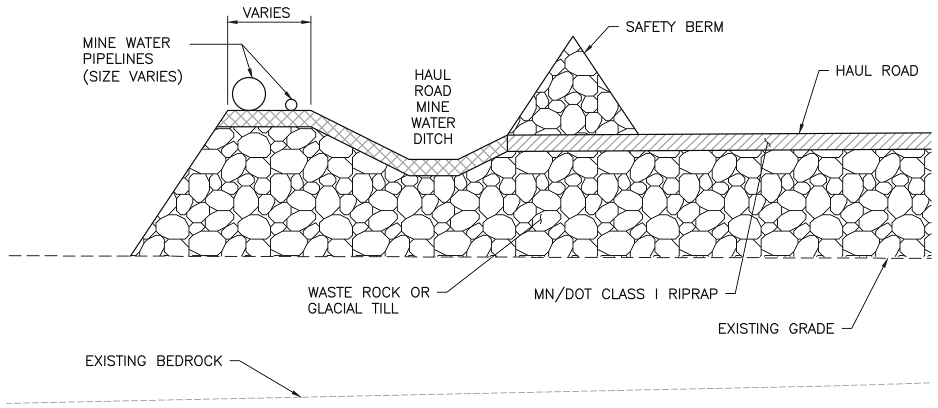
POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. MW-014
REV B

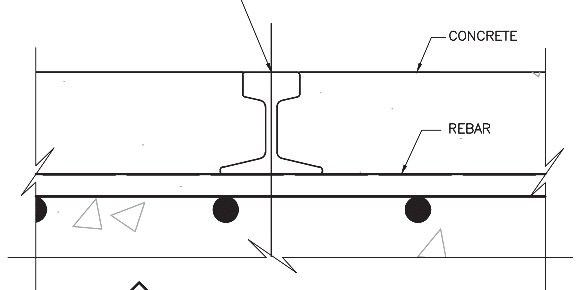
INCHES 1 2



NOTES:

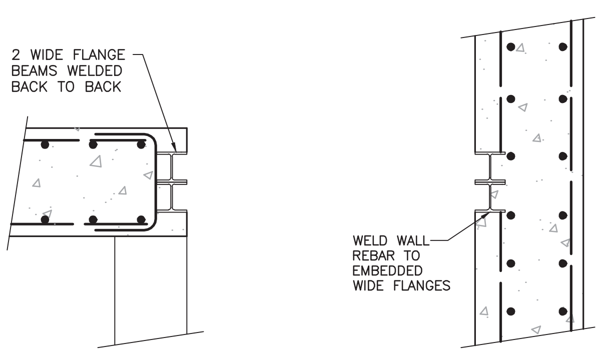
1. HAUL ROAD AND HAUL ROAD MINE WATER DITCH DESIGN IS SHOWN IN THE EARTHWORK DRAWINGS
2. MINE WATER PIPELINES WILL BE SECURED WITH COVER MATERIAL OVER THE PIPES EVERY 100'

1 SECTION: TYPICAL PIPE LOCATION
NOT TO SCALE

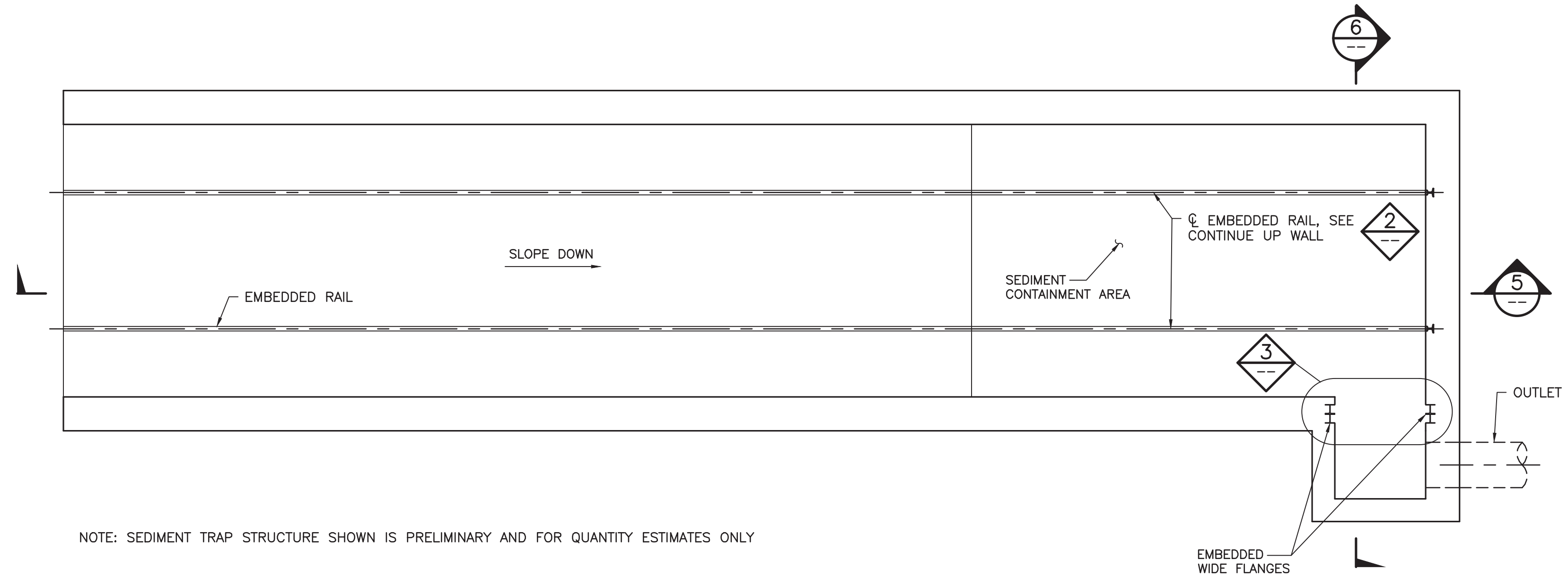


2 DETAIL: EMBEDDED RAIL

0 3 6 9 1
SCALE



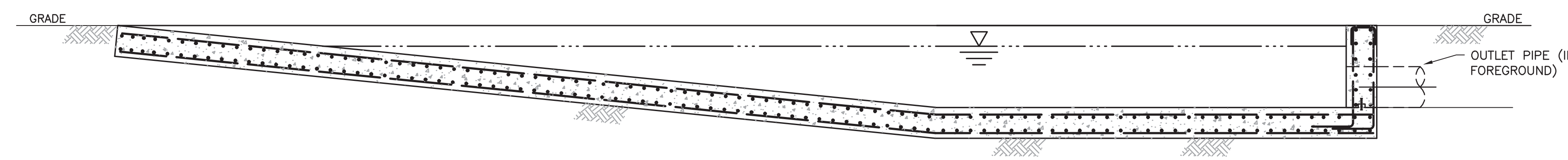
3 DETAIL: EMBEDDED WIDE FLANGES
NOT TO SCALE



NOTE: SEDIMENT TRAP STRUCTURE SHOWN IS PRELIMINARY AND FOR QUANTITY ESTIMATES ONLY

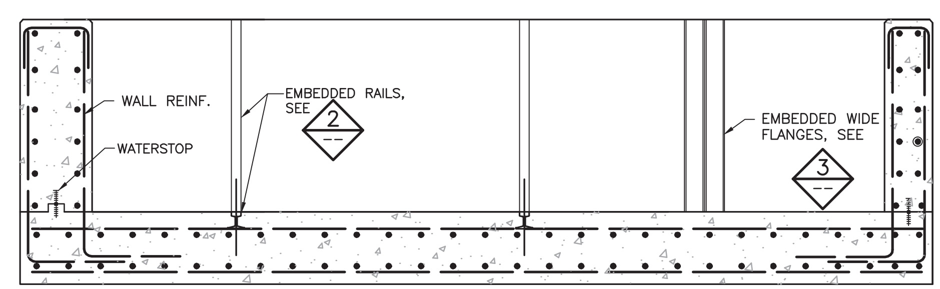
4 PLAN: SEDIMENT TRAP
MW-009

0 1 5
SCALE



5 SECTION: SEDIMENT TRAP

0 1 5
SCALE



6 SECTION: SEDIMENT TRAP

0 1 2 3 4 5
SCALE

PLANT DRAWING NUMBER:

MINE WATER INFRASTRUCTURE
SECTIONS AND DETAILS

VER NO	DATE	DESCRIPTION
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/07/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

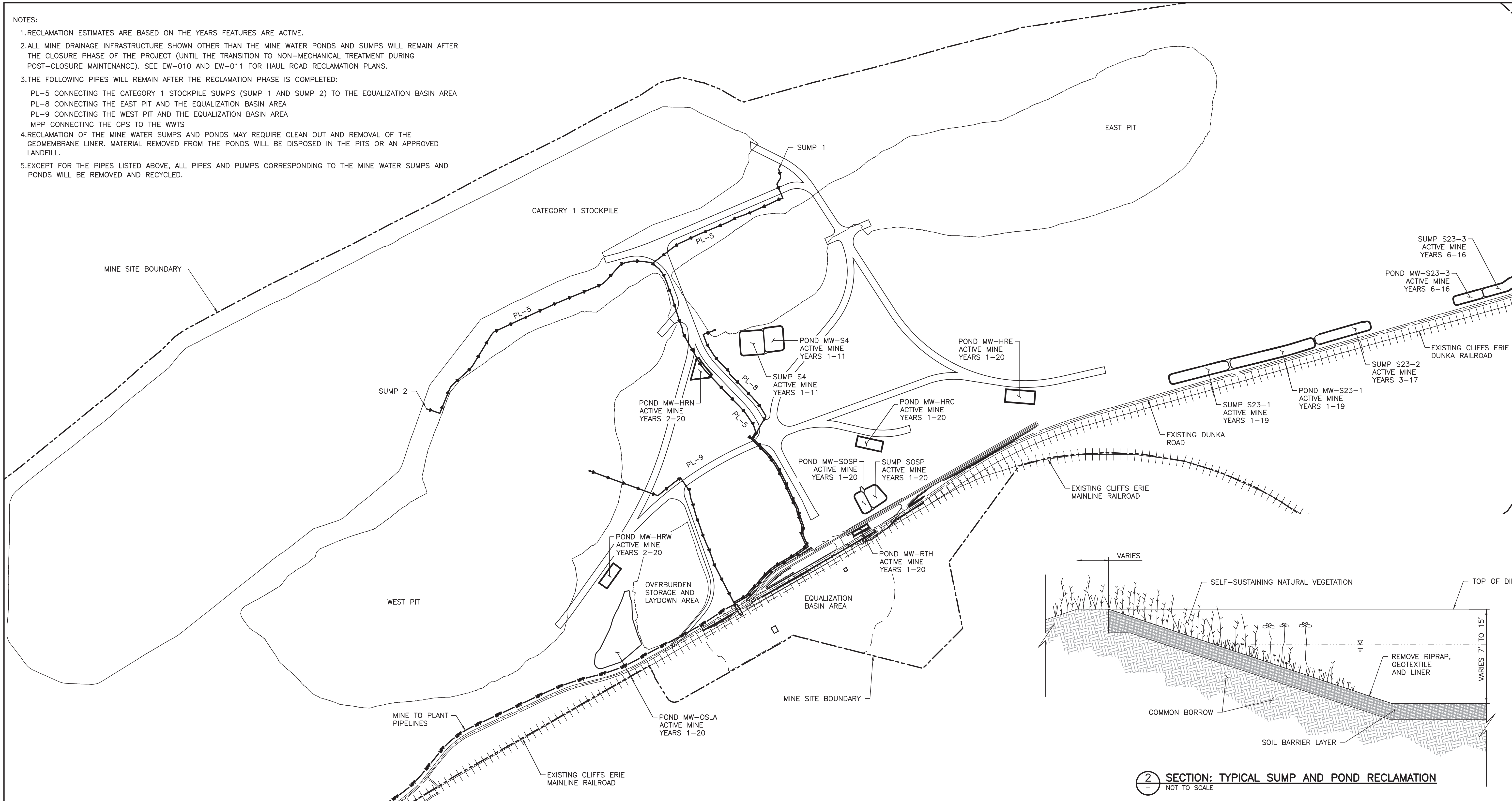
BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. MW-015
REV B

INCHES 1 2

NOTES:

1. RECLAMATION ESTIMATES ARE BASED ON THE YEARS FEATURES ARE ACTIVE.
2. ALL MINE DRAINAGE INFRASTRUCTURE SHOWN OTHER THAN THE MINE WATER PONDS AND SUMPS WILL REMAIN AFTER THE CLOSURE PHASE OF THE PROJECT (UNTIL THE TRANSITION TO NON-MECHANICAL TREATMENT DURING POST-CLOSURE MAINTENANCE). SEE EW-010 AND EW-011 FOR HAUL ROAD RECLAMATION PLANS.
3. THE FOLLOWING PIPES WILL REMAIN AFTER THE RECLAMATION PHASE IS COMPLETED:
   PL-5 CONNECTING THE CATEGORY 1 STOCKPILE SUMPS (SUMP 1 AND SUMP 2) TO THE EQUALIZATION BASIN AREA
   PL-8 CONNECTING THE EAST PIT AND THE EQUALIZATION BASIN AREA
   PL-9 CONNECTING THE WEST PIT AND THE EQUALIZATION BASIN AREA
   MPP CONNECTING THE CPS TO THE WWTS
4. RECLAMATION OF THE MINE WATER SUMPS AND PONDS MAY REQUIRE CLEAN OUT AND REMOVAL OF THE GEOMEMBRANE LINER. MATERIAL REMOVED FROM THE PONDS WILL BE DISPOSED IN THE PITS OR AN APPROVED LANDFILL.
5. EXCEPT FOR THE PIPES LISTED ABOVE, ALL PIPES AND PUMPS CORRESPONDING TO THE MINE WATER SUMPS AND PONDS WILL BE REMOVED AND RECYCLED.



1 PLAN: GENERAL LAYOUT RECLAMATION

0 600 1200
SCALE IN FEET

2 SECTION: TYPICAL SUMP AND POND RECLAMATION
NOT TO SCALE

VER NO	DATE	DESCRIPTION
1	5/18/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
2	6/07/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	2	6/07/17
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME JON M. MINNE
SIGNATURE
DATE 6/07/17 LICENSE# 25080

DRAWN: VJS
CHECKED: JMM3
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

MINE WATER INFRASTRUCTURE
RECLAMATION PLAN

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. MW-016

REV B

CADD USER: Veronica Wourms FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-55-CS-102.DWG PLOT SCALE: 1:2 PLOT DATE: 6/7/2017 9:23 AM

INCHES 1 2

Category 1 Stockpile Groundwater Containment System
Permit Application Support Drawings

Errata Sheet

Poly Met Mining, Inc. NorthMet Project

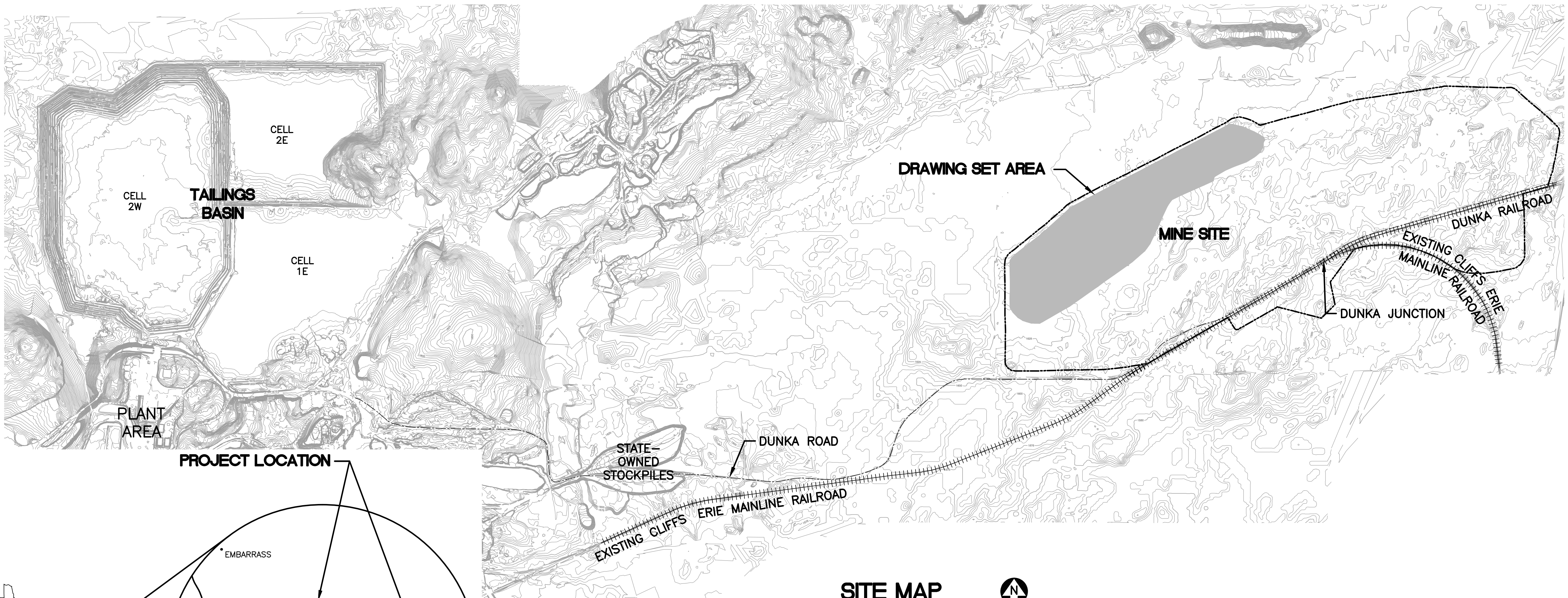
Permit Application Support Drawings: Category 1 Stockpile Groundwater Containment System

August 2017 (version 3)

Engineering design is currently in progress. The table below lists changes that have been identified to-date and have not yet been incorporated in the attached permit application support drawings within this set. Final design will incorporate these changes along with additional site-specific information (e.g., supplementary geotechnical data); therefore, additional adjustments may be made during final design that will be incorporated into the final design drawing set.

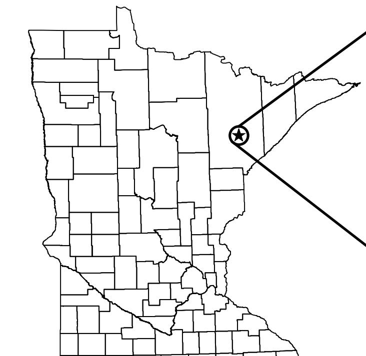
Drawing Sheet(s)	Change
Global change to all sheets, as needed	The terminology "mine drainage" as noted in these drawings will be changed to "mine water".
GCS-003	To meet construction stormwater requirements, a temporary berm will be added on the west side of the Mine Year 0 Category 1 Stockpile footprint to control mine water runoff as the stockpile is built out.
GCS-003, GCS-004, GCS-005, GCS-006, GCS-007, GCS-008, GCS-009	The "Mine Site Boundary" will be replaced by the "Mining Area Boundary" as shown on figures included in the Permit to Mine Application.

POLY MET MINING, INC. NORTHMET PROJECT
PERMIT APPLICATION SUPPORT DRAWINGS
CATEGORY 1 STOCKPILE GROUNDWATER CONTAINMENT SYSTEM
HOYT LAKES, MINNESOTA

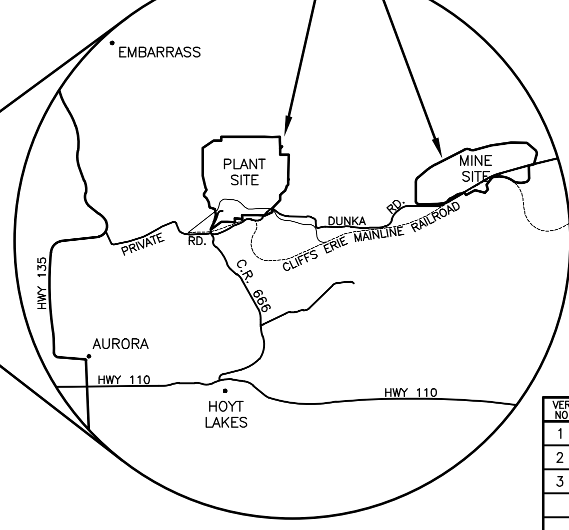


SITE MAP

0 2000 4000
SCALE IN FEET



LOCATION MAP
NOT TO SCALE



VICINITY MAP
NOT TO SCALE

VER NO	DATE	DESCRIPTION
1	10/18/11	ROCK AND OVERBURDEN MANAGEMENT PLAN – VERSIONS 5, 6, 7 – ATTACHMENT C
2	05/28/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
3	07/25/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	3	7/25/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME THOMAS J. RADUE
SIGNATURE Thomas J. Radue
DATE 7/25/17 LICENSE# 20951

DRAWN: CAD
CHECKED: TJR
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

CATEGORY 1 STOCKPILE
GROUNDWATER CONTAINMENT SYSTEM
LOCATION MAP AND SITE MAP

POLYMET MINING
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. GCS-001
REV

CADD USER: Cristian A. Diaz FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-21-CS-001.DWG PLOT SCALE: 1:2 PLOT DATE: 7/25/2017 11:01 AM

INCHES 1 2

GENERAL LEGEND

1000	EXISTING CONTOUR – MAJOR
	EXISTING CONTOUR – MINOR
	MINE SITE BOUNDARY
OF	PROPOSED SUMP OVERFLOW PIPE
	PROPOSED MINE WATER PIPE (PUMPED FLOW)
	PROPOSED MINE WATER PIPE (GRAVITY FLOW)
	PROPOSED SUMP MANHOLE
	PROPOSED ACCESS ROADS
	HAUL ROAD

ABBREVIATIONS

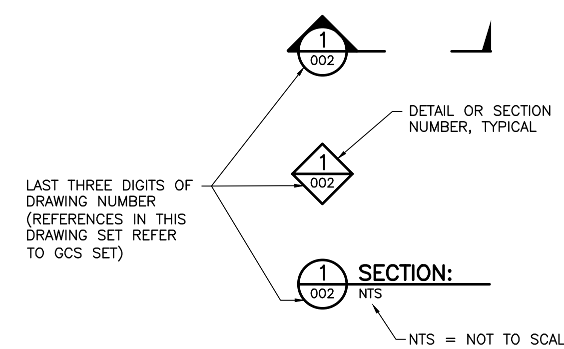
CAT – CATEGORY
DWG – DRAWING
EL – ELEVATION
GCS – GROUNDWATER CONTAINMENT SYSTEM
MH – MANHOLE
NTS – NOT TO SCALE
PVI – PROFILE VERTICAL INTERSECTION
STA – STATION
WWTS – WASTE WATER TREATMENT SYSTEM

SHEET INDEX

SHEET NO. TITLE

GENERAL DRAWINGS

DRAWING NUMBERING



NOTES

1. COORDINATE SYSTEM IS MINNESOTA STATE PLANE NORTH ZONE, NAD83.
2. ELEVATIONS ARE MEAN SEA LEVEL (MSL), NAVD88.
3. EXISTING TOPOGRAPHIC INFORMATION SHOWN ON THE DRAWINGS WAS PREPARED BY AEROMETRIC, INC. FROM LIDAR DATA COLLECTED ON MARCH 17, 2010.

