NPDES/SDS Permit Application

Volume V – Tailings Basin and Beneficiation Plant

Prepared for
Poly Met Mining, Inc.

POLYMET
MINING

July 2016

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NPDES/SDS Permit Application
Volume V – Tailings Basin and Beneficiation Plant

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List of Acronyms and Abbreviations

Acronym or Abbreviation	Description
BMP	Best Management Practice
CIP	Clean-in-Place
FEIS	Final Environmental Impact Statement
FTB	Flotation Tailings Basin
LTVSMC	LTV Steel Mining Company
MCL	Maximum Concentration Limit
MDNR	Minnesota Department of Natural Resources
MPCA	Minnesota Pollution Control Agency
NPDES	National Pollutant Discharge Elimination System
PMP	Probable Maximum Precipitation
SDS	State Disposal System
sMCL	Secondary Maximum Concentration Limit
SWPPP	Stormwater Pollution Prevention Plan
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WWTP	Waste Water Treatment Plant

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 Tailings Basin and Beneficiation Plant 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			
☒ Transmittal Form (wq-wwprm7-03) http://www.pca.state.mn.us/index.php/view-document.html?gid=6275 (For Transmittal Form: Refer to Volume I of this Permit Application.)	☐	☐	☐
☒ 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 V 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

Individual Industrial Stormwater Multi-Sector NPDES/SDS Permit Application

NPDES/SDS Wastewater Permit Program

Doc Type: Permit Application

Purpose: In addition to point source discharges, the National Pollutant Discharge Elimination System (NPDES)/State Disposal System (SDS) Permit Program regulates industrial stormwater (ISW) discharges to surface waters and land. This application applies to municipal and privately owned facilities which have Narrative Activities or a Primary Standard Industrial Classification (SIC) code listed in the *Individual Industrial Stormwater Multi-Sector Permit Application Instructions* and is requesting to incorporate their ISW permit requirements into their individual NPDES/SDS Permit. Please refer to the *Individual Industrial Stormwater Multi-Sector Permit Application Instructions* on the Minnesota Pollution Control Agency (MPCA) website at http://www.pca.state.mn.us/enzq915 detailed instructions.

Instructions: Complete the application by typing or printing in black ink. Attach additional sheets as necessary. 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. 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. **NPDES/SDS permit number:** MN TBD

1. Do you currently have coverage under the Industrial Stormwater Multi-Sector General Permit or have certified for No Exposure?

☐ Yes ☒ No **If yes**, please provide your permit ID: MNR **If no**, skip to 2.

Would you like to terminate your coverage under the Industrial Stormwater Multi-Sector General Permit and incorporate your permit requirements into your individual NPDES/SDS permit? ☐ Yes ☐ No

If no, stop here. You are responsible for maintaining compliance with the requirements of the Industrial Stormwater Multi-Sector General Permit.

2. Select all applicable Narrative Activities from the list below. If none are applicable, skip to 3.

Subsector	Subsector description	Check if applicable
A4	Timber products: discharges from wet decking storage areas	☐
C1	Runoff from phosphate fertilizer manufacturing facilities that comes into contact with any raw materials, finished product, by-products, or waste products	☐
D1	Runoff from asphalt paving and roofing material areas	☐
D2	Discharges from production of asphalt emulsions areas	☐
E2	Runoff from concrete and gypsum product manufacturing areas	☐
E3	Cement manufacturing facility, material storage runoff	☐
J1	Runoff from sand and gravel mining areas	☐
J2	Runoff from dimension, crushed stone, and nonmetallic mineral mining areas	☐
J4	Mine dewatering discharges at construction: sand and gravel, or industrial sand mining facilities	☐
K1	Hazardous waste treatment/storage/disposal facility for discharges not subject to effluent limitations in 40 CFR pt. 445, subp. A	☐
K2	Hazardous waste treatment/storage/disposal facility for discharges subject to effluent limitations in 40 CFR pt. 445, subp. A	☐
L1	Municipal solid waste landfill areas closed in accordance with 40 CFR 258.60	☐
L2	Open or closed non-hazardous waste landfill and land application site not discharging to surface water	☐
L3	Landfill that discharges to surface waters stormwater that has directly contacted solid waste	☐
O1	Coal fired and oil fired steam electric generating facility	☐
O2	Nuclear, natural gas fired, and any other fuel source used for steam electric generation	☐
O3	Runoff from coal storage piles at steam electric generating facility	☐
T1	Treatment works with design flow of one million gallons per day or more or are required to have an approved pretreatment program under 40 CFR pt. 403	☐

3. What is your facility's primary SIC code? 1021 (Active Metal Mining Facilities - Copper Ores)

(See the instructions for the definition of "primary" SIC Code.)

If your primary SIC code or Narrative Activity is not listed within the instructions, Stop here.
An application is not required; keep this document for your records.