CADD USER: Cristian A. Diaz FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-21-CS-002.DWG PLOT SCALE: 1:2 PLOT DATE: 7/25/2017 11:02 AM

INCHES 1 2

VER NO	DATE	DESCRIPTION	ISSUE STATUS		
			ISSUED	VERSION	DATE
1	10/18/11	ROCK AND OVERBURDEN MANAGEMENT PLAN – VERSIONS 5, 6, 7 – ATTACHMENT C	FOR PERMITTING	3	7/25/17
2	05/28/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS			
3	07/25/17	PERMIT APPLICATION UPDATES			
			FOR CONSTRUCTION		
			NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME THOMAS J. RADUE
SIGNATURE Thomas J. Radue
DATE 7/25/17 LICENSE# 20951

DRAWN: CAD
CHECKED: TJR
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

CATEGORY 1 STOCKPILE GROUNDWATER CONTAINMENT SYSTEM LEGEND AND SHEET INDEX

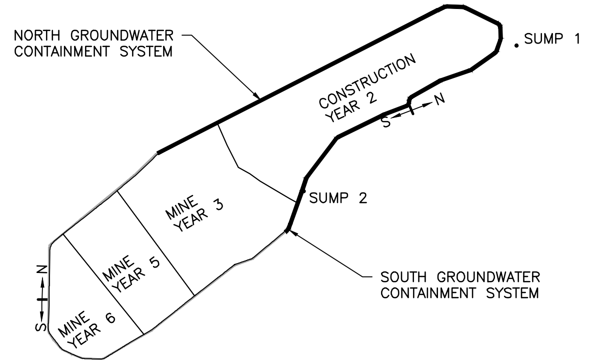
POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

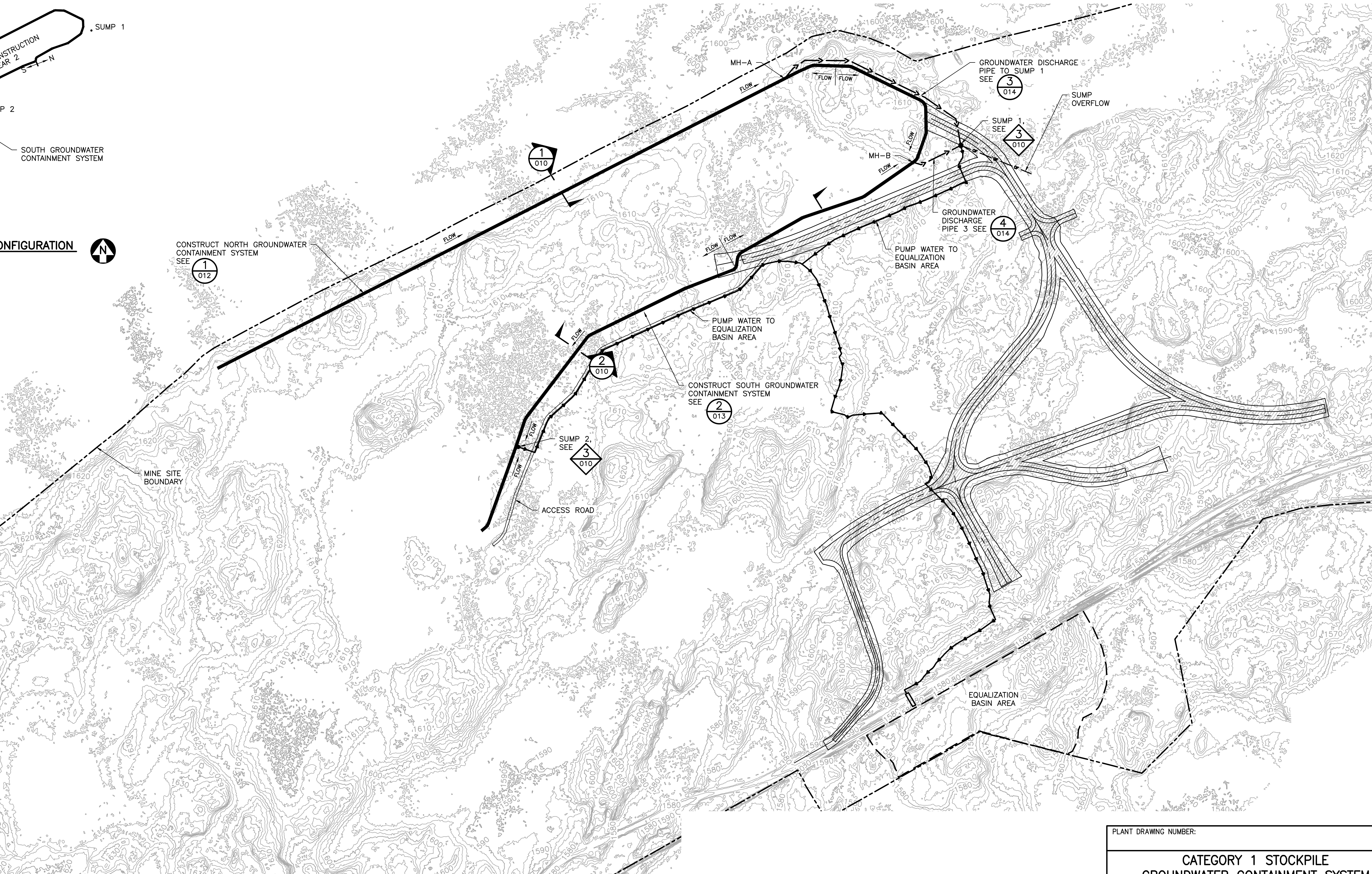
BARR

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. GCS–002 REV



1 PLAN: OVERALL CONFIGURATION
NTS



2 PLAN: GCS – MINE YEAR 0 LAYOUT
0 500 1000
SCALE IN FEET

VER NO	DATE	DESCRIPTION
1	10/18/11	ROCK AND OVERBURDEN MANAGEMENT PLAN – VERSIONS 5, 6, 7 – ATTACHMENT C
2	05/28/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
3	07/25/17	PERMIT APPLICATION UPDATES

ISSUE STATUS	VERSION	DATE
FOR PERMITTING	3	7/25/17
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME THOMAS J. RADUE
SIGNATURE Thomas J. Radue
DATE 7/25/17 LICENSE# 20951

DRAWN: CAD
CHECKED: TJR
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

CATEGORY 1 STOCKPILE GROUNDWATER CONTAINMENT SYSTEM CONSTRUCTION YEAR 2

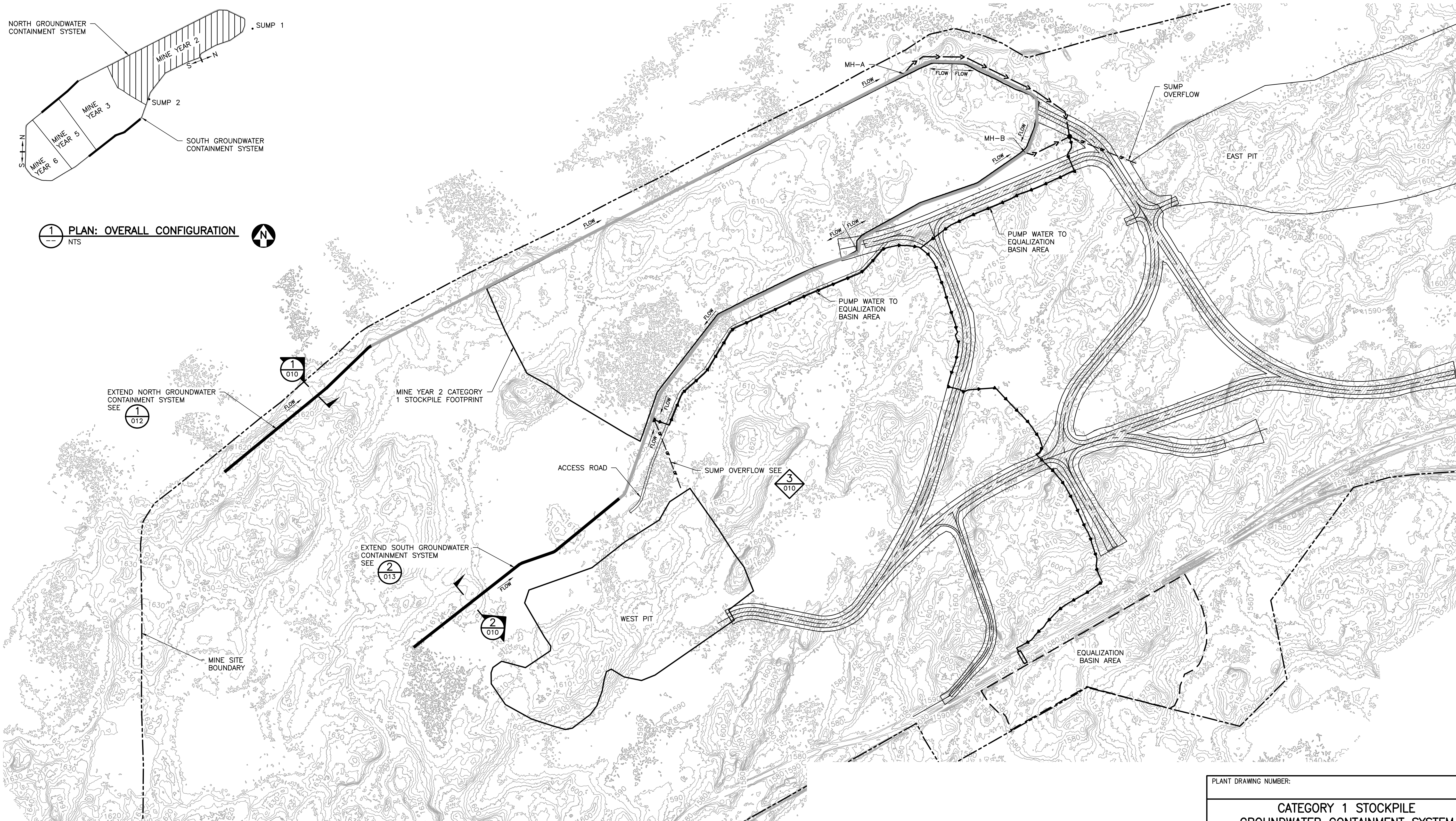
POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. GCS-003
REV

INCHES 1 2



2 PLAN: GCS – MINE YEAR 2 LAYOUT
0 500 1000
SCALE IN FEET

CADD USER: Cristian A. Diaz FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-21-CS-004.DWG PLOT SCALE: 1:2 PLOT DATE: 7/25/2017 11:06 AM

INCHES 1 2

VER NO	DATE	DESCRIPTION
1	10/18/11	ROCK AND OVERBURDEN MANAGEMENT PLAN – VERSIONS 5, 6, 7 – ATTACHMENT C
2	05/28/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
3	07/25/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	3	7/25/17
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME THOMAS J. RADUE
SIGNATURE Thomas J. Radue
DATE 7/25/17 LICENSE# 20951

DRAWN: CAD
CHECKED: TJR
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

CATEGORY 1 STOCKPILE GROUNDWATER CONTAINMENT SYSTEM MINE YEAR 2 LAYOUT

POLYMET MINING

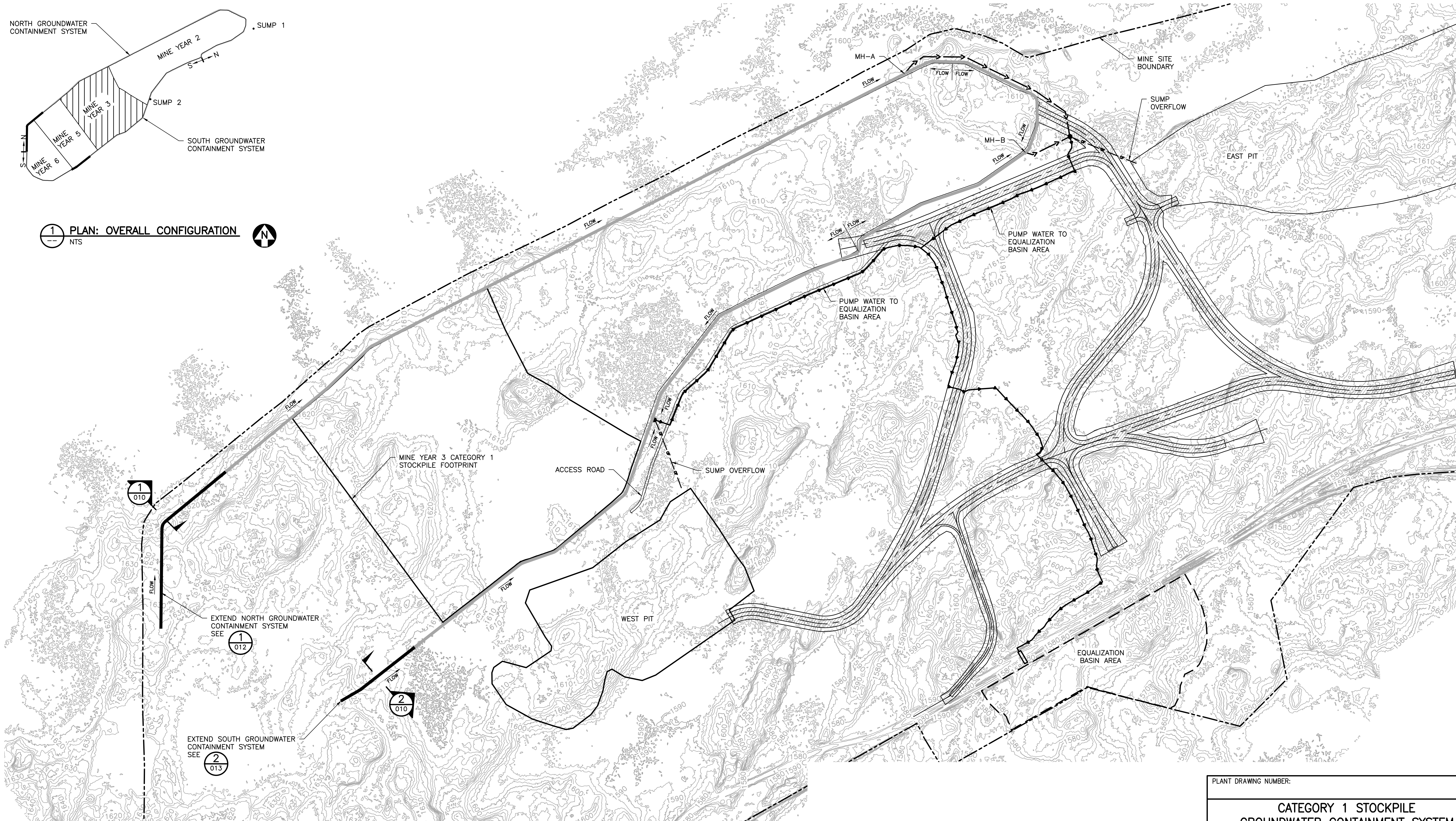
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. GCS-004

REV



1 PLAN: OVERALL CONFIGURATION
NTS

2 PLAN: GCS – MINE YEAR 3 LAYOUT
0 500 1000
SCALE IN FEET

VER NO	DATE	DESCRIPTION
1	10/18/11	ROCK AND OVERBURDEN MANAGEMENT PLAN – VERSIONS 5, 6, 7 – ATTACHMENT C
2	05/28/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
3	07/25/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	3	7/25/17
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME THOMAS J. RADUE
SIGNATURE Thomas J. Radue
DATE 7/25/17 LICENSE# 20951

DRAWN: CAD
CHECKED: TJR
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

CATEGORY 1 STOCKPILE GROUNDWATER CONTAINMENT SYSTEM MINE YEAR 3 LAYOUT

POLYMET MINING

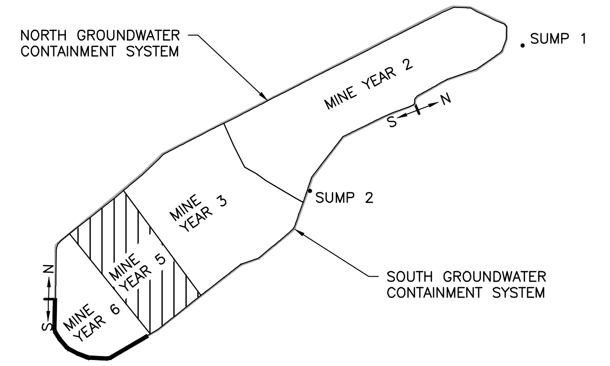
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. GCS-005
REV

CADD USER: Cristian A. Diaz FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-21-CS-005.DWG PLOT SCALE: 1:2 PLOT DATE: 7/25/2017 11:09 AM

INCHES 1 2



1 PLAN: OVERALL CONFIGURATION
NTS

2 PLAN: GCS – MINE YEAR 5 LAYOUT
0 500 1000
SCALE IN FEET

VER NO	DATE	DESCRIPTION
1	10/18/11	ROCK AND OVERBURDEN MANAGEMENT PLAN – VERSIONS 5, 6, 7 – ATTACHMENT C
2	05/28/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
3	07/25/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	3	7/25/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME THOMAS J. RADUE
SIGNATURE Thomas J. Radue
DATE 7/25/17 LICENSE# 20951

DRAWN: CAD
CHECKED: TJR
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

CATEGORY 1 STOCKPILE GROUNDWATER CONTAINMENT SYSTEM MINE YEAR 5 LAYOUT

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. GCS-006
REV

CADD USER: Cristian A. Diaz FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-21-CS-006.DWG PLOT SCALE: 1:2 PLOT DATE: 7/25/2017 11:13 AM

INCHES 1 2

2 PLAN: GCS – MINE YEAR 6 LAYOUT
0 500 1000
SCALE IN FEET

VER NO	DATE	DESCRIPTION
1	10/18/11	ROCK AND OVERBURDEN MANAGEMENT PLAN – VERSIONS 5, 6, 7 – ATTACHMENT C
2	05/28/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
3	07/25/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	3	7/25/17
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME THOMAS J. RADUE
SIGNATURE Thomas J. Radue
DATE 7/25/17 LICENSE# 20951

DRAWN: CAD
CHECKED: TJR
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

CATEGORY 1 STOCKPILE GROUNDWATER CONTAINMENT SYSTEM YEAR 6 LAYOUT

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

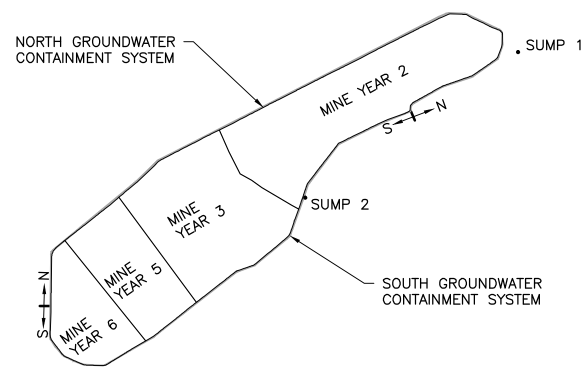
BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. GCS-007
REV

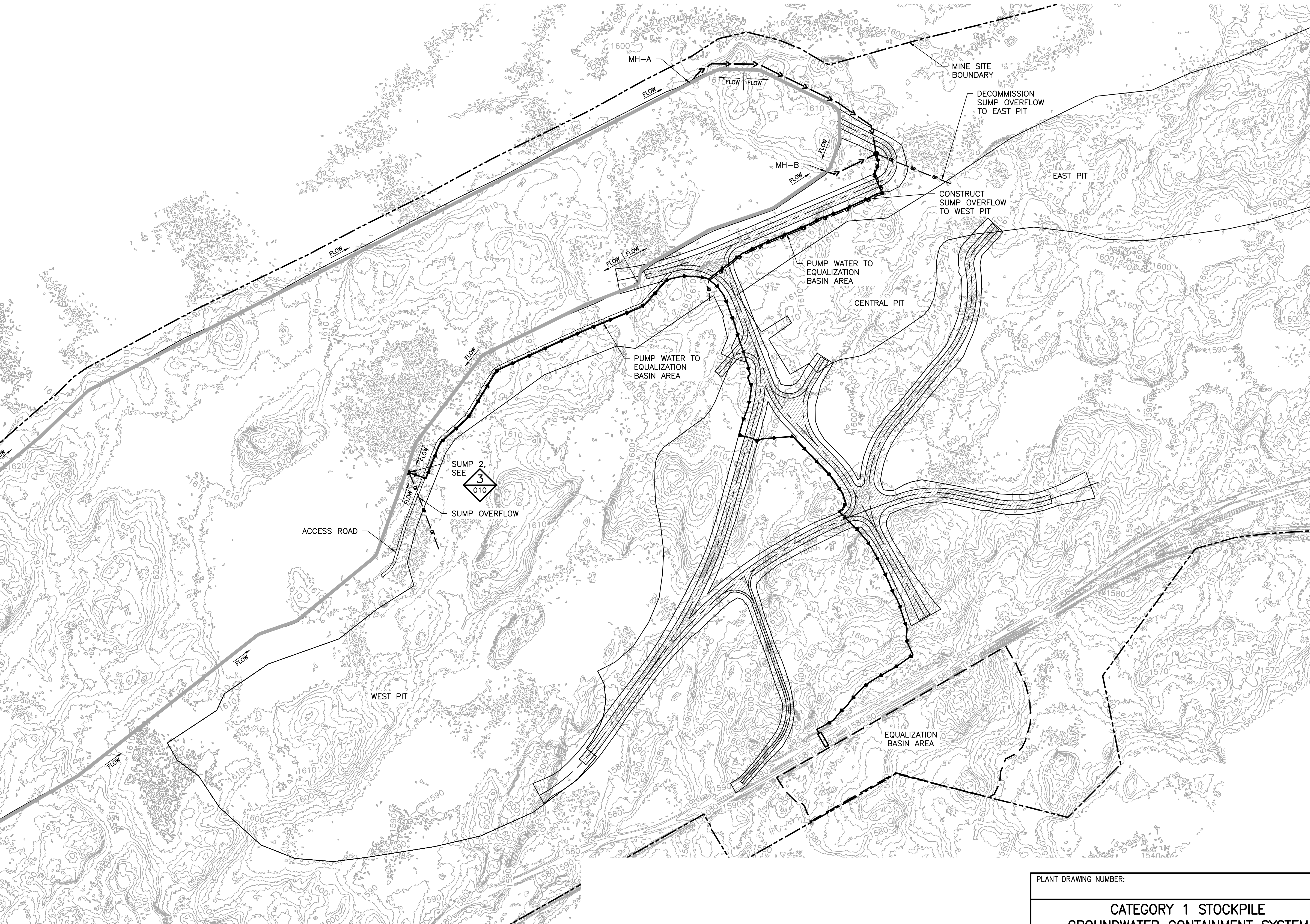
CADD USER: Cristion A. Diaz FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-21-CS-007.DWG PLOT SCALE: 1:2 PLOT DATE: 7/25/2017 11:15 AM

INCHES 1 2

CADD USER: Cristian A. Diaz FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-21-CS-008.DWG PLOT SCALE: 1:2 PLOT DATE: 7/25/2017 11:18 AM



1 PLAN: OVERALL CONFIGURATION
NTS



2 PLAN: GCS – MINE YEAR 20 LAYOUT
0 500 1000
SCALE IN FEET

VER NO	DATE	DESCRIPTION
1	10/18/11	ROCK AND OVERBURDEN MANAGEMENT PLAN – VERSIONS 5, 6, 7 – ATTACHMENT C
2	05/28/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
3	07/25/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	3	7/25/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME THOMAS J. RADUE
SIGNATURE Thomas J. Radue
DATE 7/25/17 LICENSE# 20951

DRAWN: CAD
CHECKED: TJR
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

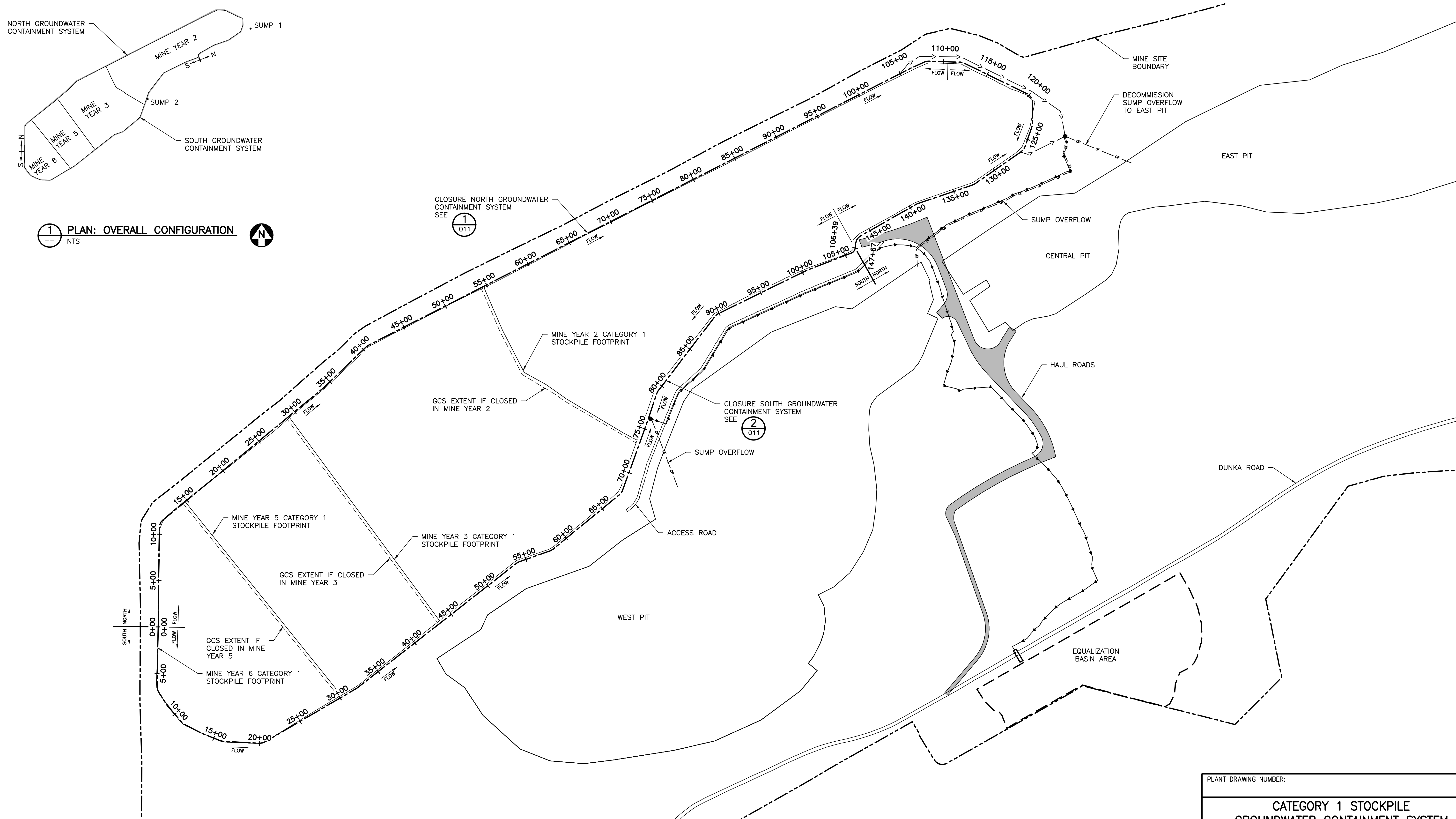
CATEGORY 1 STOCKPILE
GROUNDWATER CONTAINMENT SYSTEM
MINE YEAR 20 LAYOUT

POLYMET MINING
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. GCS-008
REV

INCHES 1 2



1 PLAN: OVERALL CONFIGURATION
NTS

2 PLAN: CLOSURE CONFIGURATION
0 500 1000
SCALE IN FEET

VER NO	DATE	DESCRIPTION
1	10/18/11	ROCK AND OVERBURDEN MANAGEMENT PLAN – VERSIONS 5, 6, 7 – ATTACHMENT C
2	05/28/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
3	07/25/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	3	7/25/17
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME THOMAS J. RADUE
SIGNATURE Thomas J. Radue
DATE 7/25/17 LICENSE# 20951

DRAWN: CAD
CHECKED: TJR
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

CATEGORY 1 STOCKPILE
GROUNDWATER CONTAINMENT SYSTEM
CLOSURE CONFIGURATION

POLYMET MINING

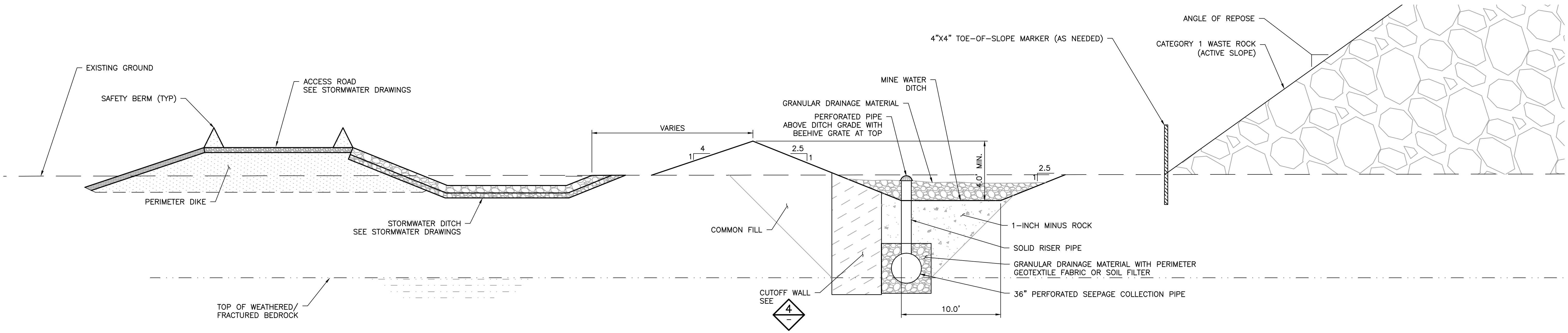
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. GCS-009
REV

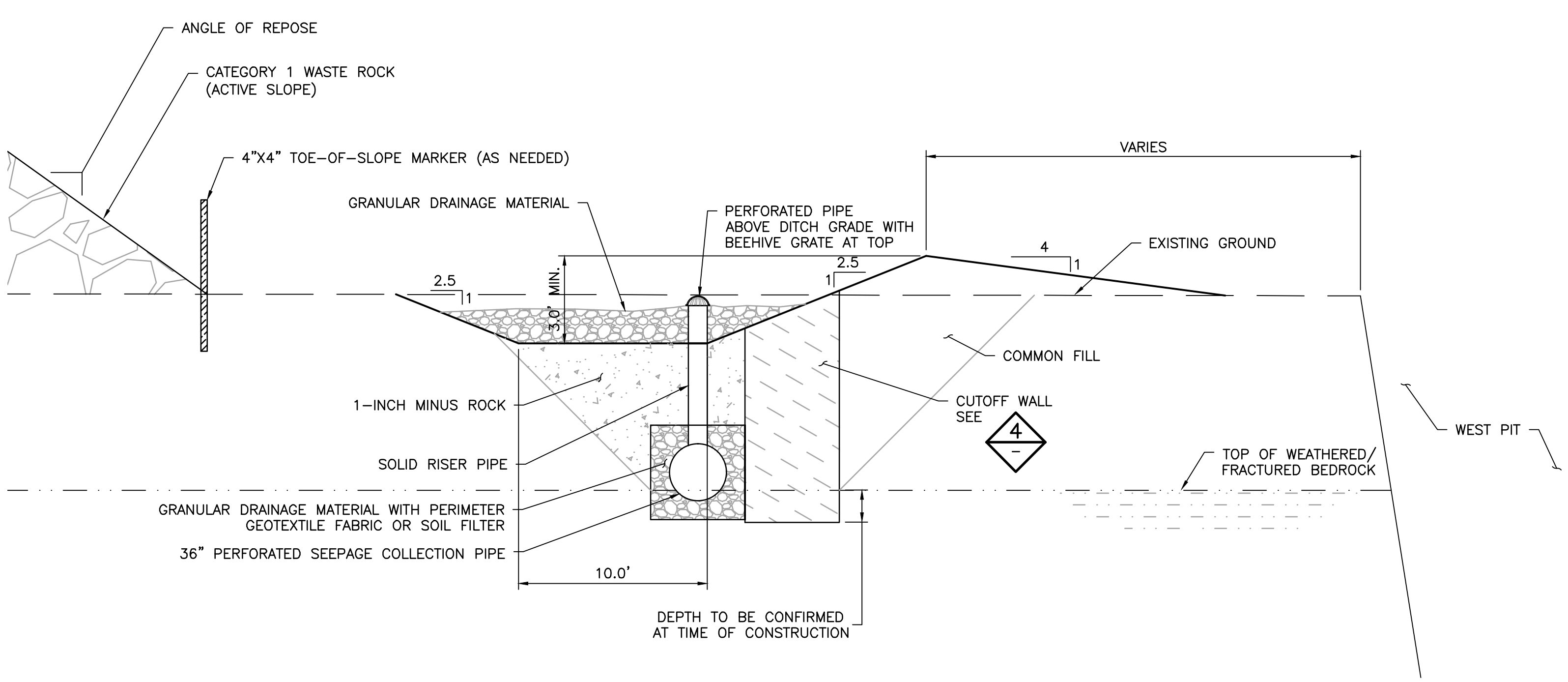
CADD USER: Cristian A. Diaz FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-21-CS-009.DWG PLOT SCALE: 1:2 PLOT DATE: 7/25/2017 11:20 AM

INCHES 1 2



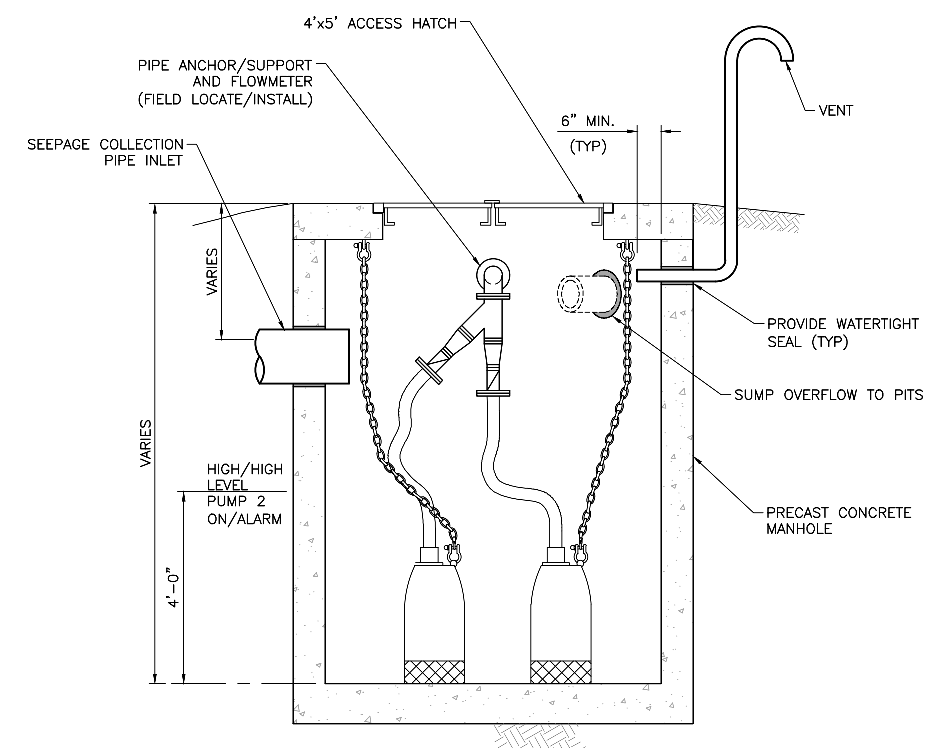
1 SECTION: NORTH GROUNDWATER CONTAINMENT SYSTEM TYPICAL SECTION – ADJACENT TO ACTIVE STOCKPILE

0 5 10
SCALE IN FEET

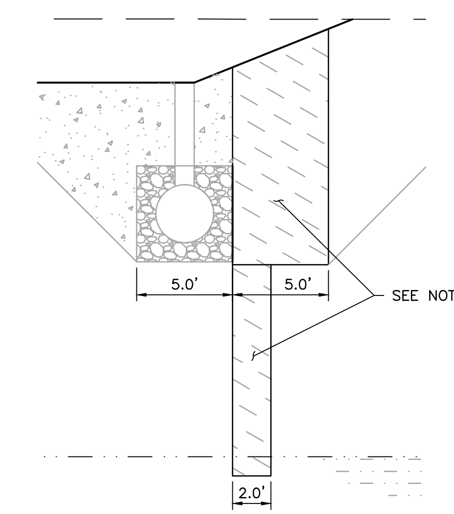


2 SECTION: SOUTH GROUNDWATER CONTAINMENT SYSTEM TYPICAL SECTION – ADJACENT TO ACTIVE STOCKPILE

0 5 10
SCALE IN FEET



3 SECTION: TYPICAL SUMP
NTS



4 SECTION: TYPICAL CUTOFF WALL

0 5 10
SCALE IN FEET

NOTES:

1. CUTOFF WALL WILL BE A HYDRAULIC BARRIER CONSTRUCTED OF COMPACTED SOIL, GEOSYNTHETIC CLAY, OR APPROVED ALTERNATE.

2. USE TRENCHLESS TECHNOLOGY TO CONSTRUCT 2' WIDE TRENCH DOWN TO COMPETENT BEDROCK IN AREAS WHERE COLLECTION PIPE IS LOCATED ABOVE BEDROCK. SEE

PLANT DRAWING NUMBER:

CATEGORY 1 STOCKPILE
GROUNDWATER CONTAINMENT SYSTEM
TYPICAL CROSS SECTIONS

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

POLYMET MINING

BARR

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

VER NO	DATE	DESCRIPTION
1	10/18/11	ROCK AND OVERBURDEN MANAGEMENT PLAN – VERSIONS 5, 6, 7 – ATTACHMENT C
2	05/28/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
3	07/25/17	PERMIT APPLICATION UPDATES

ISSUED	VERSION	DATE
FOR PERMITTING	3	7/25/17
FOR CONSTRUCTION		

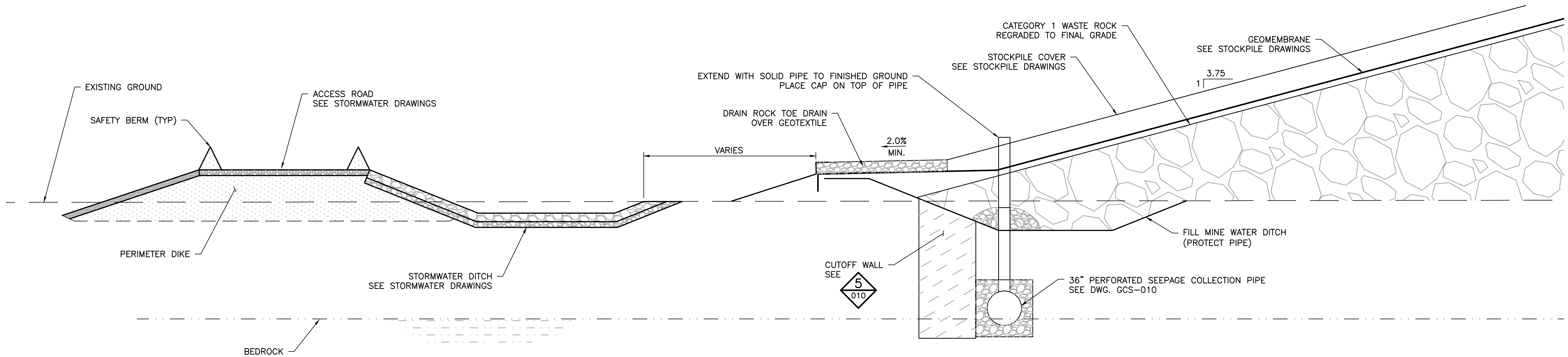
NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME THOMAS J. RADUE
SIGNATURE Thomas J. Radue
DATE 7/25/17 LICENSE# 20951

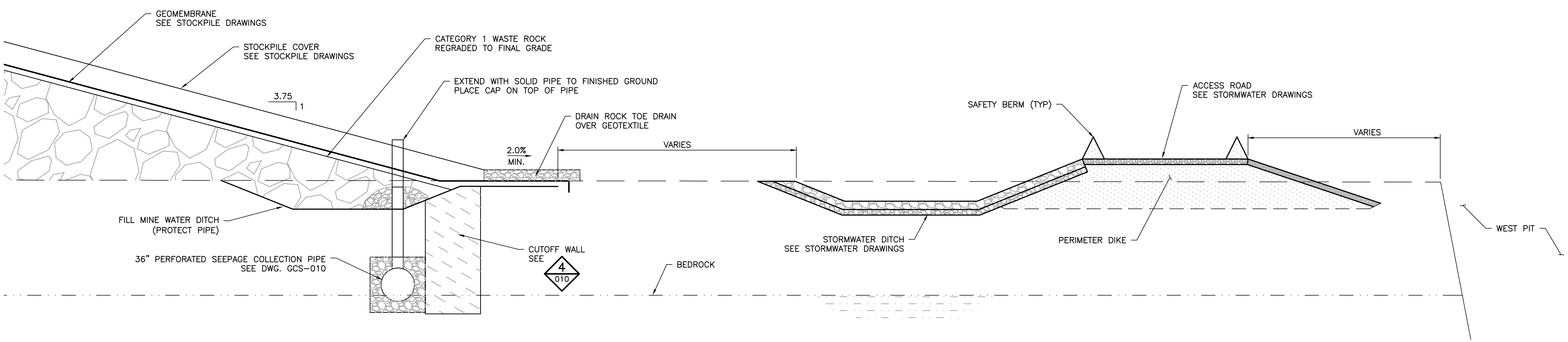
DRAWN: CAD
CHECKED: TJR
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN
DWG. NO. GCS-010
REV

INCHES 1 2



1 – SECTION: CLOSURE NORTH GROUNDWATER CONTAINMENT SYSTEM TYPICAL SECTION – ADJACENT TO RECLAIMED STOCKPILE

0 5 10
SCALE IN FEET



2 – SECTION: CLOSURE SOUTH AND GROUNDWATER CONTAINMENT SYSTEM TYPICAL SECTION – ADJACENT TO RECLAIMED STOCKPILE

0 5 10
SCALE IN FEET

VER NO	DATE	DESCRIPTION
1	10/18/11	ROCK AND OVERBURDEN MANAGEMENT PLAN – VERSIONS 5, 6, 7 – ATTACHMENT C
2	05/28/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
3	07/25/17	PERMIT APPLICATION UPDATES

ISSUED	VERSION	DATE
FOR PERMITTING	3	7/25/17
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME THOMAS J. RADUE
SIGNATURE Thomas J. Radue
DATE 7/25/17 LICENSE# 20951

DRAWN: CAD
CHECKED: TJR
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

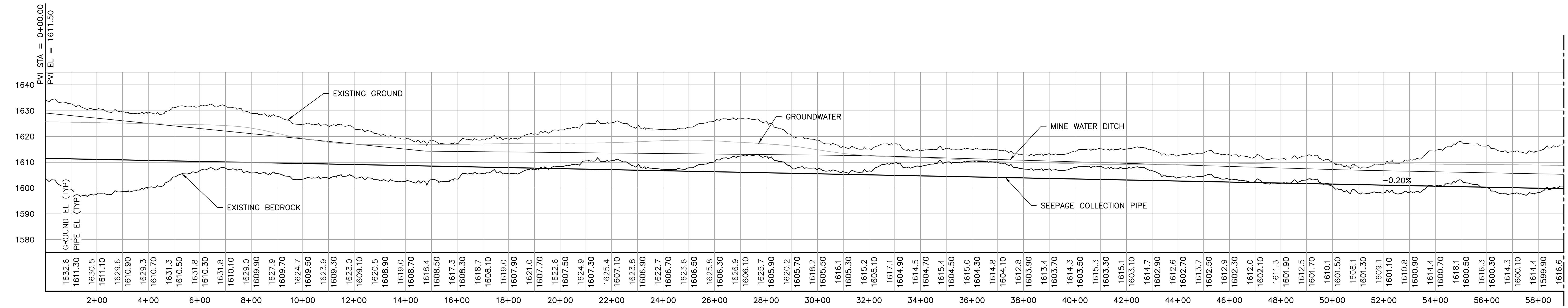
CATEGORY 1 STOCKPILE
GROUNDWATER CONTAINMENT SYSTEM
TYPICAL CROSS SECTIONS

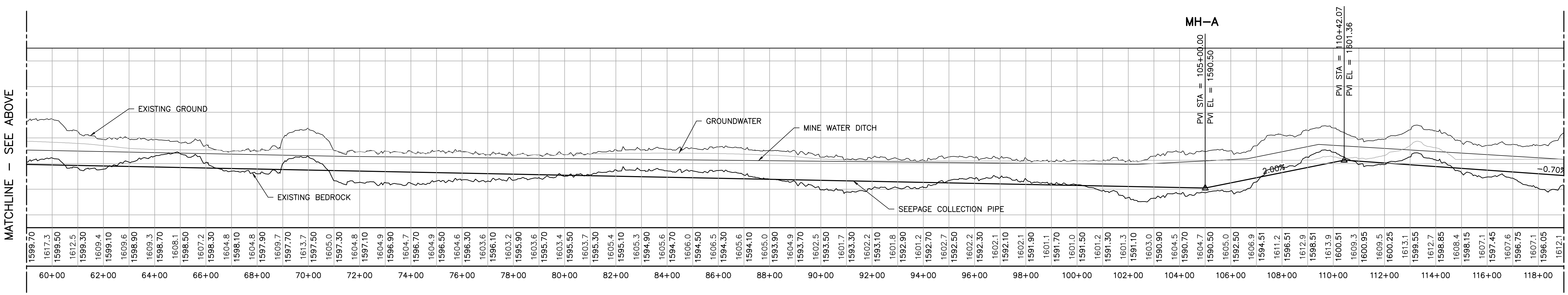
POLYMET MINING
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

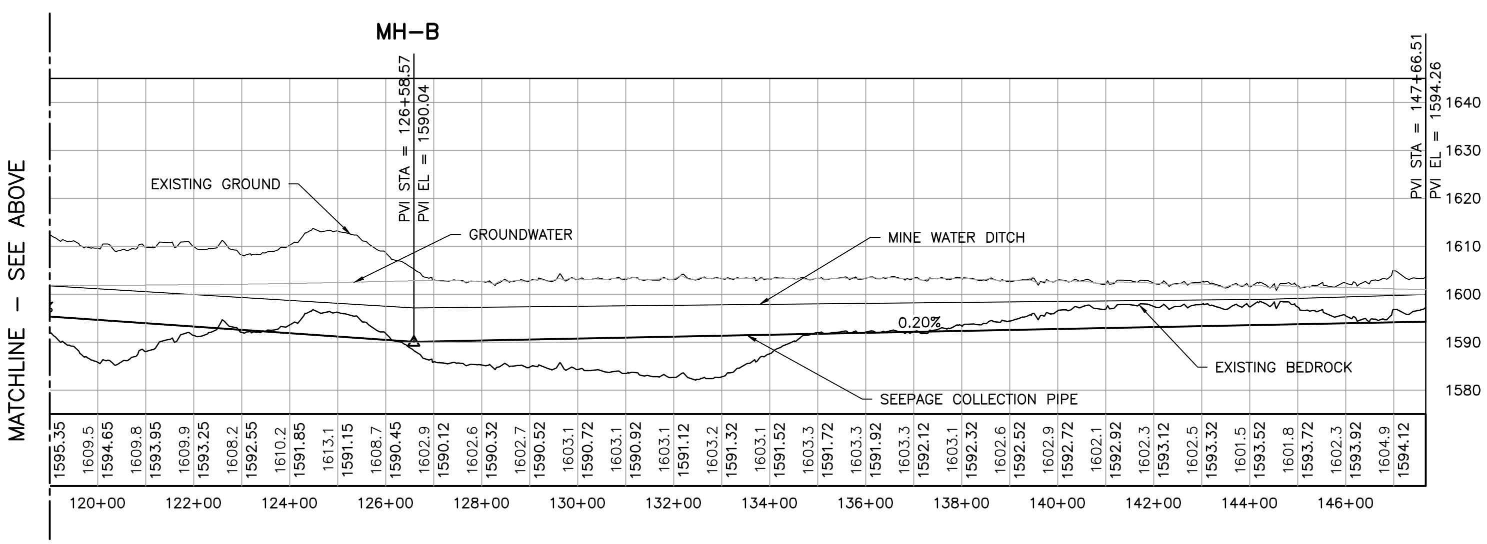
BARR
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. GCS-011
REV

INCHES 1 2







1 PROFILE: NORTH GROUNDWATER CONTAINMENT SYSTEM

NOTE:

ALL GROUNDWATER AND BEDROCK PROFILES SHOWN ARE APPROXIMATE.

VER NO	DATE	DESCRIPTION
1	10/18/11	ROCK AND OVERBURDEN MANAGEMENT PLAN – VERSIONS 5, 6, 7 – ATTACHMENT C
2	05/28/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
3	07/25/17	PERMIT APPLICATION UPDATES

ISSUED	VERSION	DATE
FOR PERMITTING	3	7/25/17
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME THOMAS J. RADUE
SIGNATURE Thomas J. Radue
DATE 7/25/17 LICENSE# 20951

DRAWN: CAD
CHECKED: TJR
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

CATEGORY 1 STOCKPILE
GROUNDWATER CONTAINMENT SYSTEM
NORTH PROFILES

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

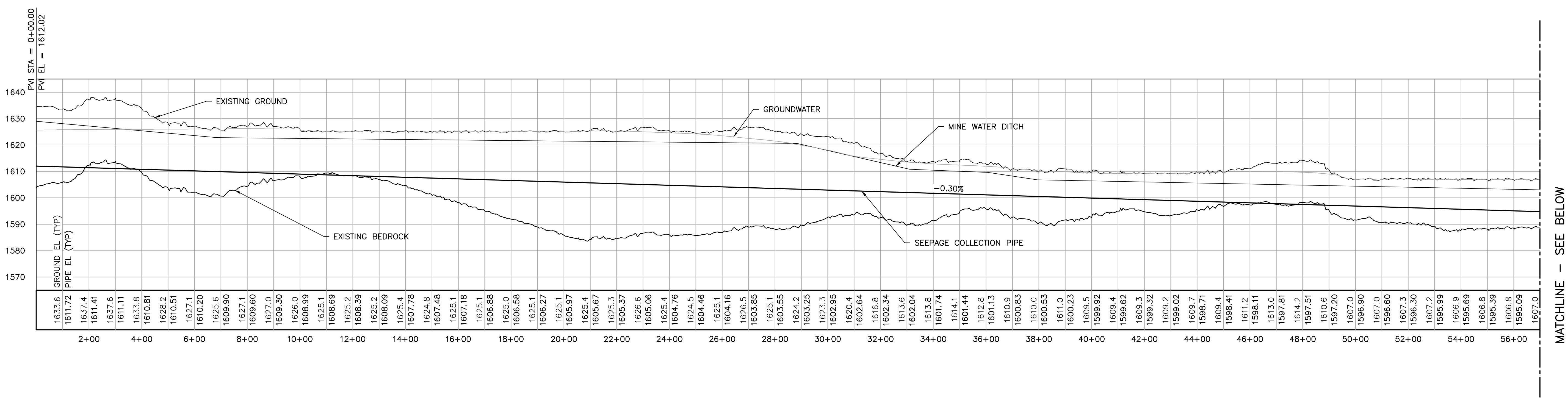
POLYMET MINING

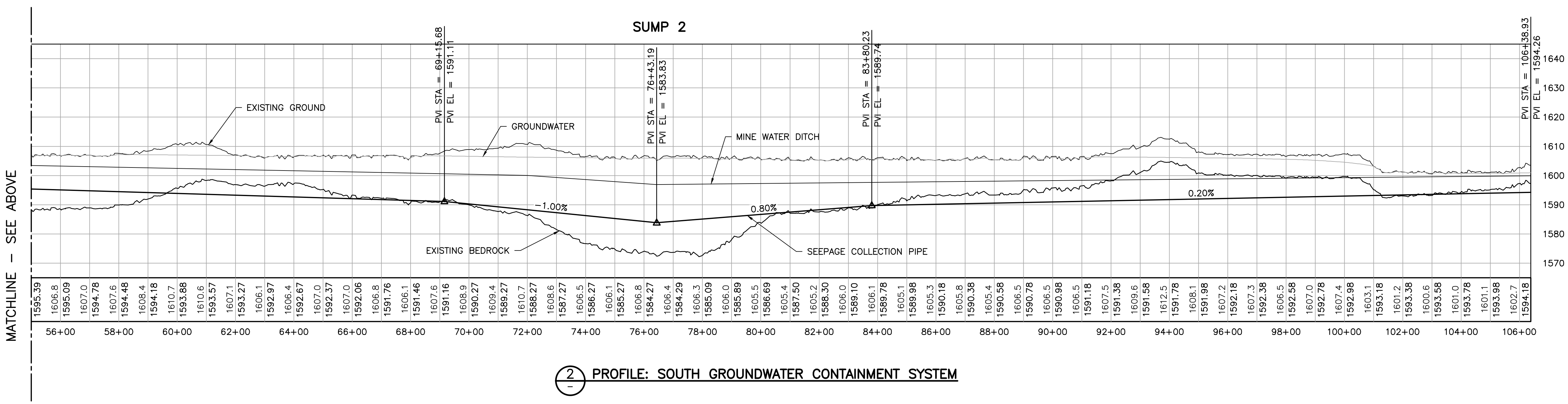
BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. GCS-012
REV

CADD USER: Cristion A. Diaz FILE: K:\DESIGN\23690C29.10\PERMIT_NMM-21-CS-012.DWG PLOT SCALE: 1:2 PLOT DATE: 7/25/2017 11:24 AM

INCHES 1 2





2 PROFILE: SOUTH GROUNDWATER CONTAINMENT SYSTEM

NOTE:

ALL GROUNDWATER AND BEDROCK PROFILES SHOWN ARE APPROXIMATE.