4. List up to five additional authorized SIC codes from the instructions, if applicable:

1099 | 1041 | | | |

5. If you listed SIC codes 2869, 4512, 4513, 4522, or 4581 in 3 or 4, list the corresponding subsector:
(Examples: 2869-C7 or 4581-S2)

Not Applicable

6. What is the acreage of your *Industrial Activities*?

Round to one decimal place *(ex: 10.4):* 4,086.4

7. Briefly describe the *industrial activities* performed at this facility:

Industrial activities at the Tailings Basin include collection and distribution of water for the Beneficiation Plant. The Flotation Tailings Basin (FTB) will also store and settle out the Flotation Tailings.

The Beneficiation Plant will crush and grind the ore, then use a flotation process to separate the base and precious sulfide minerals from the tailings. Flotation Tailings will be pumped as a slurry to the FTB.

For further information, refer to Table 1-1 of this volume.

Relatively little precipitation or runoff associated with the Tailings Basin will be managed as industrial stormwater; most will be collected in the FTB Pond or the FTB seepage capture systems and managed as tailings basin water or tailings basin seepage as described in Section 2.3 of this volume.

Precipitation and runoff managed as industrial stormwater will primarily consist of runoff from some portions of the Tailings Basin dam exterior slopes and from the access roads surrounding the seepage capture systems, where not captured by the seepage capture systems.

8. No Exposure. Are any of the following materials or activities exposed to precipitation, now or in the foreseeable future?

Responses are for those areas of the Tailings Basin where precipitation and runoff will be managed as industrial stormwater.

A. Using, storing or cleaning industrial machinery or equipment, and areas where residuals from using, storing or cleaning industrial machinery or equipment remain and are exposed to stormwater	☐ Yes ☒ No
B. Materials or residuals on the ground or in stormwater inlets from spills or leaks	☐ Yes ☒ No
C. Materials or products from past industrial activity	☒ Yes ☐ No
D. Material handling equipment (except adequately maintained vehicles)	☐ Yes ☒ No
E. Materials or products during loading or unloading or transporting activities	☐ Yes ☒ No
F. Materials or products stored outdoors (except final products intended for outside use, such as new cars, where exposure to stormwater does not result in the discharge of pollutants)	☐ Yes ☒ No
G. Materials contained in open, deteriorated or leaking storage drums, barrels, tanks and similar containers	☐ Yes ☒ No
H. Materials or products handled or stored on roads or railways owned or maintained by the discharger	☐ Yes ☒ No
I. Waste materials (except waste in covered, non-leaking containers like a covered dumpster)	☐ Yes ☒ No
J. Application or disposal of process wastewater, unless otherwise permitted (If currently unpermitted, obtain NPDES/SDS permit coverage or authorization from your local Wastewater Treatment Facility)	☐ Yes ☒ No
K. Particulate matter or visible deposits of residuals from roof stacks and/or vents not otherwise regulated (i.e., under an air quality control permit) and evident in the stormwater outflow	☐ Yes ☒ No

If you checked "yes" to any question(s) A-K, you are not eligible for the No Exposure exclusion. Go to 10.

If you checked "no" to all of the questions in A-K, you qualify for the No Exposure exclusion. Go to 9, sign, and submit form as part of the entire permit application packet to the MPCA.

9. No Exposure Owner and Operator Certification

I certify under penalty of law that I have read and understand the eligibility requirements for claiming a condition of ''no exposure'' and obtaining an exclusion from NPDES/SDS stormwater permitting; and that there are no discharges of storm water contaminated by exposure to industrial activities or materials from the industrial facility identified in this document.

I understand that I am obligated to submit a no exposure certification form once every five years to the NPDES/SDS permitting authority and, if requested, to the operator of the local Municipal Separate Storm Sewer Systems (MS4) into which this facility discharges.

I understand that I must allow the NPDES/SDS permitting authority, or MS4 operator where the discharge is into the local MS4, to perform inspections to confirm the condition of no exposure and to make such inspection reports publicly available upon request.

I understand that I must obtain coverage under an NPDES Permit prior to any point source discharge of storm water from the facility. I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted.

Based upon my inquiry of the person or persons who manage the system, or those persons directly involved in gathering the information, the information submitted is to the best of my knowledge and belief true, accurate and complete.

I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

(This certification is required by Federal Regulation 40 CFR 122.26(g)(4)(iv).)

Owner authorized signature:
(For No Exposure only)

Not Applicable (not applying for No Exposure)

Owner (please print): _____

Title: _____

Signature: _____

Date (mm/dd/yyyy): _____

Operator authorized signature:
(For No Exposure only)

Operator (if different): _____

Title: _____

Signature: _____

Date(mm/dd/yyyy): _____

If you were unable to certify for the No Exposure exclusion, continue.