VER NO	DATE	DESCRIPTION
1	10/18/11	ROCK AND OVERBURDEN MANAGEMENT PLAN - VERSIONS 5, 6, 7 - ATTACHMENT C
2	05/28/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
3	07/25/17	PERMIT APPLICATION UPDATES

ISSUED	VERSION	DATE
FOR PERMITTING	3	7/25/17
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME THOMAS J. RADUE
SIGNATURE Thomas J. Radue
DATE 7/25/17 LICENSE# 20951

DRAWN: CAD
CHECKED: TJR
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

CATEGORY 1 STOCKPILE
GROUNDWATER CONTAINMENT SYSTEM
SOUTH PROFILES

POLYMET MINING

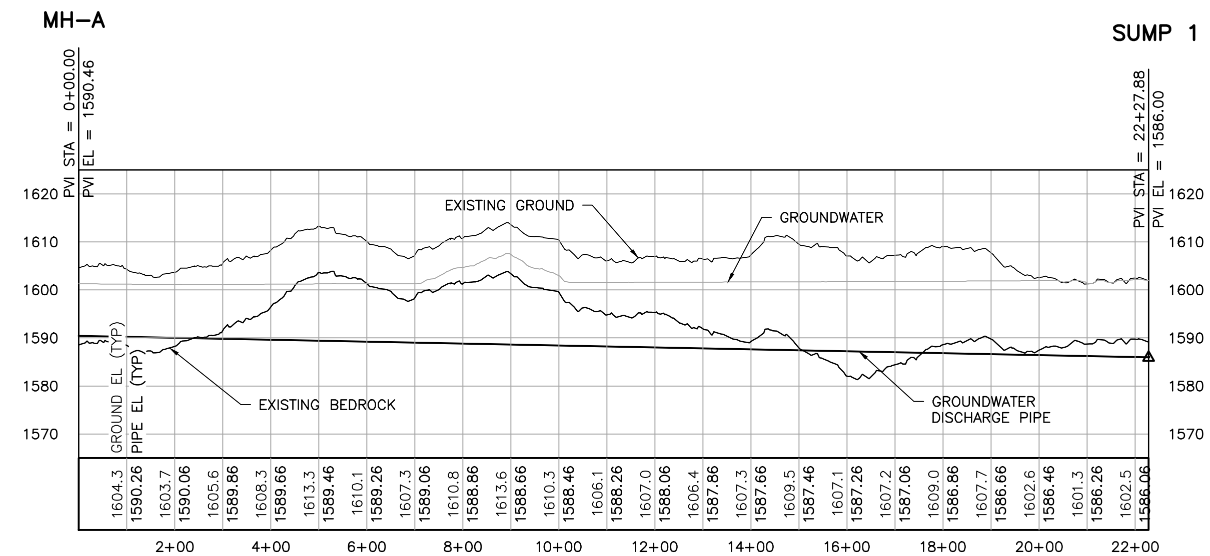
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

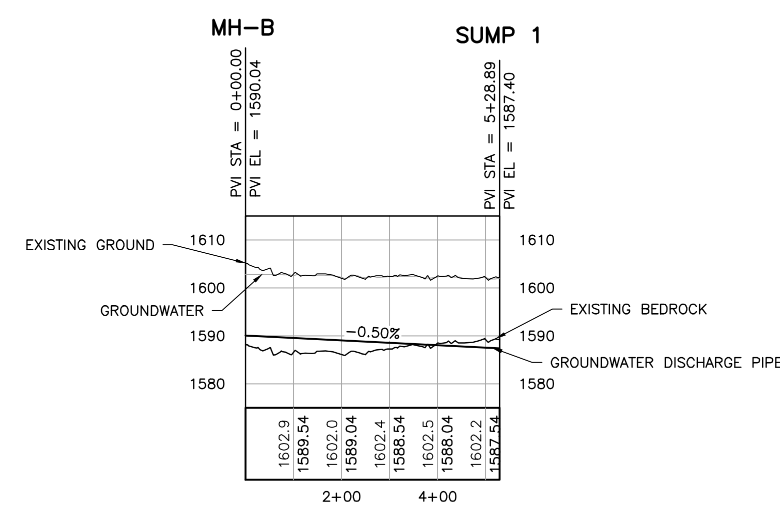
DWG. NO. GCS-013

REV

INCHES 1 2



3 PROFILE: MANHOLE A GROUNDWATER DISCHARGE PIPE TO SUMP 1



4 PROFILE: MANHOLE B GROUNDWATER DISCHARGE PIPE TO SUMP 1

NOTE:

ALL GROUNDWATER AND BEDROCK PROFILES SHOWN ARE APPROXIMATE.

VER NO	DATE	DESCRIPTION
1	10/18/11	ROCK AND OVERBURDEN MANAGEMENT PLAN – VERSIONS 5, 6, 7 – ATTACHMENT C
2	05/28/15	ISSUED FOR INCLUSION IN PERMIT APPLICATIONS
3	07/25/17	PERMIT APPLICATION UPDATES

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	3	7/25/17
FOR CONSTRUCTION		

NOT APPROVED FOR CONSTRUCTION.

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINTED NAME THOMAS J. RADUE
SIGNATURE Thomas J. Radue
DATE 7/25/17 LICENSE# 20951

DRAWN: CAD
CHECKED: TJR
BARR PROJECT NO.: 23/69–0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

CATEGORY 1 STOCKPILE
GROUNDWATER CONTAINMENT SYSTEM
DISCHARGE PROFILES

POLYMET MINING

POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR

BARR ENGINEERING CO.
4300 MARKETPOINTE DRIVE
SUITE 200
MINNEAPOLIS, MN.
Ph: 1–800–632–2277

DWG. NO. GCS–014

REV

CADD USER: Cristian A. Diaz FILE: K:\DESIGN\23690C29.10\PERMIT_NMM–21–CS–014.DWG PLOT SCALE: 1:2 PLOT DATE: 7/25/2017 11:22 AM

INCHES 1 2

Appendix C

Chemical Additives Safety Data Sheets

Appendix C

Chemical Additives Safety Data Sheets

July 2016

Contents

SAFETY DATA SHEET

1. Product and Company Identification

Product identifier	**Magnesium Chloride Aqueous Solution**
Other means of identification	7786-30-3 FREEZGARD LITE CI PLUS FREEZGARD ZERO CI PLUS FREEZGARD LITE CI PLUS LS DustGard DustGard Plus FreezGard Zero FreezGard Lite MagnaPro Chlori-Mag
Recommended use	Dust supression, deicing, general industrial, and speciality uses.
Recommended restrictions	None known.
Manufacturer	North American Salt Company A Compass Minerals Company 9900 West 109th Street, Suite 100 Overland Park, KS 66210 US Phone: 913-344-9200
CHEMTREC	1-800-424-9300
CANUTEC	1-613-996-6666

2. Hazards Identification

Physical hazards	Not classified.
Health hazards	Not classified.
Environmental hazards	Not classified.
OSHA defined hazards	Not classified.
Label elements	
Hazard symbol	None.
Signal word	None.
Hazard statement	The substance does not meet the criteria for classification.
Precautionary statement	
Prevention	Observe good industrial hygiene practices.
Response	Wash hands after handling.
Storage	Store away from incompatible materials.
Disposal	Dispose of waste and residues in accordance with local authority requirements.
Hazard(s) not otherwise classified (HNOC)	None known.
Supplemental information	Not applicable.

3. Composition/Information on Ingredients

Mixture

Composition comments	The criteria for listing components in this section are: Carcinogens, Respiratory Sensitizers, Mutagens, Teratogens and Reproductive toxins are listed when present at 0.1% or greater; components which are otherwise hazardous according to WHMIS/OSHA are listed when present at 1.0% or greater. Non hazardous components are not listed. The products pertaining to this SDS have various proportions of components which do not meet the listing criteria.

4. First Aid Measures

Inhalation	If breathing is difficult, remove to fresh air and keep at rest in a position comfortable for breathing. Call a physician if symptoms develop or persist.
Skin contact	Rinse skin with water/shower. Get medical attention if irritation develops and persists.
Eye contact	Rinse with water. Get medical attention if irritation develops and persists.
Ingestion	Rinse mouth. If ingestion of a large amount does occur, call a poison control center immediately.

Most important symptoms/effects, acute and delayed	Direct contact with eyes may cause temporary irritation.
Indication of immediate medical attention and special treatment needed	Treat symptomatically.
General information	Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

5. Fire Fighting Measures

Suitable extinguishing media	Treat for surrounding material.
Unsuitable extinguishing media	None known.
Specific hazards arising from the chemical	During fire, gases hazardous to health may be formed.
Special protective equipment and precautions for firefighters	Self-contained breathing apparatus and full protective clothing must be worn in case of fire.
Fire-fighting equipment/instructions	Use standard firefighting procedures and consider the hazards of other involved materials.
Specific methods	Cool containers exposed to flames with water until well after the fire is out.
General fire hazards	No unusual fire or explosion hazards noted.
Hazardous combustion products	May include and are not limited to: Hydrogen chloride. Chlorine gas. Oxides of magnesium.
Explosion data	
Sensitivity to mechanical impact	Not available.
Sensitivity to static discharge	Not available.

6. Accidental Release Measures

Personal precautions, protective equipment and emergency procedures	Keep unnecessary personnel away. For personal protection, see section 8 of the SDS.
Methods and materials for containment and cleaning up	Before attempting clean up, refer to hazard data given above. Small spills may be absorbed with non-reactive absorbent and placed in suitable, covered, labelled containers. Prevent large spills from entering sewers or waterways. Contact emergency services and supplier for advice. For waste disposal, see section 13 of the SDS.
Environmental precautions	Avoid discharge into drains, water courses or onto the ground.

7. Handling and Storage

Precautions for safe handling	Avoid contact with eyes, skin and clothing. Use good industrial hygiene practices in handling this material.
Conditions for safe storage, including any incompatibilities	Keep container tightly closed in a cool, dry and well-ventilated place. Store away from incompatible materials (see Section 10 of the SDS).

8. Exposure Controls/Personal Protection

Occupational exposure limits	No exposure limits noted for ingredient(s).
Biological limit values	No biological exposure limits noted for the ingredient(s).
Appropriate engineering controls	TWA PEL: No specific limits have been established for magnesium chloride (a soluble substance). As a guideline, OSHA (United States) has established the following limits which are generally recognized for inert or nuisance dust. Particulates Not Otherwise Regulated (PNOR): 5mg/cu.m. Respirable Dust 8-Hour TWA PEL, 15mg/cu.m. Total Dust 8-Hour TWA PEL. TWA TLV: No specific limits have been established for magnesium chloride (a soluble substance). As a guideline, ACGIH (United States) has established the following limits which are generally recognized for inert or nuisance dust. Particulates (insolubles) Not Otherwise Classified (PNOC): 10mg/cu.m. Inhalable Particulate 8-Hours TWA TLV, 3mg/cu.m. Respirable Particulate TWA TLV. Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits. If user operations generate dust, fumes, or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Individual protection measures, such as personal protective equipment

Eye/face protection	Safety glasses

Skin protection	
Hand protection	Rubber gloves. Confirm with a reputable supplier first.
Other	As required by employer code.
Respiratory protection	Where exposure guideline levels may be exceeded, use an approved NIOSH respirator or NIOSH-approved filtering facepiece.
Thermal hazards	Not applicable.
General hygiene considerations	Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

9. Physical and Chemical Properties

Appearance	Liquid
Physical state	Liquid.
Form	Crystalline.
Color	Colorless to Light amber
Odor	Odorless
Odor threshold	Not available.
pH	7 - 9 (5% solution)
Melting point/freezing point	-1 °F (-18.33 °C) (30% solution, periodically mixed to ensure homogeneity)
Initial boiling point and boiling range	Not applicable 225 °F (107.22 °C)
Pour point	Not available.
Specific gravity	1.24 - 1.34 (H2O = 1)
Partition coefficient (n-octanol/water)	Not available.
Flash point	Not available.
Evaporation rate	Not available.
Flammability (solid, gas)	Not applicable.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	Not available.
Flammability limit - upper (%)	Not available.
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	Not available.
Vapor density	Not available.
Relative density	Not available.
Solubility(ies)	Easily soluble in cold water, hot water, methanol, acetone.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	Not available.

10. Stability and Reactivity

Reactivity	Reactive with oxidizing agents, acids, metals in presence of moisture.
Possibility of hazardous reactions	No dangerous reaction known under conditions of normal use.
Chemical stability	Material is stable under normal conditions.
Conditions to avoid	Contact with incompatible materials.
Incompatible materials	Acids. Strong oxidizing agents. Metals.
Hazardous decomposition products	May include and are not limited to: Hydrogen chloride. Chlorine gas. Oxides of magnesium.

11. Toxicological Information

Information on likely routes of exposure	
Ingestion	Expected to be a low ingestion hazard.

Inhalation	No adverse effects due to inhalation are expected.
Skin contact	No adverse effects due to skin contact are expected.
Eye contact	Direct contact with eyes may cause temporary irritation.
Symptoms related to the physical, chemical and toxicological characteristics	Direct contact with eyes may cause temporary irritation.

Information on toxicological effects

Acute toxicity	Not classified.
Skin corrosion/irritation	Prolonged skin contact may cause temporary irritation.
Exposure minutes	Not available.
Erythema value	Not available.
Oedema value	Not available.
Serious eye damage/eye irritation	Direct contact with eyes may cause temporary irritation.
Corneal opacity value	Not available.
Iris lesion value	Not available.
Conjunctival reddening value	Not available.
Conjunctival oedema value	Not available.
Recover days	Not available.

Respiratory or skin sensitization

Respiratory sensitization	Not classified.
Skin sensitization	This product is not expected to cause skin sensitization.
Germ cell mutagenicity	No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.
Mutagenicity	No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.
Carcinogenicity	This product is not considered to be a carcinogen by IARC, ACGIH, NTP, or OSHA.
Reproductive toxicity	This product is not expected to cause reproductive or developmental effects.
Teratogenicity	Not classified.
Specific target organ toxicity - single exposure	Not classified.
Specific target organ toxicity - repeated exposure	Not classified.
Aspiration hazard	Not classified.
Chronic effects	Not classified.
Further information	This product has no known adverse effect on human health.
Name of Toxicologically Synergistic Products	Not available.

12. Ecological Information

Ecotoxicity	May be harmful to freshwater aquatic species and to plants that are not saline tolerant.
Persistence and degradability	No data is available on the degradability of this product.
Bioaccumulative potential	No data available.
Mobility in soil	No data available.
Mobility in general	Not available.
Other adverse effects	No other adverse environmental effects (e.g. ozone depletion, photochemical ozone creation potential, endocrine disruption, global warming potential) are expected from this component.

13. Disposal Considerations

Disposal instructions	Collect and reclaim or dispose in sealed containers at licensed waste disposal site.
Local disposal regulations	Dispose in accordance with all applicable regulations.
Hazardous waste code	The waste code should be assigned in discussion between the user, the producer and the waste disposal company.
Waste from residues / unused products	Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).

Contaminated packaging Empty containers should be taken to an approved waste handling site for recycling or disposal. Since emptied containers may retain product residue, follow label warnings even after container is emptied.

14. Transport Information

U.S. Department of Transportation (DOT)

Not regulated as dangerous goods.

Transportation of Dangerous Goods (TDG - Canada)

Not regulated as dangerous goods.

15. Regulatory Information

Canadian federal regulations This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the SDS contains all the information required by the Controlled Products Regulations.

WHMIS status Not Controlled

US federal regulations

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

CERCLA Hazardous Substance List (40 CFR 302.4)

Not listed.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Not regulated.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories
Immediate Hazard - No
Delayed Hazard - No
Fire Hazard - No
Pressure Hazard - No
Reactivity Hazard - No

SARA 302 Extremely hazardous substance No

SARA 311/312 Hazardous chemical No

SARA 313 (TRI reporting)

Not regulated.

Other federal regulations

Safe Drinking Water Act (SDWA) Not regulated.

Food and Drug Administration (FDA)
Total food additive
Direct food additive
GRAS food additive

US state regulations California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65): This material is not known to contain any chemicals currently listed as carcinogens or reproductive toxins.

US - California Proposition 65 - Carcinogens & Reproductive Toxicity (CRT): Listed substance

Not listed.

US. Massachusetts RTK - Substance List

Not regulated.

US. Pennsylvania RTK - Hazardous Substances

Not regulated.

US. Rhode Island RTK

Not regulated.

Inventory status

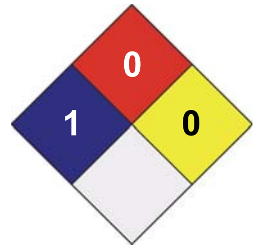
Country(s) or region	Inventory name	On inventory (yes/no)*
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)

16. Other Information

LEGEND	
Severe	4
Serious	3
Moderate	2
Slight	1
Minimal	0

HEALTH	/ 1
FLAMMABILITY	0
PHYSICAL HAZARD	0
PERSONAL PROTECTION	X



Disclaimer
The information in the sheet was written based on the best knowledge and experience currently available. Information contained herein was obtained from sources considered technically accurate and reliable. While every effort has been made to ensure full disclosure of product hazards, in some cases data is not available and is so stated. Since conditions of actual product use are beyond control of the supplier, it is assumed that users of this material have been fully trained according to the requirements of all applicable legislation and regulatory instruments. No warranty, expressed or implied, is made and supplier will not be liable for any losses, injuries or consequential damages which may result from the use of or reliance on any information contained in this document.

Issue date
16-January-2015

Effective date
15-January-2015

Expiry date
15-January-2018

Further information
For an updated SDS, please contact the supplier/manufacturer listed on the first page of the document.

Prepared by
Dell Tech Laboratories, Ltd.   Phone: (519) 858-5021

Other information
This Safety Data Sheet was prepared to comply with the current OSHA Hazard Communication Standard (HCS) adoption of the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).
This SDS conforms to the ANSI Z400.1/Z129.1-2010 Standard.

Magnesium Chloride Aqueous Solution

Observe good industrial hygiene practices.

Wash hands after handling.

Store away from incompatible materials.

Compass Minerals, 9900 West 109th Street, Suite 100, Overland Park, KS, 66210, US, 913-344-9200

Magnesium Chloride Aqueous Solution

Observe good industrial hygiene practices.

Wash hands after handling.

Store away from incompatible materials.

Compass Minerals, 9900 West 109th Street, Suite 100, Overland Park, KS, 66210, US, 913-344-9200

Product Data Sheet

Compass Minerals

9900 West 109th Street – Suite 100
Overland Park, Kansas 66210
Phone 800-755-7258 Fax 800-359-7258

DUSTGARD® LIQUID

PRODUCTION LOCATION

Ogden, Utah

PRODUCT DESCRIPTION

Produced naturally from the Great Salt Lake, DustGard Liquid is formulated to control dust and stabilize soil on unpaved roads, stockpiles, and other sources of fugitive dust. DustGard Liquid is a light amber liquid with a density of approximately 185 gallons per ton.

PHYSICAL PROPERTIES

Specific Gravity	1.31+/- 0.02
pH (5% Solution)	7.0 - 9.0
Weight	10.7 - 11.1 lbs./gallon

Typical Analysis			Typical	Range
Magnesium Chloride	$MgCl_2$	(%)	30.3	28 – 33
Sulfate	SO_4	(%)	1.9	0 – 2.7
Potassium	K	(%)	0.3	0.1 – 0.5
Water	H_2O	(%)	68	64 – 72

METHOD OF ANALYSIS

All testing is from Compass Minerals' internal quality control procedures, which are available upon request.

APPLICATION AND STORAGE

This liquid MgCl2 product in storage should be agitated regularly to minimize precipitation of undesirable solids/crystals. Application equipment should be washed daily with water. Storage equipment should be rinsed with water to prevent buildup of solids. Aluminum storage tanks or hauling equipment should not be grounded. Over application of MgCl2 may result in unusually slippery road surfaces and should be avoided.

Product Description and Codes	UPC code	Product Code
Bulk		

SAFETY DATA SHEET

Date Issued: 6/26/2015
Revision Date: 4/16/2015

BT-468

1: IDENTIFICATION

Product identifier: BT-468

Recommended use: Dust suppressant

Other identification: Aqueous amorphous polymer solution

Supplier details: Benetech, Inc.
2245 Sequoia Drive, Suite #300
Aurora, IL 60506
(phone): 630-844-1300

Emergency phone: 1-800-535-5053 (US and Canada)
1-352-323-3500 (International)

2: HAZARD(S) IDENTIFICATION

Hazard pictogram and signal word:

Warning

Hazard classification: Eye irritant; category 2A.

Hazard statements: H319; Causes serious eye irritation.

Precautionary statements:

Prevention: P264; Wash exposed area thoroughly after handling. P280; Wear eye protection/face protection.

Response: P305 + P351 + P338; IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

Storage: P403+P233; Store in well-ventilated place. Keep container tightly closed. P405; Store locked up.

Disposal: P501; Dispose of this material and its container in accordance with local, regional, national and/or international regulation.

Other hazards: Material spills may be very slippery.

3: INFORMATION ON INGREDIENTS

Ingredient	CAS Number	% by weight
Proprietary Blend	*Not applicable*	*Not applicable*

4: FIRST AID MEASURES

The following first aid procedures assume appropriate personal and industrial hygiene practices are followed.

Eyes: Flush with copious amounts of water. If symptoms are severe or persist, get medical attention.

Skin Contact: Not expected to be a skin irritant. Wash thoroughly with water. Remove contaminated clothing. Launder contaminated clothing before re-use. If symptoms are severe or persist, get medical attention.

Ingestion: Small amounts are not expected to be harmful. If instructed to do so by medical personnel, induce vomiting by either giving IPECAC syrup or by placing finger at back of throat. NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON. Get medical attention.

Inhalation: Product is non-volatile and inhalation is not an expected exposure route. Remove to fresh air. If breathing is difficult, administer oxygen. If breathing has stopped, give artificial respiration. Keep person warm, and quiet. If symptoms are severe or persist, get medical attention.

5: FIRE-FIGHTING MEASURES

Suitable extinguishing media: Class B fire extinguishers (i.e.: foam, powder)

Specific combustion hazards: None

Special protective equipment and precautions for fire-fighters: Wear full bunker gear and SCBA (Self-Contained Breathing Apparatus).

6: ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures:
Chemical Splash Goggles in compliance with OSHA regulations are advised, impermeable gloves (natural rubber, nitrile, neoprene, etc.), impermeable clothing (coveralls), and waterproof footwear. Ventilate area with fresh air for personal comfort.

Methods and materials for containment and cleaning up:

Small Spill:	Absorb liquid on paper, vermiculite, floor absorbent, or other absorbent material and transfer to appropriate container(s).
Large Spill:	Stop spill at source, dike area of spill to prevent spreading, pump liquid to salvage tank. Remaining liquid may be taken up on sand, clay, earth, floor absorbent, or other absorbent material and shoveled into appropriate containers.
	Prevent run-off to sewers, streams or other bodies of water. If run-off occurs, notify proper authorities as required, that a spill has occurred.

7: HANDLING AND STORAGE

Precautions for safe handling:
P270; Do not eat, drink, or smoke when using this product. P264; Wash skin exposed to product with soap and water. Wash hands after handling this product and before eating, drinking, or smoking. Avoid exposure to skin or eyes. Do not ingest. Do not breath aerosol containing this product. Use mechanical ventilation for personal comfort.

Conditions for safe storage:
Store material between 40°F and 120°F in original container. Protect from freezing.

8: EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters: Ventilation: Provide sufficient mechanical (general and/or local exhaust) ventilation to maintain exposure below TLV(s).

Engineering controls: Mechanical and/or engineered barriers to prevent contact with this material in concentrated form are preferred.

Personal Protective Equipment:

Eye protection; Wear eye protection/face protection. Chemical splash goggles or a face shield are recommended in emergency spill situations.

Skin protection; Avoid prolonged or repeated skin contact. Resistant gloves such as natural rubber, neoprene, nitrile rubber are recommended. Water-proof or chemical-resistant coveralls are recommended. Water-proof foot gear is recommended.

Respiratory protection; Avoid breathing aerosols, mists or sprays of this material if they were to form. If exposure to aerosols, mists, or sprays of this material in undiluted form are likely, wear a respirator designed to filter particulates and organic vapors.

Prevention of ingestion; Avoid ingesting this material. Do not eat, drink, or smoke when contamination with this material is possible. Wash hands with soap and water after handling this product and before eating, drinking, or smoking. Remove and launder contaminated clothing before eating, drinking, or smoking.

9: PHYSICAL AND CHEMICAL PROPERTIES

Appearance	Brown liquid
Liquid Upper/Lower Flammability/Explosive limits	*Not applicable*
Liquid Flammability	Non-flammable
Solid, Gas Upper/Lower Flammability/Explosive limits	*Not applicable*
Solid. Gas Flammability	*Not applicable*
Autoignition temperature	*Not applicable*
Decomposition Temperature	No data available
Flash Point	Non-flammable
pH (3% Soln.)	7 - 9
Specific Gravity	10.87-lbs./gal.
Viscosity	<100-cP
Melting point	No data available
Initial Freezing Point	28.5^{o}F
Initial Boiling point	219°F
Boiling Range	No data available
Odor	Slight
Odor Threshold	No data available
Vapor Pressure	14.2 mm Hg @ 68°F
Vapor Density	1.25 @ 68-^{o}F
Solubility, Aqueous	100% (miscible)
Partition Coefficient: n-octanol/water	100% in water
Evaporation Rate	Normal 0.4 (water)

10: STABILITY AND REACTIVITY

Reactivity: Strong oxidizing agents, caustics.
Chemical stability: Stable.
Possibility of hazardous reactions: Will not occur.
Conditions to avoid: None known.
Incompatible materials: Oxidizers, salts.

Hazardous Decomposition Products:

Substance	**Condition**
Carbon monoxide	During Combustion of Residue
Carbon dioxide	During Combustion of Residue
Hydrocarbons	During Combustion of Residue
Toxic gas, vapor or particulate	During Combustion of Residue

11: TOXICOLOGICAL INFORMATION

Health and toxicological effects:

Likely exposure routes; ingestion, eye contact.

Symptoms of exposure; None known.

Delayed and immediate effects; No significant acute or delayed adverse effects have been found in oral rat studies done on the components of this product relative to the composition of this blend.

Acute Toxicity:
Oral; mouse, LD_{50} > 5000 mg/kg.
Dermal; mouse, No data available.
Inhalation; mouse, Not applicable.

This product is not considered a potential carcinogen by NPT, IARC, or OSHA.

12: ECOLOGICAL INFORMATION

Aquatic Toxicity:
P. Promelas LC_{50}: 3.7 grams/liters (3700 ppm).
C. Dubia EC_{50}: 2.04 grams/liter (2040 ppm).

Persistence and Degradability:

Bioaccumulative potential is low, biological oxygen demand(BOD); 0.260 lbs BOD/lb solids, Chemical oxygen demand(COD); 0.919 lbs COD/lb of solids.

13: DISPOSAL CONSIDERATIONS

Waste Disposal Method: Allow waste and contaminated material to dry in open air or fume hood. Dispose of as non hazardous waste.

14: TRANSPORT INFORMATION

DOT Non-Bulk; Not regulated.
DOT Bulk; Not regulated.
IMDG; Not regulated.
ICAO/IATA; Not regulated.
CERCLA; Not regulated

15: REGULATORY INFORMATION

This product is not considered hazardous under the Clean Water Act, the Clean Air Act, or RCRA. This product is not reportable under SARA Title III, Sec 313.

16: OTHER INFORMATION

Revision History	
Date	**Comment**
4/16/2015	Original

As of the date of preparation of this document, the foregoing information is believed to be accurate and is provided in good faith to comply with applicable federal and state law(s). However, no warranty or representation with respect to such information is intended or given.

17″

BENETECH®

BT-468

Warning

H319: Causes serious eye irritation.
P264: Wash exposed area thoroughly after handling. P280: Wear chemical splash goggles when handling. Wear impermeable gloves when handling. Wear impermeable clothing or apron when handling. P305 + P351 + P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Remove contaminated clothing and launder after use. Wash hands after handling and before eating, drinking, or smoking.

Benetech, Inc. **2245 Sequoia Dr. Suite 300** **Aurora, IL 60506-6220** **www. Benetechglobal.com**	**Additional Comments**

1-352-323-3500

24″

PRODUCT BULLETIN

Haul Road Dust Suppressant
BT-468(BT-RDL)

Product Description

- Benetech BT-468 controls airborne dust caused by the heavy moving equipment and road traffic. It is a lignosulfonate based haul road dust suppressant formulated with surfactant additives to promote penetration and improve spreadability.

Primary Uses

- This product is a cost effective means of reducing dust on haul roads, parking lots, and other high traffic dirt, gravel, or coal surfaces.

Benefits

- Cost competitive
- Non-oil based, ecologically safe
- Protects against wind erosion
- Easy application procedures
- Non-corrosive
- Contains additives to promote penetration, improve spreadability, and prevent excessive run-off.
- Easy clean-up

Application

- BT-468 should be applied with a hydro-seeder water truck, or water wagon equipped with standard spraying equipment for adequate application. Consult your Benetech representative for specific application rates.

Shipping

- Bulk tank trucks.

Handling And Storage

- BT-468 is non-hazardous but should be handled with appropriate caution.
- Storage can be mild steel or fiberglass construction. Recommended storage limit 12 months.

1. PRODUCT AND COMPANY IDENTIFICATION

Product Identity: Roadsaver®-C

Recommended use of the chemical and restrictions on use: Road stabilization, dust control and de-icing

Manufacturer: EnviroTech Services, Inc.
910 54^{th} Ave, Suite 230
Greeley, CO 80634
Telephone: (970) 346-3900

Emergency Phone: **CHEMTREC: (800) 424-9300**

SDS Date of Preparation: 4/23/2015

2. HAZARDS IDENTIFICATION

GHS Classification:

Physical	Health	Environment
Not Hazardous	Not Hazardous	Not Hazardous

GHS Label Elements:

Warning!

Causes serious eye irritation.

Wash thoroughly after handling.
Wear eye and face protection.
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
If eye irritation persists: Get medical attention.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS No.	Amount
Water	7732-18-5	60-75%
Calcium Chloride	10043-52-4	25-40%

The exact concentration is determined according to customer request.

4. FIRST AID MEASURES

Eye: Flush victim's eyes with large quantities of water, while holding the eyelids apart. Get medical attention if irritation occurs and persists.
Skin: Wash skin thoroughly with soap and water. Get medical attention if irritation develops. Remove and launder clothing before reuse.
Ingestion: Do not induce vomiting. Rinse mouth with water and give one glass of water to drink. Never give anything by mouth an unconscious or convulsing person. Get medical attention if symptoms develop.
Inhalation: Remove victim to fresh air. If breathing is difficult or irritation persists, get medical attention.

Most important Symptoms: May cause slight eye and skin irritation.

Indication of immediate medical attention/special treatment: Immediate medical attention is not required.

5. FIRE FIGHTING MEASURES

Suitable (and Unsuitable) Extinguishing Media: Use media appropriate for surrounding fire. Cool fire exposed containers and structures with water.
Specific hazards arising from the chemical: Thermal decomposition may yield hydrogen chloride, halogenated compounds, and chlorine gas.
Special Protective Equipment and Precautions for Fire-Fighting Instructions: Firefighters should wear positive pressure self-contained breathing apparatus and full protective clothing. Aqueous solutions may cause surfaces to be extremely slippery and cause a slip hazard.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions, Protective Equipment, and Emergency Procedures: Wear appropriate protective clothing as described in Section 8. Wash thoroughly after handling.

Methods and Materials for Containment and Cleaning Up: Dike and collect liquid or absorb with an inert absorbent and place in appropriate containers for disposal. Flush spill area with water. Report releases as required by local, state, and federal authorities.

7. HANDLING AND STORAGE

Precautions for Safe Handling: Avoid contact with the eyes, skin, and clothing. Avoid breathing mists or aerosols. Wear protective clothing and equipment as described in Section 8. Wash thoroughly with soap and water after handling. Keep containers closed when not in use.

Conditions for Safe Storage, Including Any Incompatibilities: Store in a cool, dry, well-ventilated area away from incompatible materials. Product may be corrosive to some metals.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Exposure Guidelines:

Calcium Chloride	None Established
Performance Additive	None Established

Engineering Controls: Use with adequate general ventilation to minimize exposures.
Respiratory Protection: In operations where exposure levels are excessive, a NIOSH approved respirator with dust/mist cartridges or supplied air respirator appropriate for the form and concentration of the contaminants should be used. Selection and use of respiratory equipment must be in accordance with OSHA 1910.134 and good industrial hygiene practice.
Skin Protection: Wear impervious gloves such as rubber or neoprene if needed to avoid prolonged skin contact.
Eye Protection: Safety glasses recommended.
Other: Long-sleeved clothing and long pants recommended to avoid prolonged skin contact. Suitable washing facilities should be available in the work area.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance And Odor: Clear liquid with no odor.

Physical State: Liquid	**Odor Threshold:** Not established
Vapor Density: Not determined	**Initial Boiling Point/Range:** 110-122°C (230-252°F)
Solubility In Water: Soluble	**Vapor Pressure:** Not determined
Relative Density: 1.25-1.42	**Evaporation Rate:** Not determined
Melting/Freezing Point: Not determined	**pH:** 5-10
VOC Content: Not determined	**Octanol/Water Coefficient:** Not determined
Solubility: Complete	**Decomposition Temperature:** Not determined
Viscosity: <100 cP @ 70°F	**Flammability (solid, gas):** Not applicable
Flashpoint: None	**Autoignition Temperature:** Not determined
Flammable Limits: LEL: Not determined	**UEL:** Not determined

10. STABILITY AND REACTIVITY

Reactivity: Not normally reactive
Chemical Stability: Stable under normal storage and handling conditions.
Possibility of Hazardous Reactions: None known.
Conditions to Avoid: None known.
Incompatible Materials: Strong oxidizing agents, concentrated acids, and some metals.
Hazardous Decomposition Products: When heated to decomposition emits hydrogen chloride, halogenated compounds, and chlorine gas.

11. TOXICOLOGICAL INFORMATION

HEALTH HAZARDS:
Ingestion: Ingestion may cause slight irritation with nausea, vomiting, and diarrhea.
Inhalation: Inhalation of mists may cause slight irritation of the nose throat and upper respiratory tract.
Eye: May cause slight irritation with pain and tearing.
Skin: May cause slight irritation on prolonged or repeated contact.
Sensitization: This material is not known to cause sensitization.
Chronic: None known.

Carcinogenicity: None of the components is listed as a carcinogen or suspected carcinogen by IARC, NTP, or OSHA.
Germ Cell Mutagenicity: None currently known.
Reproductive Toxicity: None currently known.

Numerical Measures of Toxicity:
No toxicity data available

12. ECOLOGICAL INFORMATION

Ecotoxicity: No data available
Persistence and Degradability: Biodegradation is not applicable to inorganic substances.
Bioaccumulative Potential: No data available
Mobility in Soil: No data available
Other Adverse Effects: None known

13. DISPOSAL CONSIDERATIONS

Dispose in accordance with local, state, and federal environmental regulations.

14. TRANSPORT INFORMATION

DOT Hazardous Materials Description:
Proper Shipping Name: Not regulated
UN Number: None
Hazard Class/Packing Group: None
Labels Required: None

15. REGULATORY INFORMATION

CERCLA: This product is not subject to CERCLA release reporting. Many states have more stringent release reporting requirements. Report spills required under federal, state, and local regulations.

SARA Hazard Category (311/312): Not Hazardous

SARA 313: This product contains the following chemicals subject to Annual Release Reporting Requirements under SARA Title III, Section 313 (40 CFR 372): None

EPA TSCA Inventory: All of the ingredients in this product are listed on the EPA TSCA Inventory.

CANADA:
This product has been classified under the CPR and this MSDS discloses information elements required by the CPR.

Canadian CEPA: All the components of this product are listed on the Canadian DSL.
Canadian WHMIS Classification: Not classified as dangerous

16. OTHER INFORMATION

NFPA Rating: Health = 2 Flammability = 0 Instability = 0
HMIS Rating: Health = 2 Flammability = 0 Physical Hazard = 0

SDS Revision History:
5/15/2014: New SDS
4/23/2015: Updated SDS with new classification

Disclaimer: *This Safety Data Sheet (SDS) is provided in response to customer requests to address the safe handling of the product. All statements, technical information and recommendations contained herein are the best of our knowledge, reliable and accurate. This SDS is not intended to make any representation as to how the product will perform when used for its intended purpose by a user. In that regards the product is sold "AS IS" and nothing in this SDS should be deemed to be a representation or warranty of any injury, loss, or damage, of any kind or nature, which are sustained by or arise from the use of the product. Nothing in this SDS is intended to be a representation or warranty by the manufacturer of the accuracy, safety, or usefulness for any purpose of any technical information, materials, techniques, or practices.*

The information contained in this Safety Data Sheet is, to the best of our knowledge, accurate and reliable. This information should be provided to all individuals handling this product. Federal, state, and local regulations should be followed when handling this product.

Roadsaver-C

Warning

Causes serious eye irritation.

Wash thoroughly after handling Wear eye protection/face protection. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical attention.

EnviroTech, 910 54th Ave, Suite 230, Greely, CO, 80634, US, 970-346-3900

Roadsaver-C

Warning

Causes serious eye irritation.

Wash thoroughly after handling Wear eye protection/face protection. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical attention.

EnviroTech, 910 54th Ave, Suite 230, Greely, CO, 80634, US, 970-346-3900

1. PRODUCT AND COMPANY IDENTIFICATION

Product Identity: Roadsaver®

Recommended use of the chemical and restrictions on use: Road stabilization and dust control

Manufacturer:	EnviroTech Services, Inc. 910 54th Ave, Suite 230 Greeley, CO 80634
Telephone:	(970) 346-3900

Emergency Phone: **CHEMTREC: (800) 424-9300**

SDS Date of Preparation: 5/15/2014

2. HAZARDS IDENTIFICATION

GHS Classification:

Physical	Health	Environment
Not Hazardous	Not Hazardous	Not Hazardous

GHS Label Elements:
None Required

3. COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS No.	Amount
Water	7732-18-5	65-75%
Magnesium Chloride	7791-18-6	25-35%
Magnesium Sulfate	7487-88-9	<5.0%

The exact concentration is being withheld as a trade secret.

4. FIRST AID MEASURES

Eye: Flush victim's eyes with large quantities of water, while holding the eyelids apart. Get medical attention if irritation occurs and persists.
Skin: Wash skin thoroughly with soap and water. Get medical attention if irritation develops. Remove and launder clothing before reuse.
Ingestion: Do not induce vomiting. Rinse mouth with water and give one glass of water to drink. Never give anything by mouth to an unconscious or convulsing person. Get medical attention if symptoms develop.
Inhalation: Remove victim to fresh air. If breathing is difficult or irritation persists, get medical attention.

Most important Symptoms: May cause slight eye and skin irritation.

Indication of immediate medical attention/special treatment: Immediate medical attention is not required.

5. FIRE FIGHTING MEASURES

Suitable (and Unsuitable) Extinguishing Media: Use media appropriate for surrounding fire. Cool fire exposed containers and structures with water.
Specific hazards arising from the chemical: Thermal decomposition may yield hydrogen chloride, halogenated compounds, and chlorine gas.
Special Protective Equipment and Precautions for Fire-Fighting Instructions: Firefighters should wear positive pressure self-contained breathing apparatus and full protective clothing. Aqueous solutions may cause surfaces to be extremely slippery and cause a slip hazard.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions, Protective Equipment, and Emergency Procedures: Wear appropriate protective clothing as described in Section 8. Wash thoroughly after handling.

Methods and Materials for Containment and Cleaning Up: Dike and collect liquid or absorb with an inert absorbent and place in appropriate containers for disposal. Flush spill area with water. Report releases as required by local, state and federal authorities.

7. HANDLING AND STORAGE

Precautions for Safe Handling: Avoid contact with the eyes, skin and clothing. Avoid breathing mists or aerosols. Wear protective clothing and equipment as described in Section 8. Wash thoroughly with soap and water after handling. Keep containers closed when not in use.

Conditions for Safe Storage, Including Any Incompatibilities: Store in a cool, dry, well-ventilated area away from incompatible materials. Product may be corrosive to some metals.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Exposure Guidelines:

Magnesium chloride	None Established

Engineering Controls: Use with adequate general ventilation to minimize exposures.
Respiratory Protection: In operations where exposure levels are excessive, a NIOSH approved respirator with dust/mist cartridges or supplied air respirator appropriate for the form and concentration of the contaminants should be used. Selection and use of respiratory equipment must be in accordance with OSHA 1910.134 and good industrial hygiene practice.
Skin Protection: Wear impervious gloves such as rubber or neoprene if needed to avoid prolonged skin contact.
Eye Protection: Safety glasses recommended.
Other: Long-sleeved clothing and long pants recommended to avoid prolonged skin contact. Suitable washing facilities should be available in the work area.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance And Odor: Clear to slight yellow liquid with low or no odor.

Physical State: Liquid	**Odor Threshold:** Not established
Vapor Density: Not determined	**Initial Boiling Point/Range:** 107.2°C (225°F)
Solubility In Water: Soluble	**Vapor Pressure:** Not determined
Relative Density: 1.24-1.34	**Evaporation Rate:** Not determined
Melting/Freezing Point: Not determined	**pH:** 4-9
VOC Content: Not determined	**Octanol/Water Coefficient:** Not determined
Solubility: Complete	**Decomposition Temperature:** Not determined
Viscosity: <60 cP @ 70°F	**Flammability (solid, gas):** Not applicable
Flashpoint: None	**Autoignition Temperature:** Not determined
Flammable Limits: LEL: Not determined	**UEL:** Not determined

10. STABILITY AND REACTIVITY

Reactivity: Not normally reactive
Chemical Stability: Stable under normal storage and handling conditions.
Possibility of Hazardous Reactions: None known.
Conditions to Avoid: None known.
Incompatible Materials: Strong oxidizing agents, concentrated acids, and some metals.
Hazardous Decomposition Products: When heated to decomposition emits hydrogen chloride, halogenated compounds, and chlorine gas.

11. TOXICOLOGICAL INFORMATION

HEALTH HAZARDS:
Ingestion: Ingestion may cause slight irritation with nausea, vomiting, and diarrhea.
Inhalation: Inhalation of mists may cause slight irritation of the nose, throat, and upper respiratory tract.
Eye: May cause slight irritation with pain and tearing.
Skin: May cause slight irritation on prolonged or repeated contact.
Sensitization: This material is not known to cause sensitization.
Chronic: None known.
Carcinogenicity: None of the components is listed as a carcinogen or suspected carcinogen by IARC, NTP, or OSHA.
Germ Cell Mutagenicity: None currently known.
Reproductive Toxicity: None currently known.

Numerical Measures of Toxicity:
No toxicity data available

12. ECOLOGICAL INFORMATION

Ecotoxicity:
Product: Fathead minnow NOEC: 1.00 g/L; Ceriodaphnia dubia NOEC: 1.00 g/L; Selenastrum growth NOEC: 2.00 g/L
Persistence and Degradability: Biodegradation is not applicable to inorganic substances.
Bioaccumulative Potential: No data available
Mobility in Soil: No data available
Other Adverse Effects: None known

13. DISPOSAL CONSIDERATIONS

Dispose in accordance with local, state, and federal environmental regulations.

14. TRANSPORT INFORMATION

DOT Hazardous Materials Description:
Proper Shipping Name: Not regulated
UN Number: None
Hazard Class/Packing Group: None
Labels Required: None

15. REGULATORY INFORMATION

CERCLA: This product is not subject to CERCLA release reporting. Many states have more stringent release reporting requirements. Report spills required under federal, state and local regulations.

SARA Hazard Category (311/312): Not Hazardous

SARA 313: This product contains the following chemicals subject to Annual Release Reporting Requirements under SARA Title III, Section 313 (40 CFR 372): None

EPA TSCA Inventory: All of the ingredients in this product are listed on the EPA TSCA Inventory.

CANADA:
This product has been classified under the CPR and this SDS discloses information elements required by the CPR.
Canadian CEPA: All the components of this product are listed on the Canadian DSL.
Canadian WHMIS Classification: Not classified as dangerous

16. OTHER INFORMATION

NFPA Rating: Health = 0 Flammability = 0 Instability = 0
HMIS Rating: Health = 1 Flammability = 0 Physical Hazard = 0

SDS Revision History:
5/15/2014: New SDS
4/23/2015: Reviewed, no changes required

Disclaimer: *This Safety Data Sheet (SDS) is provided in response to customer requests to address the safe handling of the product. All statements, technical information and recommendations contained herein are the best of our knowledge, reliable and accurate. This SDS is not intended to make any representation as to how the product will perform when used for its intended purpose by a user. In that regards the product is sold "AS IS" and nothing in this SDS should be deemed to be a representation or warranty of any injury, loss, or damage, of any kind or nature, which are sustained by or arise from the use of the product. Nothing in this SDS is intended to be a representation or warranty by the manufacturer of the accuracy, safety, or usefulness for any purpose of any technical information, materials, techniques, or practices.*

The information contained in this Safety Data Sheet is, to the best of our knowledge, accurate and reliable. This information should be provided to all individuals handling this product. Federal, state, and local regulations should be followed when handling this product.

Roadsaver

EnviroTech, 910 54th Ave, Suite 230,
Greely, CO, 80634, US, 970-346-3900

Roadsaver

EnviroTech, 910 54th Ave, Suite 230,
Greely, CO, 80634, US, 970-346-3900

DURASOIL® SAFETY DATA SHEET

SECTION 1 –IDENTIFICATION

PRODUCT NAME	**DURASOIL** Ultra-Pure Synthetic Dust Control Fluid
RELATED PATENTS	U.S. Patent No. 8,968,592 Additional patents may be pending in the U.S. and elsewhere
CHEMICAL FAMILY	Non-Petroleum Synthetic Alkane Fluid
COMMON NAMES	Dust Binder, Dust Control Agent, Dust Control Material, Dust Inhibitor, Dust Palliative, Dust Retardant, Dust Stabilizer and Dust Suppressant
MANUFACTURER	**Soilworks, LLC** – Soil Stabilization & Dust Control 7580 N Dobson Rd, Ste 320 Scottsdale, Arizona 85256 USA (800) 545-5420 USA +1 (480) 545-5454 International info@soilworks.com www.soilworks.com
EMERGENCY PHONE NUMBERS	(800) 545-5420 USA +1 (480) 545-5454 International

U.S. DATA UNIVERSAL NUMBERING SYSTEM (DUNS NUMBER)

Soilworks, LLC	131946159

U.S. DEPARTMENT OF DEFENSE COMMERCIAL AND GOVERNMENT ENTITY CODE (CAGE CODE)

Soilworks, LLC	3FTH5

U.S. DEPARTMENT OF DEFENSE NATIONAL STOCK NUMBERS (NSN)

275-gallon (1,041 Liter)	Intermediate Bulk Container (IBC) Tote	6850-01542-5354
55-gallon (208 Liter)	Drum	6850-01-542-3715

U.S. GENERAL SERVICES ADMINISTRATION (GSA) CONTRACT

Soilworks, LLC	GS-07F-5364P	October 31, 2018

SYNONYMS/OTHER MEANS OF IDENTIFICATION

Durasoil is a synthetic fluid based dust binder, dust control agent, dust control fluid, dust control liquid, dust control material, dust control product, dust inhibitor, dust palliative, dust retardant, dust stabilizer and dust suppressant.

INTENDED USES

Durasoil is an environmentally safe, 100% non-petroleum, genuine synthetic fluid binder used for a wide variety of applications to abate dust, control dust, eliminate dust, inhibit dust, mitigate dust, reduce dust, retard dust, stabilize dust, stop dust and suppress dust for dust abatement, dust control, dust elimination, dust mitigation, dust reduction, dust stabilization and dust suppression.

SECTION 2 – HAZARDS IDENTIFICATION

This material is NOT considered hazardous according to OSHA criteria.