10. Do industrial stormwater discharges flow from the facility to a regulated MS4?

☐ Yes ☒ No If Yes, name of Regulated MS4 Owner: _____

(Ex: St. Paul Municipal Stormwater)

11. List all surface waters that receive your industrial stormwater discharge.

Indicate below the name of surface water(s) and type of surface water (Fen, Ditch, Lake, Lake Trout Lake, Pond, River, Stream, Trout Stream, or Wetland) that receive your industrial stormwater discharges. If you are unsure of your receiving waters, the following website may be useful: http://viewer.nationalmap.gov/viewer/. Once you have found your location select the Hydro-NHD button in the upper right hand corner.

Name of surface water	Type of surface water

Runoff from the exterior slopes of the Tailings Basin South Dam will drain south and be managed with Plant Site industrial stormwater as described in Section 2.3.2 of Volume IV. Refer to the Individual Industrial Stormwater Multi-Sector NPDES/SDS Permit Application in Volume IV for surface waters that will receive the industrial stormwater discharge.

12. Monitoring location information.

List all Benchmark and Effluent Monitoring Locations. **A minimum of one monitoring location is required.** These monitoring locations apply to sheltered product/activity/waste storage areas as well. See instructions for clarification. Attach additional sheets as necessary.

#	Describe the location of the monitoring location	Latitude	Longitude	List Subsector of Narrative Activities and/or SIC Codes for monitoring location
1				
2				
3				
4				
5				
6				

Runoff from the exterior slopes of the Tailings Basin South Dam will drain south and be managed with Plant Site industrial stormwater as described in Section 2.3.2 of Volume IV. Refer to the Individual Industrial Stormwater Multi-Sector NPDES/SDS Permit Application in Volume IV for associated benchmark monitoring locations.

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**	**Average rate of use** (weight or volume per day)	**Maximum rate of use** (weight or volume per day)
SIPX (Sodium Isopropyl Xanthate) (Primary)	Collector: Selectively adsorb minerals based on hydrophobicity of the collector and mineral	Flotation Circuit, specifically the Flotation Roughers, Scavengers, and Cleaner Circuit	Continuous	2.74 tons/day (1,000 tons/year)	4.79 tons/day (1,750 tons/year)
PAX (Potassium Amyl Xanthate) (Potential Substitute)	Collector: Selectively adsorb minerals based on hydrophobicity of the collector and mineral	Flotation Circuit, specifically the Flotation Roughers, Scavengers, and Cleaner Flotation Cells	Continuous	2.74 tons/day (1,000 tons/year)	4.79 tons/day (1,750 tons/year)
MIBC (Methyl Isobutyl Carbinol, 100% Solution) (Primary)	Frother: Used to improve stability of froth bubbles as they rise through the flotation cells	Flotation Circuit, specifically the Flotation Roughers, Scavengers, and Cleaner Flotation Cells	Continuous	2.88 tons/day (1,050 tons/year)	4.11 tons/day (1,500 tons/year)
F-160-05 Frother (Potential Substitute)	Frother: Used to improve stability of froth bubbles as they rise through the flotation cells	Flotation Circuit, specifically the Flotation Roughers, Scavengers, and Cleaner Flotation Cells	Continuous	2.88 tons/day (1,050 tons/year))	4.11 tons/day (1,500 tons/year)
F-160-13 Frother (Potential Substitute)	Frother: Used to improve stability of froth bubbles as they rise through the flotation cells	Flotation Circuit, specifically the Flotation Roughers, Scavengers, and Cleaner Flotation Cells	Continuous	2.88 tons/day (1,050 tons/year)	4.11 tons/day (1,500 tons/year)
NALCO DVS4U038 (Potential Substitute)	Frother: Used to improve stability of froth bubbles as they rise through the flotation cells	Flotation Circuit, specifically the Flotation Roughers, Scavengers, and Cleaner Flotation Cells	Continuous	2.88 tons/day (1,050 tons/year)	4.11 tons/day (1,500 tons/year)
Copper Sulfate Pentahydrate	Activator: Used to increase the available adsorption sites on the mineral to allow	Flotation Circuit, specifically Scavenger Cells	Continuous	1.71 tons/day (625 tons/year)	2.05 tons/day (750 tons/year)