Emergency Overview	
Appearance:	Bright clear (colorless) viscous liquid (fluid).
Odor:	None. Odorless.
Health Hazards:	Harmful: may cause lung damage if swallowed.
Safety Hazards:	Nonflammable, but will burn on prolonged exposure to flame for high temperature.
Environmental Hazards:	NOT classified as dangerous for the environment.

HEALTH HAZARDS

INHALATION	Under normal conditions of use, this material is NOT expected to be a primary route of exposure.
SKIN CONTACT	Prolonged or repeated skin contact without proper cleaning can clog the pores of the skin resulting in disorders such as acne/folliculitis.
EYE CONTACT	May cause slight irritation to eyes.
INGESTION	Harmful: may cause lung damage if swallowed.

SIGNS AND SYMPTOMS

If material enters lungs, signs and symptoms may include coughing, choking, wheezing, difficulty in breathing, chest congestion, shortness of breath, and/or fever. The onset of respiratory symptoms may be delayed for several hours after exposure. Ingestion may result in nausea, vomiting and/or diarrhea.

U.S. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) 704 HAZARD CLASS

Health	0	No unusual hazard
Flammability	1	Nonflammable, but will burn on prolonged exposure to flame for high temperature.
Reactivity	0	Stable, non-reactive and non-explosive

U.S. HAZARDOUS MATERIALS IDENTIFICATION SYSTEM (HMIS) RATING

Health	0	No significant risk to health
Flammability	1	Nonflammable, but will burn on prolonged exposure to flame for high temperature.
Physical Hazard	0	Stable, non-reactive and non-explosive
Personal Protection	-	No special hazard under normal use

SECTION 3 – COMPOSITION/ INFORMATION ON INGREDIENTS

#	COMPONENT	%	CASRN
1.	A complex mixture of synthetic linear, branched and cyclic alkanes	Trade secret	Non-Hazardous
2.	Proprietary	Trade secret	Non-Hazardous

SECTION 4 – FIRST-AID MEASURES

EYE CONTACT

If irritation or redness develops from exposure, flush eyes with clean water. If irritation persists, seek medical attention.

SKIN CONTACT

No treatment necessary under normal conditions of use. Remove contaminated clothing. Wash affected area with mild soap and water. If irritation or redness develops and persists, seek medical attention.

INHALATION

No treatment necessary under normal conditions of use. If breathing difficulties develop move victim away from source of exposure and into fresh air in a position comfortable for breathing. If symptoms persist, seek medical attention.

INGESTION

No treatment necessary under normal conditions of use. If swallowed do not induce vomiting. If symptoms persist, seek medical attention.

SECTION 5 – FIRE-FIGHTING MEASURES

FLAMMABILITY

Nonflammable, but will burn on prolonged exposure to flame or high temperature.

FLASH POINT

420° F (216° C) ASTM D-93 (PMCC)
474° F (246° C) ASTM D-92 (COC)

AUTOIGNITION TEMPERATURE

>605° F (>318° C)

EXTINGUISHING MEDIA

Use foam, water spray or fog. Dry chemical powder, carbon dioxide, sand or earth may be used for small fires only.

SPECIAL FIRE FIGHTING PROCEDURES & PROTECTIVE EQUIPMENT

Do NOT use water in a jet. Proper protective equipment including breathing apparatus must be worn when approaching a fire in a confined space.

SPECIFIC HAZARDS

Hazardous combustion products may include: a complex mixture of airborne solid and liquid particulates and gasses (smoke). Carbon monoxide. Unidentified compounds.

U.S. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) 704 HAZARD CLASS

Health	0	No unusual hazard
Flammability	1	Nonflammable, but will burn on prolonged exposure to flame or high temperature.
Reactivity	0	Stable, non-reactive and non-explosive

(0 – Minimal, 1 – Slight, 2 – Moderate, 3 – Serious, 4 – Severe)

SECTION 6 – ACCIDENTAL RELEASE MEASURES

Avoid contact with spilled or released material. For guidance on selection of personal protective equipment see Chapter 8 of this Safety Data Sheet. See Chapter 13 for information on disposal. Observe the relevant local and international regulations.

PROTECTIVE MEASURES

Stop the leak, if possible. Avoid contact with skin and eyes. Use appropriate containment to avoid environmental contamination. Prevent from spreading or entering drains, ditches, sewers, rivers or open bodies of water by using sand, earth or other appropriate barriers.

CLEAN-UP METHODS

Avoid accidents, clean up immediately. Slippery when spilled. Prevent from spreading by making a barrier with sand, earth or other containment material. Reclaim liquid directly or in an absorbent. Soak up residue with an absorbent such as clay, sand or other suitable material and dispose of properly.

ADDITIONAL ADVICE

Local authorities should be advised if significant spillages cannot be contained.

SECTION 7 - HANDLING AND STORAGE

GENERAL PRECAUTIONS

Use local exhaust ventilation if there is risk of inhalation of vapors, mists or aerosols. Properly dispose of any contaminated rags or cleaning materials in order to prevent fires. Use the information in this data sheet as input to a risk assessment of local circumstances to help determine appropriate controls for safe handling, storage and disposal of this material.

STORAGE

Keep container tightly closed in a cool, well-ventilated place. Use properly labelled and closeable containers.

HANDLING

Avoid breathing vapors or mist. Avoid contact with eyes. Avoid prolonged or repeated contact with skin. Wash thoroughly after handling. When handling product in drums, safety footwear should be worn and proper handling equipment should be used.

RECOMMENDED MATERIALS

For containers or container linings, use mild steel or high density polyethylene.

ADDITIONAL INFORMATION

Polyethylene containers should not be exposed to high temperatures because of possible risk of distortion.

SECTION 8 – EXPOSURE CONTROLS / PERSONAL PROTECTION

OCCUPATIONAL EXPOSURE LIMITS

ACGIH (mist) :	TWA (inhalable fraction)	5 mg/m^3
OSHA Z1 (Mist):	PEL	5 mg/m^3
OSHA Z1A (Mist):	TWA	5 mg/m^3

EXPOSURE CONTROLS

The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Select controls based on a risk assessment of local circumstances. Appropriate measures include: Adequate ventilation to control airborne concentrations. Where material is heated, sprayed or mist formed, there is greater potential for airborne concentrations to be generated.

PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment (PPE) should meet recommended national standards. Check with PPE suppliers.

RESPIRATORY PROTECTION

Respiratory protection is NOT required under normal conditions of use in a well-ventilated workplace. In accordance with good industrial hygiene practices, precautions should be taken to avoid breathing of material. If engineering controls do not maintain airborne concentrations to a level which is adequate to protect worker health, select respiratory protection equipment suitable for the specific conditions of use and meeting relevant legislation. Check with respiratory protective equipment suppliers. Where air-filtering respirators are suitable, select an appropriate combination of mask and filter. Select a filter suitable for combined particulate/organic gases and vapors.

HAND PROTECTION

Where hand contact with the product may occur the use of gloves approved to relevant standards (e.g. Europe: EN374, US: F739) made from the following materials may provide suitable chemical protection: PVC, neoprene or nitrile rubber gloves. Suitability and durability of a glove is dependent on usage, e.g. frequency and duration of contact, chemical resistance of glove material, glove thickness, dexterity. Always seek advice from glove suppliers. Contaminated gloves should be replaced. Personal hygiene is a key element of effective hand care. Gloves must only be worn on clean hands. After using gloves, hands should be washed with soap and water and dried thoroughly.

EYE PROTECTION

Eye protection is NOT required under normal conditions of use. If material is handled such that it could be splashed into eyes, wear splash-proof safety goggles or full face shield.

PROTECTIVE CLOTHING

Skin protection is NOT required under normal conditions of use or for single, short duration exposures. For prolonged or repeated exposures, use impervious chemical resistant boots, gloves and/or aprons over parts of the body subject to exposure.

MONITORING METHODS

Monitoring of the concentration of substances in the breathing zone of workers or in the general workplace may be required to confirm compliance with an OEL and adequacy of exposure controls.

SECTION 9 – PHYSICAL AND CHEMICAL PROPERTIES

ANILINE POINT	235 °F (113 °C)
ASH CONTENT	<0.01% (None detected)
AUTO IGNITION TEMPERATURE	>605° F (>318° C)
BOILING POINT	464 °F (240 °C)
CLOUD POINT	-22 °F (-30 °C)
COLOR	None. Colorless, clear and bright
CONDUCTIVITY	5,886 pS/m
DENSITY	<6.8 lb/gal (816 kg/m^3) @ 59 °F (15 °C)
DIELECTRIC STRENGTH	46 MV/m
FLASH POINT (ASTM D92 COC)	474 °F (246 °C)
FLASH POINT (ASTM D93 PMCC)	420 °F (216 °C)
KINEMATIC VISCOSITY	4 cSt @ 212 °F (100 °C)
ODOR	None, Odorless
OIL SHEEN	None. Oil sheen free
PH	Not applicable. Not an aqueous solution
PHYSICAL FORM	Liquid, Synthetic Fluid
POUR POINT	-40 °F (-40 °C)
SPECIFIC GRAVITY	0.8155 @ 59 °F (15 °C)
VAPOR DENSITY (Air = 1)	>1
VAPOR PRESSURE	<0.5 Pa @ 68 °F (20 °C)
VISCOSITY INDEX	130 (minimal change with temperature)
WATER CONTENT	<0.01% (None detected)
WATER SOLUBILITY	Insoluble

SECTION 10 - STABILITY AND REACTIVITY

CHEMICAL STABILITY
Stable.

CONDITIONS TO AVOID
Extreme heat.

MATERIALS TO AVOID
Strong oxidizing agents.

HAZARDOUS DECOMPOSITION
Hazardous decomposition products are NOT expected to form during normal storage.

CORROSIVITY
Non-corrosive.

AIRCRAFT SURFACE REACTIVITY
Non-injurious to aircraft surfaces (Boeing Specification D6-17487 revision R)

Sandwich Corrosion	Pass / Conforms	No corrosion
Acrylic Crazing	Pass / Conforms	No crazing, cracking or etching
Paint Softening	Pass / Conforms	No hardness change, discoloration or staining
Hydrogen Embrittlement	Pass / Conforms	No failure

SECTION 11 - TOXICOLOGICAL INFORMATION

SKIN IRRITATION
Expected to be slightly irritating. Prolonged or repeated contact may cause defatting of the skin which can lead to dermatitis.

EYE IRRITATION
Expected to be slightly irritating.

RESPIRATORY IRRITATION
Inhalation of vapors or mists may cause irritation.

SENSITIZATION
NOT expected to be a skin sensitizer.

REPEATED DOSE TOXICITY
NOT expected to be a hazard.

CARCINOGENICITY
Components are NOT known to be associated with carcinogenic effects.

OSHA	U.S. Occupational Safety and Health Administration	Not listed as carcinogenic
NTP	U.S. National Toxicology Program	Not listed as carcinogenic
IARC	World Health Organization International Agency for Research on Cancer	Not listed as carcinogenic
Prop 65	California Office of Environmental Health Hazard Assessment Proposition 65	Not listed as carcinogenic

REPRODUCTIVE AND DEVELOPMENTAL TOXICITY
NOT expected to be a hazard.

BENZENE & NAPHTHALENE	None Detected – EPA 5030B & 8260B
DIOXINS & FURANS (PCDDs / PCDFs)	None Detected – QC066-97, GC-MS
HALOGENATED VOLATILE ORGANICS	None Detected – EPA 5030B & 8260B
METALS (TCLP)	None Detected - EPA 6010B & 7470A
METALS	None Detected - EPA 200.7 & 245.1
METALS	None Detected – EPA 6020 & 3050B, ICP
MUTAGENICITY	None Detected – APHA 8030B
PESTICIDES, HERBICIDES AND PCBS	None Detected - EPA 8151A
PESTICIDES, HERBICIDES AND PCBS (TCLP)	None Detected - EPA 8081A & 8151A
PHENOLIC COMPOUNDS	None Detected – QC066-97, GC-MS
POLYCHLORINATED BIPHENYL (PCBs)	None Detected – GC-MS
POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)	None Detected – EPA 3510, QC058-97, GC-MS
SEMI-VOLATILE ORGANIC COMPOUNDS	None Detected – EPA 3510 & 8270, GC-MS
SEMI-VOLATILE ORGANIC COMPOUNDS (SVOC)	None Detected - EPA 8270C
SEMI-VOLATILE ORGANIC COMPOUNDS (TCLP)	None Detected - EPA 8270 & 1311
VOLATILE ORGANIC COMPOUNDS (TCLP)	None Detected - EPA 8260
VOLATILE ORGANIC COMPOUNDS (VOC)	None Detected - EPA 8260B

SECTION 12 - ECOLOGICAL INFORMATION

Based on EPA guidelines, Durasoil is classified as practically non-toxic to all species. When used and applied properly, Durasoil is not known to pose any ecological problems.

AQUATIC TOXICITY

Bacterium	Aliivibrio fischeri	15 minute	IC_{50}	>500,000 mg/L
Fathead Minnow	Pimephales promelas	7 day	IC_{25}	>2,000 mg/L
Fathead Minnow	Pimephales promelas	7 day	IC_{50}	>39,000 mg/L
Fathead Minnow	Pimephales promelas	7 day	LC_{50}	>28,000 mg/L
Microalga	Pseudokirchneriella subcapita	96 hour	IC_{50}	>500,000 mg/L
Mysid Shrimp	Americamysis bahia	7 day	IC_{25}	>1,000 mg/L
Mysid Shrimp	Americamysis bahia	7 day	LC_{50}	>2,000 mg/L
Rainbow Trout	Oncorhynchus mykiss	96 hour	LC_{50}	>2,000 mg/L
Water Flea	Daphnia magna	48 hour	LC_{50}	18,000 mg/L

TERRESTRIAL TOXICITY

Lettuce	Seed germination	120 hour	LC_{50}	>680,000 mg/L
Lettuce	Root elongation	120 hour	EC_{50}	>13,000 mg/L
Earthworm	Eisenia andrei	14 day	LC_{50}	>670,000 mg/L

DEGRADABILITY

Major constituents are expected to be readily biodegradable

MOBILITY

Liquid under most environmental conditions. Floats on water. If it enters soil, it will adsorb to the soil particles and will NOT be mobile.

OTHER ADVERSE EFFECTS

The synthetic fluid contains non-volatile components, which are NOT expected to be released to air in any significant quantities. Synthetic fluid is NOT expected to have ozone depletion potential, photochemical ozone creation potential or global warming potential.

SECTION 13 - DISPOSAL CONSIDERATIONS

MATERIAL DISPOSAL

Recover or recycle if possible. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste classification and disposal methods in compliance with applicable regulations. Do NOT dispose into the environment, in drains or in water courses.

CONTAINER DISPOSAL

Dispose in accordance with prevailing regulations, preferably to a recognized collector or contractor. The competence of the collector or contractor should be established beforehand.

LOCAL LEGISLATION

Dispose in accordance with applicable regional, national and local laws and regulations.

SECTION 14 - TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION (DOT)

NOT regulated.	This material is NOT subject to DOT regulations under 49 CFR Parts 171-180.

INTERNATIONAL MARITIME DANGEROUS GOODS (IMDG)

NOT regulated.	This material is NOT classified as dangerous under IMDG regulations.

INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA)

NOT regulated.	This material is either NOT classified as dangerous under IATA regulations or needs to follow country specific requirements.

SECTION 15 - REGULATORY INFORMATION

The regulatory information is not intended to be comprehensive. Other regulations may apply to this material.

U.S. FEDERAL REGULATIONS

EPA COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT (CERCLA)

This material does NOT contain any chemicals with U.S. EPA CERCLA reportable quantities.

EPA SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA)

This material does NOT contain any chemicals with SARA reportable quantities.

EPA TOXIC SUBSTANCES CONTROL ACT (TSCA)

All components listed.

EPA CERCLA/SARA SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES AND TPQS

This material does NOT contain any chemicals subject to the reporting requirements of SARA 302 and 40 CFR 372.

EPA CERCLA/SARA SECTION 311/312 (TITLE III HAZARD CATEGORIES)

Acute Health:	No
Chronic Health:	No
Fire Hazard:	No
Pressure Hazard:	No
Reactive Hazard:	No

EPA CERCLA/SARA SECTION 313 AND 40 CFR 372

This material does NOT contain any chemicals subject to the reporting requirements of SARA 313 and 40 CFR 372.

U.S. STATE REGULATIONS

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65)

This material does NOT contain any chemicals known to the State of California to cause cancer, birth defects or reproductive harm.

CANADIAN REGULATIONS

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the SDS contains all the information required by the regulations.

CANADIAN DOMESTIC SUBSTANCES LIST (DSL)

All components listed.

WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHIMIS)

None. This synthetic fluid is NOT a controlled product under the Canadian WHIMIS.

BUREAU DE NORMALIZATION DU QUÉBEC (BNQ)

Durasoil conforms as a dust control agent for non-asphalted roads and other similar surfaces. Certificate of Conformity: August 6, 2014, Certificate #: 1743, Standard #: BNQ 2410-300/2009-10-01, Certification Protocol #: BNQ 2410-900/2010-01-12

EUROPEAN REGULATIONS

EUROPEAN INVENTORY OF EXISTING COMMERCIAL SUBSTANCES (EINECS)

All components listed.

SECTION 16 – OTHER INFORMATION

SDS VERSION NUMBER 1.1

SDS EFFECTIVE DATE 2/27/2015

SDS REGULATIONS

The content and format of this SDS is in accordance with the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

SDS DISTRIBUTION

The information in this document should be made available to all who may handle the product.

DISCLAIMER

The information presented in this Safety Data Sheet is based on data believed to be accurate as of the date this Safety Data Sheet was prepared. HOWEVER, NO WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR ANY OTHER WARRANTY IS EXPRESSED OR IS TO BE IMPLIED REGARDING THE ACCURACY OR COMPLETENESS OF THE INFORMATION PROVIDED ABOVE, THE RESULTS TO BE OBTAINED FROM THE USE OF THIS INFORMATION OR THE PRODUCT, THE SAFETY OF THIS PRODUCT, OR THE HAZARDS RELATED TO ITS USE. No responsibility is assumed for any damage or injury resulting from abnormal use or from any failure to adhere to recommended practices. The information provided above, and the product, are furnished on the condition that the person receiving them shall make their own determination as to the suitability of the product for their particular purpose and on the condition that they assume the risk of their use. In addition, no authorization is given nor implied to practice any patented invention without a license.

Durasoil

May cause lung damage if swallowed. Nonflammable but will burn on prolonged exposure to flame for high temperature.

Soilworks, 7580 N Dobson Rd, Ste 320, Scottsdale, AZ, 800-545-5420, US, 800-545-5420

Durasoil

May cause lung damage if swallowed. Nonflammable but will burn on prolonged exposure to flame for high temperature.

Soilworks, 7580 N Dobson Rd, Ste 320, Scottsdale, AZ, 800-545-5420, US, 800-545-5420

SOILWORKS®

DURASOIL®

Ultra-Pure Synthetic Dust Control Fluid

Volume*: 275 gal (1,041 L)

Gross Weight*: 2,040 lbs (925 kg)

Dimensions*: 40 x 48 x 42 in (100 x 120 x 116 cm)

*Specifications are approximate

- **Read Material Safety Data Sheet before using this product**
- **Keep out of reach of children**
- **For industrial and professional use only**

FIRST AID

Inhalation: no treatment necessary under normal conditions of use. If symptoms persist, obtain medical advice. Skin: Remove contaminated clothing. Flush exposed area with water and follow by washing with soap. Eyes: flush with copious quantities of water. If persistent irritation occurs, obtain medical attention. Ingestion: if swallowed, do not induce vomiting: transport to nearest medical facility for additional treatment.

FIRE

Foam, water spray or fog.

SPILLS

Slippery when spilled. Avoid accidents and clean up immediately. Prevent from spreading or entering drains, ditches or open bodies of water by making a barrier with sand, earth or other containment material. Reclaim liquid directly or in an absorbent such as clay, sand or other suitable material and dispose of properly.

HMIS	Health	Fire	React	Special
	0	1	0	-

GSA Contract Holder
Contract GS-07F-5364P

Manufactured & Distributed by
Soilworks, LLC
Soil Stabilization & Dust Control
7580 N Dobson Rd, Ste 320, Scottsdale, AZ 85256
800.545.5420 USA| 001.480.545.5454 International
www.soilworks.com | info@soilworks.com
NSN: 6850-01-542-5354 | Cage Code: 3FTH5 | DUNS: 13-19-46159

SOILWORKS
Soil Stabilization & Dust Control

800.545.5420 USA
001.480.545.5454 International
www.soilworks.com

1750 E Northrop Blvd, Ste 250
Chandler, AZ 85286 USA
info@soilworks.com

MATERIAL SAFETY DATA SHEET

SECTION 1 - MATERIAL IDENTIFICATION

PRODUCT NAME	**GORILLA-SNOT***
	*GORILLA-SNOT is a registered trademark of Soilworks, LLC.
MANUFACTURER	Soilworks, LLC.
	1750 E Northrop Blvd, Ste 250 Chandler, AZ 85286-1595 USA
ONLINE INFORMATION	www.soilworks.com
EMERGENCY TELEPHONE NUMBERS	800.545.5420 USA
	001.480.545-5454 International
REVISION DATE	August 2013 *(supersedes November 2007)*
PHYSICAL FORM	Mobile liquid
COLOR	Milky White (transparent once cured)
ODOR	Mild / Slight (no odor once cured)
C.A.S. CHEMICAL NAME	Mixture
SYNONYMS	Soil stabilizer, soil stabilization agent, soil solidifier, soil amendment, soil additive, soil crusting agent, dust control agent, dust inhibitor, dust palliative, dust suppressant, dust retardant
CHEMICAL FAMILY	Vinyl Copolymer Emulsion
EMPIRICAL FORMULA	Mixture
INTENDED USE	Soil stabilization, soil solidification, fugitive dust control, dust suppression, dust abatement, tackifier, dust abatement, PM_{10} and $PM_{2.5}$ air quality control and erosion control

SECTION 2 - INGREDIENTS

	%	CAS Number	Chemical Name
1.	20-60	Proprietary	Vinyl Copolymer
2.	80-40	7732-18-5	Water

SECTION 3 – HEALTH HAZARDS

ROUTES OF ENTRY

Eye Contact, Skin Contact, Ingestion and Inhalation

SIGNS AND SYMPTOMS OF ACUTE EXPOSURE

Eyes: Direct contact with this material may cause eye irritation including lachrymation (tearing).

Inhalation: Inhalation of vapor or aerosol may cause irritation to the respiratory tract (nose, throat, and lungs).

Skin: Contact may cause skin irritation.

Ingestion: No hazard in normal industrial use.

SIGNS AND SYMPTOMS OF CHRONIC EXPOSURE

Prolonged or repeated contact with skin may cause irritation and dermatitis (inflammation).

CARCINOGENICITY

This material **does not** contain 0.1% or more of any chemical listed by the International Agency for Research on Cancer (IARC), the National Toxicology Program (NTP), or regulated by the Occupational Safety and Health Administration (OSHA) as a carcinogen.

SECTION 4 – FIRST AID

EYE CONTACT

Flush eyes with clean water for at least 15 minutes. Get immediate medical attention.

SKIN CONTACT

Remove contaminated clothing and shoes. Wash affected area with soap and water. Get medical attention if irritation develops or persists.

800.545.5420 USA
001.480.545.5454 International
www.soilworks.com
1750 E Northrop Blvd, Ste 250
Chandler, AZ 85286 USA
info@soilworks.com

INHALATION

Move patient to fresh air. If breathing has stopped or is labored give assisted respiration (e.g. mouth-to-mouth). Supplemental oxygen may be indicated. Seek medical advice.

INGESTION

Give the victim one or two glasses of water or milk to drink. Get immediate medical attention. Never give anything by mouth to an unconscious person.

SECTION 5 – FIRE AND EXPLOSION DATA

FLASH POINT (closed cup)	Not applicable
UPPER EXPLOSION LIMIT (UEL)	Not applicable
LOWER EXPLOSION LIMIT (LEL)	Not applicable
AUTOIGNITION TEMPERATURE	Not applicable
FIRE HAZARD CLASSIFICATION (OSHA/NFPA)	Non-Combustible

EXTINGUISHING MEDIA

Product does not burn. The product will only burn after the water it contains is driven off. For dry polymer use carbon dioxide, foam, dry chemical or water fog to extinguish fire. Aqueous solution **is not flammable.**

FIRE FIGHTING EQUIPMENT

Wear self-contained breathing apparatus (SCBA) and full fire-fighting protective clothing. Thoroughly decontaminate all protective equipment after use.

FIRE FIGHTING INSTRUCTIONS

Containers of this material may build up pressure if exposed to heat (fire). Use water spray to cool fire-exposed containers.

FIRE AND EXPLOSION HAZARDS

This material **will not burn** unless it is evaporated to dryness. Closed containers may rupture when exposed to extreme heat.

HAZARDOUS COMBUSTION PRODUCTS

When dried polymer burns, water (H_2O), carbon dioxide (CO_2), carbon monoxide (CO) and smoke are produced.

SECTION 6 – ACCIDENTAL RELEASE MEASURES

CONTAINMENT TECHNIQUES (Removal of ignition sources, diking etc)

Stop the leak, if possible. Ventilate the space involved.

CLEAN-UP PROCEDURES

Wear suitable protective equipment. If recovery is not feasible, admix with dry soil, sand or non-reactive absorbent and place in an appropriate chemical waste container. Prevent spilled material from entering sanitary sewers, storm sewers, drainage systems and from entering bodies of water or ditches that lead to waterways. Transfer to containers by suction, preparatory for later disposal. Place in metal containers for recovery or disposal. Flush area with water spray. Wash contaminated property (e.g., automobiles) quickly before the material dries. For large spills, recover spilled material with a vacuum truck.

OTHER EMERGENCY ADVICE

Spilled polymer emulsion is very slippery. Use care to avoid falls. A film will form on drying. Remove saturated clothing and wash contacted skin area with soap and water. Product imparts a milky white color to contaminated waters. Foaming may result. Sewage treatment plants may not be able to remove the white color imparted to the water.

SECTION 7 – HANDLING AND STORAGE

STORAGE

Keep from freezing. Store in a dry area. Keep containers closed when not in use to minimize contact with atmospheric air and prevent inoculation with microorganisms.

HANDLING

Use only in well-ventilated areas. Avoid contact with eyes. Avoid breathing vapors. Avoid prolonged or repeated contact with skin. Wash hands thoroughly after handling and before eating or drinking.

800.545.5420 USA
001.480.545.5454 International
www.soilworks.com

1750 E Northrop Blvd, Ste 250
Chandler, AZ 85286 USA
info@soilworks.com

SECTION 8 – PERSONAL PROTECTION / EXPOSURE CONTROLS

EXPOSURE GUIDELINES

There are no Occupational Safety and Health (OSHA) Permissible Exposure Limits (PEL) or American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV) or Short Term Exposure Limits (STEL) established for the component(s) of this product.

EYE PROTECTION

Chemical safety glasses.

HAND PROTECTION

Rubber Gloves. The breakthrough time of the selected glove(s) must be greater than the intended use period.

RESPIRATORY PROTECTION

Not required under normal use.

PROTECTIVE CLOTHING

No specific recommendation.

ENGINEERING CONTROLS

Good general ventilation should be sufficient to control airborne levels of irritating vapors.

SECTION 9 – TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL FORM	Liquid
COLOR	Milky White (transparent once cured)
ODOR	Mild / Slight (no odor once cured)
pH	4-9
EVAPORATION RATE	< 1 (BuAc=1)
VAPOR DENSITY	> 1 (Air = 1)
BOILING POINT	>100.00°C (>212.00°F)
FREEZING POINT	<0°C (<32°F)
SOLUBILITY IN WATER	Completely (100%) (until cured)
SPECIFIC GRAVITY (Water = 1)	1.02-1.10

SECTION 10 – STABILITY AND REACTIVITY

STABILITY

Stable at ambient temperatures. Coagulation may occur following freezing, thawing or boiling.

INCOMPATIBILITY (Materials to Avoid)

No incompatibilities have been identified.

HAZARDOUS DECOMPOSITION PRODUCTS

Thermal decomposition may form: Acetic acid and Acrolein. Thermal decomposition may produce various hydrocarbons and irritating, acrid vapors.

HAZARDOUS POLYMERIZATION

Will not occur

CONDITIONS TO AVOID

Freezing temperatures (until cured).

SECTION 11 – TOXICOLOGICAL PROPERTIES

ACUTE EYE TOXICITY

No information is available.

ACUTE ORAL TOXICITY

No information is available.

ACUTE SKIN TOXICITY

No information is available.

ACUTE INHALATION TOXICITY

No information is available.

800.545.5420 USA
001.480.545.5454 International
www.soilworks.com
1750 E Northrop Blvd, Ste 250
Chandler, AZ 85286 USA
info@soilworks.com

CHRONIC/CARCINOGENICY

This material **does not** contain 0.1% or more of any chemical listed by the International Agency for Research on Cancer (IARC), the National Toxicology Program (NTP), or regulated by the Occupational Safety and Health Administration (OSHA) as a carcinogen.

SECTION 12 – ECOLOGICAL INFORMATION

ECOTOXICITY

Common Name	Species	Test	Result	Concentration
Green Algae	Raphidocelus Subcapitata	96-hr chronic LC50	>1,000	Undiluted
Fathead Minnow	Pimephales Promelas	96-hr acute LC50	>1,208	Undiluted
Rainbow Trout	Oncorhynchus Mykiss	96-hr acute LC50	>1,000	Undiluted

ENVIRONMENTAL FATE

No data is available

SECTION 13 – DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD

This material **is not** a RCRA hazardous waste. Disposal of this material is not regulated under RCRA. Consult federal, state and local regulations to ensure that this material and its containers, if discarded, is disposed of in compliance with all regulatory requirements. NOTE: As supplied or diluted, product material (foam included), when splashed on automobiles or other personal property, is difficult to remove if allowed to dry.

RCRA HAZARD CLASS

This material **is not** a RCRA hazardous waste. When discarded in its purchased form, this material would not be regulated as a RCRA Hazardous waste under 40 CFR 261.

SECTION 14 – TRANSPORT INFORMATION

DOT NON-BULK SHIPPING NAME	Refer to Bill of Lading - Not DOT Regulated // Keep From Freezing // Not dangerous goods
DOT BULK SHIPPING NAME	Refer to Bill of Lading.
IMO SHIPPING DATA	Refer to Bill of Lading.
ICAO/IATA SHIPPING DATA	Refer to Bill of Lading - Not IATA Regulated // Keep From Freezing // Not dangerous goods
CFR	Not Regulated // Keep From Freezing // Not dangerous goods
IMDG	Not Regulated // Keep From Freezing // Not dangerous goods
CTC	Not Regulated // Keep From Freezing // Not dangerous goods

SECTION 15 – REGULATORY INFORMATION

TSCA SECTION 8(b) INVENTORY STATUS

All components are included in the EPA Toxic Substances Control Act (TSCA) Chemical Substance Inventory.

TSCA SECTION 12(b) EXPORT NOTIFICATION

This material **does not** contain any components that are subject to the U.S. Toxic Substances Control Act (TSCA) Section 12 (b) Export Notification requirements.

OSHA Hazard Communication Standard (29CFR1910.1200) hazard class(es)

This material **is not** classified as hazardous under the criteria of the U.S. Occupational Safety and Health Administration (OSHA) Hazard Communication Standard, 29 CFR 1910.1200

EPA SARA Title III Section 304 CERCLA

Reportable quantities have not been established for any of this material's components.

EPA SARA Title III Section 311/312 HAZARD COMMUNICATION STANDARD (HCS)

This material **is not** a hazardous chemical.

EPA SARA Title III Section 313 TOXIC CHEMICAL LIST (TCL)

This product **does not** contain Section 313 Reportable Ingredients.

CANADIAN INVENTORY STATUS

All components of this material are listed on the Canadian Domestic Substances List (DSL)

CANADIAN WHMIS

This material **is not** classified as a controlled product under the Canadian Workplace Hazardous Material Information System.

ADDITIONAL CANADIAN REGULATORY INFORMATION

This product **does not** contain a substance present on the WHMIS Ingredient Disclosure List (IDL) which is at or above the specified concentration limit.

EUROPEAN INVENTORY STATUS (EINECS)

The polymer portion of this product is manufactured from reactants which are listed on EINECS and meets the EINECS definition of an exempt polymer.

AICS (Australia)

Included on inventory

ENCS (Japan)

Included on inventory

ECL (South Korea)

Included on inventory

SEPA (China)

Included on inventory

SECTION 16 – OTHER INFORMATION

HMIS and NFPA Classification

Health	: 1
Flammability	: 0
Reactivity	: 0
Special Hazard	: 0

Gorilla Snot

Direct contact with this material may cause eye irritation including lachrymation (tearing).

Inhalation of vapor or aerosol may cause irritation to the respiratory tract.

Contact may cause skin irritation.

Eye contact: flush eyes with clean water for at least 15 minutes. Get immediate medical attention.

Skin contact: Remove contaminated chlothing and shoes. Wash affected area with soap and water. Get medical attention if irritation persists.

Ihalation: Move patient to fresh air. If breathing has stopped or is labored give assisted respiration. Supplemented oxygen may be indicated. Seek medical advice.

Ingestion: Give the victim one or two glasses of water or milk to drink. Get immediate medical attention.

Soilworks, 7580 N Dobson Rd, Ste 320, Scottsdale, AZ, 800-545-5420, US, 800-545-5420

Gorilla Snot

Direct contact with this material may cause eye irritation including lachrymation (tearing).

Inhalation of vapor or aerosol may cause irritation to the respiratory tract.

Contact may cause skin irritation.

Eye contact: flush eyes with clean water for at least 15 minutes. Get immediate medical attention.

Skin contact: Remove contaminated chlothing and shoes. Wash affected area with soap and water. Get medical attention if irritation persists.

Ihalation: Move patient to fresh air. If breathing has stopped or is labored give assisted respiration. Supplemented oxygen may be indicated. Seek medical advice.

Ingestion: Give the victim one or two glasses of water or milk to drink. Get immediate medical attention.

Soilworks, 7580 N Dobson Rd, Ste 320, Scottsdale, AZ, 800-545-5420, US, 800-545-5420

SOILWORKS®

GORILLA-SNOT®

Vinyl Copolymer Soil Stabilizer & Dust Control Agent

Volume*: 275 gal (1,041 L)

Gross Weight*: 2,500 lbs (1,135 kg)

Dimensions*: 40 x 48 x 42 in (100 x 120 x 116 cm)

*Specifications are approximate

- **Read Material Safety Data Sheet before using this product**
- **Keep out of reach of children**
- **For industrial and professional use only**
- **Protect from Freezing**

FIRST AID

Inhalation: no treatment necessary under normal conditions of use. If symptoms persist, obtain medical advice. Skin: Remove contaminated clothing. Flush exposed area with water and follow by washing with soap. Eyes: flush with copious quantities of water. If persistent irritation occurs, obtain medical attention. Ingestion: if swallowed, do not induce vomiting: transport to nearest medical facility for additional treatment.

SPILLS

Slippery when spilled. Avoid accidents and clean up immediately. Prevent from spreading or entering drains, ditches or open bodies of water by making a barrier with sand, earth or other containment material. Reclaim liquid directly or in an absorbent such as clay, sand or other suitable material and dispose of properly.

HMIS	Health	Fire	React	Special
	1	0	0	-

GSA Contract Holder
Contract GS-07F-5364P

Manufactured & Distributed by

Soilworks, LLC

Soil Stabilization & Dust Control

7580 N Dobson Rd, Ste 320, Scottsdale, AZ 85256
800.545.5420 USA | 001.480.545.5454 International
www.soilworks.com | info@soilworks.com
NSN: 6850-01-542-5389 | Cage Code: 3FTH5 | DUNS: 13-19-46159

SOILWORKS
Soil Stabilization & Dust Control

800.545.5420 USA
001.480.545.5454 International
www.soilworks.com

1750 E Northrop Blvd, Ste 250
Chandler, AZ 85286 USA
info@soilworks.com

MATERIAL SAFETY DATA SHEET

SECTION 1 - MATERIAL IDENTIFICATION

PRODUCT NAME	**SOILTAC*** *SOILTAC is a registered trademark of Soilworks, LLC.
MANUFACTURER	Soilworks, LLC. 1750 East Northrop Blvd, Suite 250 Chandler, Arizona 85286-1747 USA www.soilworks.com
TELEPHONE NUMBER	800-545-5420 Toll Free USA / +1.480.545.5454 (International)
ONLINE INFORMATION	www.Soilworks.com
EMERGENCY TELEPHONE NUMBERS	800-545-5420 Toll Free USA / +1.480.545.5454 (International)
REVISION DATE	June 2013 *(supersedes November 2006)*
PHYSICAL FORM	Mobile liquid
COLOR	Milky White (transparent once cured)
ODOR	Mild / Slight (no odor once cured)
C.A.S. CHEMICAL NAME	Mixture
SYNONYMS	Soil stabilizer, soil stabilization agent, soil solidifier, soil amendment, soil additive, soil crusting agent, dust control agent, dust inhibitor, dust palliative, dust suppressant, dust retardant
CHEMICAL FAMILY	Vinyl Copolymer Emulsion
EMPIRICAL FORMULA	Mixture
INTENDED USE	Soil stabilization, soil solidification, fugitive dust control, dust suppression, dust abatement, tackifier, dust abatement, PM_{10} and $PM_{2.5}$ air quality control and erosion control

SECTION 2 - INGREDIENTS

	%	CAS Number	Chemical Name
1.	50-60	Proprietary	Vinyl Copolymer
2.	40-50	7732-18-5	Water

SECTION 3 - HEALTH HAZARDS

ROUTES OF ENTRY

Eye Contact, Skin Contact, Ingestion and Inhalation

SIGNS AND SYMPTOMS OF ACUTE EXPOSURE

Eyes: Direct contact with this material may cause eye irritation including lachrymation (tearing).
Inhalation: Inhalation of vapor or aerosol may cause irritation to the respiratory tract (nose, throat, and lungs).
Skin: Contact may cause skin irritation.
Ingestion: No hazard in normal industrial use.

SIGNS AND SYMPTOMS OF CHRONIC EXPOSURE

Prolonged or repeated contact with skin may cause irritation and dermatitis (inflammation).

CARCINOGENICITY

This material **does not** contain 0.1% or more of any chemical listed by the International Agency for Research on Cancer (IARC), the National Toxicology Program (NTP), or regulated by the Occupational Safety and Health Administration (OSHA) as a carcinogen.

SECTION 4 - FIRST AID

EYE CONTACT

Flush eyes with clean water for at least 15 minutes. Get immediate medical attention.

SKIN CONTACT

Remove contaminated clothing and shoes. Wash affected area with soap and water. Get medical attention if irritation develops or persists.

INHALATION

Move patient to fresh air. If breathing has stopped or is labored give assisted respiration (e.g. mouth-to-mouth). Supplemental oxygen may be indicated. Seek medical advice.

800.545.5420 USA
001.480.545.5454 International
www.soilworks.com
1750 E Northrop Blvd, Ste 250
Chandler, AZ 85286 USA
info@soilworks.com

INGESTION

Give the victim one or two glasses of water or milk to drink. Get immediate medical attention. Never give anything by mouth to an unconscious person.

SECTION 5 - FIRE AND EXPLOSION DATA

FLASH POINT (closed cup)	Not applicable
UPPER EXPLOSION LIMIT (UEL)	Not applicable
LOWER EXPLOSION LIMIT (LEL)	Not applicable
AUTOIGNITION TEMPERATURE	Not applicable
FIRE HAZARD CLASSIFICATION (OSHA/NFPA)	Non-Combustible

EXTINGUISHING MEDIA

Product does not burn. The product will only burn after the water it contains is driven off. For dry polymer use carbon dioxide, foam, dry chemical or water fog to extinguish fire. Aqueous solution **is not flammable**.

FIRE FIGHTING EQUIPMENT

Wear self-contained breathing apparatus (SCBA) and full fire-fighting protective clothing. Thoroughly decontaminate all protective equipment after use.

FIRE FIGHTING INSTRUCTIONS

Containers of this material may build up pressure if exposed to heat (fire). Use water spray to cool fire-exposed containers.

FIRE AND EXPLOSION HAZARDS

This material **will not burn** unless it is evaporated to dryness. Closed containers may rupture when exposed to extreme heat.

HAZARDOUS COMBUSTION PRODUCTS

When dried polymer burns, water (H_2O), carbon dioxide (CO_2), carbon monoxide (CO) and smoke are produced.

SECTION 6 - ACCIDENTAL RELEASE MEASURES

CONTAINMENT TECHNIQUES (Removal of ignition sources, diking etc)

Stop the leak, if possible. Ventilate the space involved.

CLEAN-UP PROCEDURES

Wear suitable protective equipment. If recovery is not feasible, admix with dry soil, sand or non-reactive absorbent and place in an appropriate chemical waste container. Prevent spilled material from entering sanitary sewers, storm sewers, drainage systems and from entering bodies of water or ditches that lead to waterways. Transfer to containers by suction, preparatory for later disposal. Place in metal containers for recovery or disposal. Flush area with water spray. Wash contaminated property (e.g., automobiles) quickly before the material dries. For large spills, recover spilled material with a vacuum truck.

OTHER EMERGENCY ADVICE

Spilled polymer emulsion is very slippery. Use care to avoid falls. A film will form on drying. Remove saturated clothing and wash contacted skin area with soap and water. Product imparts a milky white color to contaminated waters. Foaming may result. Sewage treatment plants may not be able to remove the white color imparted to the water.

SECTION 7 - HANDLING AND STORAGE

STORAGE

Keep from freezing. Store in a dry area. Keep containers closed when not in use to minimize contact with atmospheric air and prevent inoculation with microorganisms.

HANDLING

Use only in well-ventilated areas. Avoid contact with eyes. Avoid breathing vapors. Avoid prolonged or repeated contact with skin. Wash hands thoroughly after handling and before eating or drinking.

SECTION 8 - PERSONAL PROTECTION / EXPOSURE CONTROLS

EXPOSURE GUIDELINES

There are no Occupational Safety and Health (OSHA) Permissible Exposure Limits (PEL) or American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV) or Short Term Exposure Limits (STEL) established for the component(s) of this product.

EYE PROTECTION

Chemical safety glasses.

HAND PROTECTION

Rubber Gloves. The breakthrough time of the selected glove(s) must be greater than the intended use period.

RESPIRATORY PROTECTION

Not required under normal use.

PROTECTIVE CLOTHING

No specific recommendation.

ENGINEERING CONTROLS

Good general ventilation should be sufficient to control airborne levels of irritating vapors.

SECTION 9 - TYPICAL PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL FORM	liquid
COLOR	Milky White (transparent once cured)
ODOR	Mild / Slight (no odor once cured)
pH	4.5-6.0
EVAPORATION RATE	< 1 (BuAc=1)
VAPOR DENSITY	> 1 (Air = 1)
BOILING POINT	>100.00°C (>212.00°F)
FREEZING POINT	<0°C (<32°F)
SOLUBILITY IN WATER	Completely (100%) (until cured)
SPECIFIC GRAVITY (Water = 1)	1.05-1.10

SECTION 10 - STABILITY AND REACTIVITY

STABILITY

Stable at ambient temperatures. Coagulation may occur following freezing, thawing or boiling.

INCOMPATIBILITY (Materials to Avoid)

No incompatibilities have been identified.

HAZARDOUS DECOMPOSITION PRODUCTS

Thermal decomposition may form: Acetic acid and Acrolein. Thermal decomposition may produce various hydrocarbons and irritating, acrid vapors.

HAZARDOUS POLYMERIZATION

Will not occur

CONDITIONS TO AVOID

Freezing temperatures (until cured).

SECTION 11 - TOXICOLOGICAL PROPERTIES

ACUTE EYE TOXICITY

No Information is available.

ACUTE ORAL TOXICITY

No Information is available.

ACUTE SKIN TOXICITY

No Information is available.

ACUTE INHALATION TOXICITY

No Information is available.

CHRONIC/CARCINOGENICY

This material **does not** contain 0.1% or more of any chemical listed by the International Agency for Research on Cancer (IARC), the National Toxicology Program (NTP), or regulated by the Occupational Safety and Health Administration (OSHA) as a carcinogen.

SECTION 12 - ECOLOGICAL INFORMATION

ECOTOXICITY

Common Name	Species	Test	Result	Concentration
Green Algae	Raphidocelus Subcapitata	96-hr chronic LC50	>1,000	Undiluted
Fathead Minnow	Pimephales Promelas	96-hr acute LC50	>1,208	Undiluted
Rainbow Trout	Oncorhynchus Mykiss	96-hr acute LC50	>1,000	Undiluted

ENVIRONMENTAL FATE

No data is available.

SECTION 13 - DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD

This material **is not** a RCRA hazardous waste. Disposal of this material is not regulated under RCRA. Consult federal, state and local regulations to ensure that this material and its containers, if discarded, is disposed of in compliance with all regulatory requirements. NOTE: As supplied or diluted, product material (foam included), when splashed on automobiles or other personal property, is difficult to remove if allowed to dry.

RCRA HAZARD CLASS

This material **is not** a RCRA hazardous waste. When discarded in its purchased form, this material would not be regulated as a RCRA Hazardous waste under 40 CFR 261.

SECTION 14 - TRANSPORT INFORMATION

DOT NON-BULK SHIPPING NAME	Refer to Bill of Lading - Not DOT Regulated // Keep From Freezing // Not dangerous goods
DOT BULK SHIPPING NAME	Refer to Bill of Lading.
IMO SHIPPING DATA	Refer to Bill of Lading.
ICAO/IATA SHIPPING DATA	Refer to Bill of Lading - Not IATA Regulated // Keep From Freezing // Not dangerous goods
CFR	Not Regulated // Keep From Freezing // Not dangerous goods
IMDG	Not Regulated // Keep From Freezing // Not dangerous goods
CTC	Not Regulated // Keep From Freezing // Not dangerous goods

SECTION 15 - REGULATORY INFORMATION

TSCA SECTION 8(b) INVENTORY STATUS

All components are included in the EPA Toxic Substances Control Act (TSCA) Chemical Substance Inventory.

TSCA SECTION 12(b) EXPORT NOTIFICATION

This material **does not** contain any components that are subject to the U.S. Toxic Substances Control Act (TSCA) Section 12 (b) Export Notification requirements.

OSHA Hazard Communication Standard (29CFR1910.1200) hazard class(es)

This material **is not** classified as hazardous under the criteria of the U.S. Occupational Safety and Health Administration (OSHA) Hazard Communication Standard, 29 CFR 1910.1200

EPA SARA Title III Section 304 CERCLA

Reportable quantities have not been established for any of this material's components.

EPA SARA Title III Section 311/312 HAZARD COMMUNICATION STANDARD (HCS)

This material **is not** a hazardous chemical.

EPA SARA Title III Section 313 TOXIC CHEMICAL LIST (TCL)

This product **does not** contain Section 313 Reportable Ingredients.

CANADIAN INVENTORY STATUS

All components of this material are listed on the Canadian Domestic Substances List (DSL)

CANADIAN WHMIS

This material **is not** classified as a controlled product under the Canadian Workplace Hazardous Material Information System.

ADDITIONAL CANADIAN REGULATORY INFORMATION

This product **does not** contain a substance present on the WHMIS Ingredient Disclosure List (IDL) which is at or above the specified concentration limit.

EUROPEAN INVENTORY STATUS (EINECS)

The polymer portion of this product is manufactured from reactants which are listed on EINECS and meets the EINECS definition of an exempt polymer.

AICS (Australia)

Included on inventory

ENCS (Japan)

Included on inventory

ECL (South Korea)

Included on inventory

SEPA (China)

Included on inventory

800.545.5420 USA
001.480.545.5454 International
www.soilworks.com
1750 E Northrop Blvd, Ste 250
Chandler, AZ 85286 USA
info@soilworks.com

SECTION 16 – OTHER INFORMATION

HMIS and NFPA Classification

Health	: 1
Flammability	: 0
Reactivity	: 0
Special Hazard	: 0

Soiltac

Direct contact with this material may cause eye irritation including lychrymation (tearing). Flush eyes with water for at least 15 minutes. Get medical attention.

Inhalation of vapor or aerosol may cause irritation to the respiratory tract. Move patient to fresh air. If breathing has stopped or is labored give assisted respiration. Supplemental oxygen may be indicated. Seek medical advice.

Contact may cause skin irritation. Remove contaminated clothing and shoes. Wash affected area with soap and water. Get medical attention if irritation develops or persists.

Soilworks, 7580 N Dobson Rd, Ste 320, Scottsdale, AZ, 800-545-5420, US, 800-545-5420

Soiltac

Direct contact with this material may cause eye irritation including lychrymation (tearing). Flush eyes with water for at least 15 minutes. Get medical attention.

Inhalation of vapor or aerosol may cause irritation to the respiratory tract. Move patient to fresh air. If breathing has stopped or is labored give assisted respiration. Supplemental oxygen may be indicated. Seek medical advice.

Contact may cause skin irritation. Remove contaminated clothing and shoes. Wash affected area with soap and water. Get medical attention if irritation develops or persists.

Soilworks, 7580 N Dobson Rd, Ste 320, Scottsdale, AZ, 800-545-5420, US, 800-545-5420

SOILWORKS®

SOILTAC®

Vinyl Copolymer Soil Stabilizer & Dust Control Agent

Volume*: 275 gal (1,041 L)

Gross Weight*: 2,600 lb (1,180 kg)

Dimensions*: 40 x 48 x 42 in (100 x 120 x 116 cm)

*Specifications are approximate

- **Read Material Safety Data Sheet before using this product**
- **Keep out of reach of children**
- **For industrial and professional use only**
- **Protect from Freezing**

FIRST AID

Inhalation: no treatment necessary under normal conditions of use. If symptoms persist, obtain medical advice. Skin: Remove contaminated clothing. Flush exposed area with water and follow by washing with soap. Eyes: flush with copious quantities of water. If persistent irritation occurs, obtain medical attention. Ingestion: if swallowed, do not induce vomiting; transport to nearest medical facility for additional treatment.

SPILLS

Slippery when spilled. Avoid accidents and clean up immediately. Prevent from spreading or entering drains, ditches or open bodies of water by making a barrier with sand, earth or other containment material. Reclaim liquid directly or in an absorbent such as clay, sand or other suitable material and dispose of properly.

HMIS	Health	Fire	React	Special
	0	0	0	-

GSA Contract Holder
Contract GS-07F-5364P

Manufactured & Distributed by
Soilworks, LLC
Soil Stabilization & Dust Control
7580 N Dobson Rd, Ste 320, Scottsdale, AZ 85256
800.545.5420 USA | 001.480.545.5454 International
www.soilworks.com | info@soilworks.com
NSN: 6850-01-519-4708 | Cage Code: 3FTH5 | DUNS: 13-19-46159

DUST CONTROL

MATERIAL SAFETY DATA SHEET

NAME OF PRODUCT *COHEREX*

FILE NUMBER: 1900
DATE PREPARED: 8/09/05

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME:	COHEREX
SYNONYMS:	PETROLEUM EMULSION
PRODUCT CODES:	1900
MANUFACTURER:	TRICOR REFINING, LLC
DIVISION:	BAKERSFIELD
ADDRESS:	P.O. BOX 5877, BAKERSFIELD, CA 93388
EMERGENCY PHONE:	(661) 393-7110
PREPARED BY:	TRICOR REFINING, LLC HEALTH, SAFETY AND ENVIRONMENTAL DEPARTMENT

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM

HMIS® HAZARD RATING		
4 - SEVERE	HEALTH	1 *
3 - SERIOUS	FLAMMABILITY	0
2 - MODERATE	REACTIVITY	0
1 - SLIGHT		
0 - MINIMAL		

SECTION 2: HAZARDOUS INGREDIENTS / IDENTITY INFORMATION

CHEMICAL FAMILY: PETROLEUM HYDROCARBON IN WATER EMULSION

HAZARDOUS COMPONENT(S)	CAL-OSHA PEL-TWA (8 HOUR)	ACGIH TLV TWA (8 HOUR)	OTHER LIMITS RECOMMENDED	% BY WEIGHT
Heavy Naphthenic Distillate Solvent Extract CAS No. 64742-11-6	5 mg/m³ (As mineral oil mist)	5 mg/m³ (As mineral oil mist)	None	100

SECTION 3: HEALTH HAZARDS IDENTIFICATION

ROUTES OF ENTRY:	EYES: Yes	SKIN: Yes	INGESTION: Yes	INHALATION: Yes

HEALTH HAZARDS (ACUTE AND CHRONIC):

EYES: No data available.

SKIN: Prolonged skin contact may cause irritation.

INGESTION: This product is not expected to be acutely toxic by ingestion. If swallowed, do not induce vomiting. Call a physician.

INHALATION: Remove the person to fresh air if respiratory discomfort occurs.

CARCINOGENICITY: ACGIH, NTP, OSHA and IARC carcinogen lists were checked for those components with CAS Registry Numbers 64742-11-6.

ACGIH: This product contains no ingredients classified as carcinogens.

IARC: This product contains petroleum oils similar to ones categorized by the International Agency for Research on Cancer as causing skin cancer in laboratory animals when the oil was repeatedly applied for most of the lifetime of the animal with no effort made to remove the oil between applications. Handling instructions and precautions outlined in this MSDS should be followed when handling this product.

NTP: This product contains no ingredients classified as carcinogens.

OSHA: This product contains no ingredients classified as carcinogens.

CA PROP 65: This product contains chemicals in trace quantities that are on the California Proposition 65 List.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE:
Persons susceptible to dermatitis (skin rash) may aggravate their condition by skin contact with this product.

SECTION 4: EMERGENCY AND FIRST AID MEASURES

EYES: Immediately flush eyes with water for a minimum of 15 minutes. Seek medical attention immediately.

SKIN: Wash with soap and water.

INGESTION: Contact a physician immediately.

INHALATION: If operating conditions create airborne concentrations that exceed the exposure standard, move the person to fresh air. Administer CPR if required. Provide oxygen if breathing is difficult. Seek medical attention immediately.

SECTION 5: FIRE AND EXPLOSION HAZARD DATA

FLAMMABLE LIMITS IN AIR, (% BY VOLUME) UPPER: No data available
LOWER: No data available
FLASH POINT: COC °F: Not applicable
EXTINGUISHING MEDIA: Foam, water fog, dry chemical, CO_2
SPECIAL FIRE FIGHTING PROCEDURES: None
HAZARDOUS DECOMPOSITION PRODUCTS:
Normal combustion forms carbon dioxide and water vapor, and may produce oxides of sulfur and nitrogen. Incomplete combustion can produce carbon monoxide.

SECTION 6: SPILL OR LEAK PROCEDURES

ACCIDENTAL RELEASE MEASURES: In case of spill, clean up using absorbent material such as earth or sand. If spilled into the water, remove the bulk of the product by skimming. If spilled into a navigable waterway in the United States or that may enter the United States, and a film, sheen or discoloration of any water surface is observed, the spill must be reported to the United States National Response Center by calling (800) 424-8802.

WASTE DISPOSAL METHOD: Dispose of in accordance with all applicable Federal, Provincial and Local Regulations.

SECTION 7: HANDLING AND STORAGE

HANDLING AND STORAGE: Avoid fire, sparks or open flame. Wear appropriate personal protective equipment to ensure that this product does not contact the eyes or skin.

VENTILATION: Use adequate ventilation to keep the airborne concentrations of this material below the established exposure limits.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

RESPIRATORY PROTECTION: If operating conditions create airborne concentrations that exceed the exposure standard for mineral oil mists, the use of an approved NIOSH/OSHA respirator for organic vapors or air supplied breathing equipment is recommended.

EYE PROTECTION: Wear appropriate safety glasses, goggles or face shield.

SKIN PROTECTION:	Long sleeve cotton shirt and cotton pants are recommended. Wear appropriate gloves.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE:	N/T (non Transparent) Yellow
ODOR:	Petroleum Odor
PHYSICAL STATE:	Liquid
INITIAL BOILING POINT:	Greater than 100 ◈ C (212 ° F)

VAPOR PRESSURE (mmHg):	Same as water	**PERCENT VOLATILE (% BY VOL.):**	NA
VAPOR DENSITY (AIR = 1):	Same as water	**EVAPORATION RATE (WATER = 1):**	1
SPECIFIC GRAVITY (H_2O = 1):	1.0	**SOLUBILITY IN WATER:**	Readily dispersible

SECTION 10: REACTIVITY DATA

STABILITY:	Stable
CONDITIONS CONTRIBUTING TO INSTABILITY:	None
INCOMPATIBILITY (MATERIAL TO AVOID):	May react with strong oxidizers.
HAZARDOUS DECOMPOSITION OR BY-PRODUCTS:	Normal combustion forms carbon dioxide and water vapor, and may produce oxides of sulfur and nitrogen. Incomplete combustion can produce carbon monoxide.
HAZARDOUS POLYMERIZATION:	Will not occur

SECTION 11: TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION	Not regulated as a hazardous material for transportation.

SECTION 12: REGULATORY INFORMATION

U.S. FEDERAL REGULATIONS:

TSCA (TOXIC SUBSTANCE CONTROL ACT) REGISTRY: Listed

CERCLA (COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION AND LIABILITY ACT):

Petroleum emulsions are not a hazardous substance under CERCLA.

SARA TITLE III (SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT):

Section 302/304: Petroleum emulsions are not a hazardous chemical under 40 CFR Part 355. Petroleum emulsions are not listed as an extremely hazardous substance in 40 CFR Part 355, and are not known to contain an extremely hazardous substance in a concentration greater than one percent by weight.

Section 311/312:

Acute Health Hazard:	No
Chronic Health Hazard:	Yes
Fire Hazard:	No
Pressure Release Hazard:	No
Reactivity Hazard:	No

Section 313: This product is not known to contain any components in concentrations above *de minimus* levels that are listed as toxic in 40 CFR Part 372 pursuant to the requirements of Section 313 of SARA.

WHMIS: D2A

OSHA: 29 CFR 1910.1200 (Hazard Communication) required

UNITED STATES REGULATIONS: Mineral oil, petroleum extracts, heavy naphthenic distillate solvent appears on one or more of the hazardous substances lists in the following states:

MA

The information provided in this Material Safety Data Sheet is believed to be accurate and reliable on and as of the date on page one. **However, this Material Safety Data Sheet is not a guarantee or warranty of any kind, express or implied. Any and all warranties of merchantability and/or fitness for a particular purpose are specifically disclaimed.** It is the user's responsibility to determine the conditions under which the product is used, including the selection of engineering controls, work practices and Personal Protective Equipment to minimize hazards.

coherex

Skin: Prolonged skin contact may cause irritation. Wash with soap and water.

Ingestion: If swallowed call a physician. Do not induce vomiting.

Inhalation: Remove the person to fresh air if respiratory discomfort occurs. Administer CPR if required. Provide oxygen if breathing is difficult. Seek Medical attention immediately.

Eyes: Immediately flush eyes with water for at least 15 minutes. Seek medical attention immediately.

Tricor Refining LLC, P.O. Box 5877, Bakersfield, CA, 93388, US, 661-393-7110

coherex

Skin: Prolonged skin contact may cause irritation. Wash with soap and water.

Ingestion: If swallowed call a physician. Do not induce vomiting.

Inhalation: Remove the person to fresh air if respiratory discomfort occurs. Administer CPR if required. Provide oxygen if breathing is difficult. Seek Medical attention immediately.

Eyes: Immediately flush eyes with water for at least 15 minutes. Seek medical attention immediately.

Tricor Refining LLC, P.O. Box 5877, Bakersfield, CA, 93388, US, 661-393-7110

GOLDEN BEAR
OIL SPECIALTIES

COHEREX®
Dust Control Agent and Base

Golden Bear Oil Specialties
PO Box 456, Chandler, AZ 85244-0161 Tel: (800) 456-3878 Fax: (480) 963-2270

Specifications: Coherex Dust Control Agent

Tests:	Test Method ASTM	AASHTO	Requirements Min.	Max.
Viscosity @ 25°C, SFS	D-244	T-59	15	40
Sieve Test, % w[1]	D-244	T-59	---	0.1
Residue, % w[2]	D-244	T-59	60	65
Particle Charge Test	D-244	T-59	Positive	

[1]Test procedure identical with ASTM except that distilled water shall be used in place of 2% sodium oleate solution.

[2]ASTM D-244 Evaporation Test for percent of residue is modified by heating 50 gram sample to 149°C (300°F) until foaming ceases, then cooling immediately and calculating results.

Note: For gal/ton conversion use 242 gal/ton.

Specifications: Coherex Base

Tests:	Test Method ASTM	AASHTO	Requirements Min.	Max.
Viscosity @ 100°C, cSt	D-445	----	17.17	23.83
Flash Point, COC, °C	D-92	T-48	208	-----
Asphaltenes, %w	D-2006-70	----	----	0.75
Saturated Hydrocarbons, %w	D-2006-70	----	----	20
Specific Gravity	D-1298	T-277	1.000	1.040

Note: Data presented are typical. Slight variation may occur from lot to lot.

SAFETY DATA SHEET

1. Product and Company Identification

Product identifier — **Calcium Chloride**

Other means of identification — IceAway Max
Safe Step Extreme 7300 Calcium Chloride

Recommended use — De-icer.

Recommended restrictions — None known.

Manufacturer — Compass Minerals International
9900 West 109th Street, Suite 100
Overland Park, KS 66210 US
Phone 913-344-9200
Emergency US CHEMTREC 1-800-424-9300
Emergency Canada CANUTEC 1-613-996-6666

CHEMTREC — 1-800-424-9300

CANUTEC — 1-613-996-6666

2. Hazards Identification

Physical hazards — Not classified.

Health hazards

Acute toxicity, oral	Category 4
Serious eye damage/eye irritation	Category 2A

Environmental hazards — Not classified.

OSHA defined hazards — Not classified.

Label elements

Signal word — Warning

Hazard statement — Harmful if swallowed.
Causes serious eye irritation.

Precautionary statement

Prevention — Wash thoroughly after handling.
Do not eat, drink or smoke when using this product.
Wear eye/face protection.

Response — If swallowed: Call a poison center/doctor if you feel unwell. Rinse mouth.
If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical advice/attention.

Storage — Store away from incompatible materials.

Disposal — Dispose of contents/container in accordance with local/regional/national/international regulations.

Hazard(s) not otherwise classified (HNOC) — None known.

Supplemental information — 100% of the mixture consists of component(s) of unknown acute inhalation toxicity.

3. Composition/Information on Ingredients

Mixture

Chemical name	Common name and synonyms	CAS number	%
Calcium chloride		10043-52-4	60-100

Composition comments — US GHS: The exact percentage (concentration) of composition has been withheld as a trade secret in accordance with paragraph (i) of §1910.1200.

4. First Aid Measures

Inhalation — If symptoms develop move victim to fresh air. If symptoms persist, obtain medical attention.

Skin contact — Flush with cool water. Wash with soap and water. Obtain medical attention if irritation persists.

Eye contact — If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical advice/attention.

Ingestion	If swallowed: Call a poison center/doctor if you feel unwell. Rinse mouth.
Most important symptoms/effects, acute and delayed	Symptoms may include stinging, tearing, redness, swelling, and blurred vision.
Indication of immediate medical attention and special treatment needed	Treat patient symptomatically.
General information	Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. Show this safety data sheet to the doctor in attendance. Avoid contact with eyes. Keep out of reach of children.

5. Fire Fighting Measures

Suitable extinguishing media	Dry chemical, CO2, water spray or regular foam.
Unsuitable extinguishing media	Not available.
Specific hazards arising from the chemical	Firefighters should wear a self-contained breathing apparatus.
Special protective equipment and precautions for firefighters	Firefighters should wear full protective clothing including self contained breathing apparatus.
Fire-fighting equipment/instructions	In the event of fire, cool tanks with water spray. Cool containers with flooding quantities of water until well after fire is out.
Specific methods	Use standard firefighting procedures and consider the hazards of other involved materials.
General fire hazards	No unusual fire or explosion hazards noted.
Hazardous combustion products	May include and are not limited to: Hydrogen chloride. Chlorine gas. Calcium oxide
Explosion data	
Sensitivity to mechanical impact	Not available.
Sensitivity to static discharge	Not available.

6. Accidental Release Measures

Personal precautions, protective equipment and emergency procedures	Keep people away from and upwind of spill/leak. Keep out of low areas. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Ensure adequate ventilation. Local authorities should be advised if significant spillages cannot be contained. For personal protection, see section 8 of the SDS.
Methods and materials for containment and cleaning up	Before attempting clean up, refer to hazard data given above. Use broom or dry vacuum to collect material for proper disposal without raising dust. Rinse area with water. Prevent large spills from entering sewers or waterways. Contact emergency services and supplier for advice. For waste disposal, see section 13 of the SDS.
Environmental precautions	Do not discharge into lakes, streams, ponds or public waters.

7. Handling and Storage

Precautions for safe handling	Avoid contact with eyes. Avoid breathing dust. Use only with adequate ventilation. Wear appropriate personal protective equipment. Observe good industrial hygiene practices. Wash thoroughly after handling. When using do not eat or drink.
Conditions for safe storage, including any incompatibilities	Store in a closed container. Store away from incompatible materials (see Section 10 of the SDS). Keep out of reach of children.

8. Exposure Controls/Personal Protection

Occupational exposure limits	No exposure limits noted for ingredient(s).
Biological limit values	No biological exposure limits noted for the ingredient(s).

Exposure guidelines	TWA PEL: No specific limits have been established for calcium chloride (soluble substance). As a guideline, OSHA (United States) has established the following limits which are generally recognized for inert or nuisance dust. Particulates Not Otherwise Regulated (PNOR): 5mg/cu.m. Respirable Dust 8-Hour TWA PEL, 15mg/cu.m. Total Dust 8-Hour TWA PEL. TWA TLV: No specific limits have been established for calcium chloride (soluble substance). As a guideline, ACGIH (United States) has established the following limits which are generally recognized for inert or nuisance dust. Particulates (insolubles) Not Otherwise Classified (PNOC): 10mg/cu.m. Inhalable Particulate 8-Hours TWA TLV, 3mg/cu.m. Respirable Particulate TWA TLV.
Appropriate engineering controls	Ensure adequate ventilation.

Individual protection measures, such as personal protective equipment

Eye/face protection	Wear safety glasses with side shields (or goggles).
Skin protection	
Hand protection	Wear suitable gloves.
Other	As required by employer code.
Respiratory protection	Where exposure guideline levels may be exceeded, use an approved NIOSH respirator.
Thermal hazards	Not applicable.
General hygiene considerations	Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and immediately after handling the product. When using do not eat or drink.

9. Physical and Chemical Properties

Appearance	Pellets
Physical state	Solid.
Form	Solid.
Color	White
Odor	Odorless
Odor threshold	Not applicable
pH	Not available
Melting point/freezing point	1421.6 °F (772 °C)
Initial boiling point and boiling range	3515 °F (1935 °C)
Pour point	Not applicable
Specific gravity	Not available
Partition coefficient (n-octanol/water)	Not applicable
Flash point	Not applicable
Evaporation rate	Not applicable
Flammability (solid, gas)	Not applicable.

Upper/lower flammability or explosive limits

Flammability limit - lower (%)	Not available.
Flammability limit - upper (%)	Not available.
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	Not applicable
Vapor density	Not applicable
Relative density	0.75 g/cm3 @ 20°C
Solubility(ies)	745 g/l
Auto-ignition temperature	Not applicable
Decomposition temperature	Not available.
Viscosity	Not applicable

10. Stability and Reactivity

Reactivity	This product may react with oxidizing agents.
Possibility of hazardous reactions	Hazardous polymerization does not occur.

Chemical stability	Stable under recommended storage conditions.
Conditions to avoid	Do not mix with other chemicals.
Incompatible materials	Acids. Oxidizers. Hot water.
Hazardous decomposition products	May include and are not limited to: Chlorine gas. Calcium oxide. Hydrogen chloride.

11. Toxicological Information

Routes of exposure	Eye, Skin contact, Inhalation, Ingestion.

Information on likely routes of exposure

Ingestion	Not a normal route of exposure. May cause stomach distress, nausea or vomiting.
Inhalation	Not a normal route of exposure. May cause respiratory tract irritation.
Skin contact	No adverse effects due to skin contact are expected.
Eye contact	Causes serious eye irritation.
Symptoms related to the physical, chemical and toxicological characteristics	Symptoms may include stinging, tearing, redness, swelling, and blurred vision.

Information on toxicological effects

Acute toxicity	Harmful if swallowed.

Components	Species	Test Results
Calcium chloride (CAS 10043-52-4)		
Acute		
Dermal		
LD50	Rat	2630 mg/kg
Inhalation		
LC50	Not available	
Oral		
LD50	Mouse	1940 mg/kg
	Rat	1000 mg/kg

Skin corrosion/irritation	Prolonged skin contact may cause temporary irritation.
Exposure minutes	Not available.
Erythema value	Not available.
Oedema value	Not available.
Serious eye damage/eye irritation	Causes serious eye irritation.
Corneal opacity value	Not available.
Iris lesion value	Not available.
Conjunctival reddening value	Not available.
Conjunctival oedema value	Not available.
Recover days	Not available.

Respiratory or skin sensitization

Respiratory sensitization	Not available.
Skin sensitization	This product is not expected to cause skin sensitization.
Germ cell mutagenicity	Not classified.
Mutagenicity	Not classified.
Carcinogenicity	Not classified or listed by IARC, NTP, OSHA and ACGIH.
Reproductive toxicity	Not classified.
Teratogenicity	Not classified.
Specific target organ toxicity - single exposure	Not classified.
Specific target organ toxicity - repeated exposure	Not classified.
Aspiration hazard	Not classified.
Chronic effects	Not available.
Further information	Not available.

Name of Toxicologically Synergistic Products Not available.

12. Ecological Information

Ecotoxicity See below

Components		Species	Test Results
Calcium chloride (CAS 10043-52-4)			
Crustacea	EC50	Daphnia	52 mg/L, 48 Hours
Aquatic			
Fish	LC50	Fathead minnow (Pimephales promelas)	3930 - 5360 mg/l, 96 hours

Persistence and degradability No data is available on the degradability of this product.

Bioaccumulative potential No data available.

Mobility in soil No data available.

Mobility in general Not available.

Other adverse effects No other adverse environmental effects (e.g. ozone depletion, photochemical ozone creation potential, endocrine disruption, global warming potential) are expected from this component.

13. Disposal Considerations

Disposal instructions Dispose of contents/container in accordance with local/regional/national/international regulations.

Local disposal regulations Dispose in accordance with all applicable regulations.

Hazardous waste code The waste code should be assigned in discussion between the user, the producer and the waste disposal company.

Waste from residues / unused products Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).

Contaminated packaging Empty containers should be taken to an approved waste handling site for recycling or disposal. Since emptied containers may retain product residue, follow label warnings even after container is emptied.

14. Transport Information

General Canada: TDG Proof of Classification: In accordance with Part 2.2.1 (SOR/2014-152) of the Transportation of Dangerous Goods Regulations, we certify that the classification of this product is correct as of the SDS date of issue. If applicable, the technical name and the classification of the product will appear below.

U.S. Department of Transportation (DOT)

Not regulated as dangerous goods.

Transportation of Dangerous Goods (TDG - Canada)

Not regulated as dangerous goods.

15. Regulatory Information

Canadian federal regulations This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the SDS contains all the information required by the Controlled Products Regulations.

Canada Priority Substances List (Second List): Listed substance

Calcium chloride (CAS 10043-52-4) Listed.

WHMIS status Controlled

WHMIS classification Class D - Division 2B

WHMIS labeling

US federal regulations This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.
All components are on the U.S. EPA TSCA Inventory List.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

CERCLA Hazardous Substance List (40 CFR 302.4)

Not listed.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Not regulated.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories Immediate Hazard - Yes
Delayed Hazard - No
Fire Hazard - No
Pressure Hazard - No
Reactivity Hazard - No

SARA 302 Extremely hazardous substance No

SARA 311/312 Hazardous chemical No

SARA 313 (TRI reporting)

Not regulated.

Other federal regulations

Safe Drinking Water Act (SDWA) Not regulated.

Food and Drug Administration (FDA) Not regulated.

US state regulations This product does not contain a chemical known to the State of California to cause cancer, birth defects or other reproductive harm.

US - California Proposition 65 - Carcinogens & Reproductive Toxicity (CRT): Listed substance

Not listed.

US - Texas Effects Screening Levels: Listed substance

Calcium chloride (CAS 10043-52-4) Listed.

US. Massachusetts RTK - Substance List

Not regulated.

US. Pennsylvania RTK - Hazardous Substances

Not regulated.

US. Rhode Island RTK

Not regulated.

Inventory status

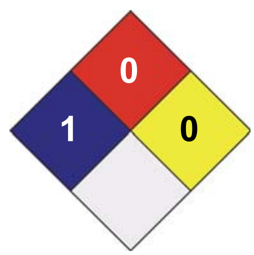
Country(s) or region	Inventory name	On inventory (yes/no)*
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)

16. Other Information

LEGEND	
Severe	4
Serious	3
Moderate	2
Slight	1
Minimal	0

HEALTH	/ 1
FLAMMABILITY	0
PHYSICAL HAZARD	0
PERSONAL PROTECTION	X



Disclaimer Information contained herein was obtained from sources considered technically accurate and reliable. While every effort has been made to ensure full disclosure of product hazards, in some cases data is not available and is so stated. Since conditions of actual product use are beyond control of the supplier, it is assumed that users of this material have been fully trained according to the requirements of all applicable legislation and regulatory instruments. No warranty, expressed or implied, is made and supplier will not be liable for any losses, injuries or consequential damages which may result from the use of or reliance on any information contained in this document.

Issue date 24-June-2015

Effective date 15-June-2015

Expiry date 15-June-2018

Further information For an updated SDS, please contact the supplier/manufacturer listed on the first page of the document.

Prepared by Dell Tech Laboratories, Ltd. Phone: (519) 858-5021

Other information

This Safety Data Sheet was prepared to comply with the current OSHA Hazard Communication Standard (HCS) adoption of the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).
This SDS conforms to the ANSI Z400.1/Z129.1-2010 Standard.

Calcium Chloride

Warning

Harmful if swallowed.
Causes serious eye irritation.

Wash thoroughly after handling Do not eat, drink or smoke when using this product. IF SWALLOWED: Immediately call a POISON CENTER/doctor if you feel unwell.. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Rinse Mouth. If eye irritation persists: Get medical advice/attention. Dispose of contents/ container in accordance with specified local/regional/national/ international regulations for disposal.

Store away from incompatible materials.

Tricor Refining LLC, P.O. Box 5877, Bakersfield, CA, 93388, US, 661-393-7110

Calcium Chloride

Warning

Harmful if swallowed.
Causes serious eye irritation.

Wash thoroughly after handling Do not eat, drink or smoke when using this product. IF SWALLOWED: Immediately call a POISON CENTER/doctor if you feel unwell.. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Rinse Mouth. If eye irritation persists: Get medical advice/attention. Dispose of contents/ container in accordance with specified local/regional/national/ international regulations for disposal.

Store away from incompatible materials.

Tricor Refining LLC, P.O. Box 5877, Bakersfield, CA, 93388, US, 661-393-7110