(Primary)	for adsorption by the Collector				
MagnaFloc 10 (Primary)	Flocculant: Promote flocculation of suspended particles in liquors	Flotation Circuit, specifically Concentrate Thickeners	Continuous	0.082 tons/day (30 tons/year)	0.14 tons/day (50 tons/year)
MagnaFloc 455 (Potential Substitute)	Flocculant: Promote flocculation of suspended particles in liquors	Flotation Circuit, specifically Concentrate Thickeners	Continuous	0.07 tons/day (25 tons/year)	0.14 tons/day (50 tons/year)
Neo NS 6655 (Potential Substitute)	Flocculant: Promote flocculation of suspended particles in liquors	Flotation Circuit, specifically Concentrate Thickeners	Continuous	0.07 tons/day (25 tons/year))	0.14 tons/day (50 tons/year)
NALCO 83949 (Potential Substitute)	Flocculant: Promote flocculation of suspended particles in liquors	Flotation Circuit, specifically Concentrate Thickeners	Continuous	0.07 tons/day (25 tons/year)	0.14 tons/day (50 tons/year)
NALCO 9877 PULV (Potential Substitute)	Flocculant: Promote flocculation of suspended particles in liquors	Flotation Circuit, specifically Concentrate Thickeners	Continuous	0.07 tons/day (25 tons/year)	0.14 tons/day (50 tons/year
CMC (Carboxyl Methyl Cellulose) (Tennapress PE26) (Primary)	Flocculant: Used to depress gangue minerals in flotation cells to improve selectivity towards Cu Ni minerals	Flotation Circuit, specifically Rougher and Pyrhotite Cleaner Flotation Cells	Continuous	3.29 tons/day (1,200 tons/year)	4.79 tons/day (1,750 tons/year)
Lime Slurry (Primary)	pH Modifier: Used to regulate pH in the Flotation Circuit	Flotation Circuit, specifically the Separation Cleaner Flotation Cells	Continuous	28.15 tons/day (10,274 tons/year)	41.10 tons/day (15,000 tons/year)

***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 V of the National Pollutant Discharge Elimination System (NPDES) / State Disposal System (SDS) Permit Application for Poly Met Mining, Inc.'s (PolyMet) NorthMet Project (Project), focuses on the Tailings Basin and Beneficiation Plant at the Plant Site. Refer to Section 2.0 of Volume I for discussion of the permitting approach for this permit application as it applies to the Tailings Basin and Beneficiation Plant.

The Beneficiation Plant will produce Flotation Tailings throughout 20 years of ore processing. Flotation Tailings are the materials remaining after metallic sulfide minerals are liberated from the finely ground ore in the flotation process. Flotation Tailings will be deposited in the Flotation Tailings Basin (FTB), which will be placed on top of a portion of the existing former LTV Steel Mining Company (LTVSMC) tailings basin. In this permit application, the "FTB" means the newly constructed NorthMet Flotation Tailings Basin, the "LTVSMC tailings basin" means the existing former LTVSMC tailings basin, and the "Tailings Basin" means the combined LTVSMC tailings basin and the FTB. Seepage from the Tailings Basin will be collected by the FTB Seepage Containment System and the FTB South Seepage Management System (collectively known as the FTB seepage capture systems).

Table 1-1 provides a high-level overview of the Beneficiation Plant and the Tailings Basin.

Table 1-1 Beneficiation Plant and Tailings Basin Summary

Beneficiation Plant and Tailings Basin Summary	
Purpose	To produce copper and nickel concentrates, and to safely contain Flotation Tailings generated by the Beneficiation Plant in a manner that results in compliance with applicable water quality standards at appropriate compliance points.
Location	At the Project Plant Site. The Beneficiation Plant is located at the former LTV Steel Mining Company (LTVSMC) taconite process plant area, and the Tailings Basin lies to the north (Large Figure 1).
Beneficiation Plant description	The Beneficiation Plant will crush and grind the ore, then use a flotation process to separate the base and precious minerals from the tailings. Flotation Tailings will be pumped as a slurry to the FTB. Water for use in Beneficiation Plant processes will be drawn primarily from the FTB Pond, supplemented as necessary with water from the Plant Reservoir.
Tailings Basin description	The FTB will be the primary collection and distribution facility for water used by the Beneficiation Plant. The FTB will be constructed atop a portion of the LTVSMC tailings basin. The LTVSMC tailings basin is divided into cells; Cell 1E, Cell 2E, and Cell 2W. The FTB will occupy Cells 1E and 2E. The FTB will expand from an area, measured at the crest of the dams, of about 530 acres at the beginning of operations to a maximum area of about 1,370 acres. FTB dams will be constructed using upstream methods.

Beneficiation Plant and Tailings Basin Summary	
FTB seepage capture systems	The FTB Seepage Containment System and the FTB South Seepage Management System (collectively known as the FTB seepage capture systems) will collect water seeping from the Tailings Basin via surface or shallow groundwater flow. The FTB Seepage Containment System will surround the western and northern sides and extend to a portion of the eastern side of the Tailings Basin. It will consist of a cutoff wall installed to the top of the bedrock, with a collection trench and drain pipe installed on the upgradient side (tailings basin side) of the cutoff wall. The FTB South Seepage Management System, which currently exists as the SD026 pumpback system, consists of a berm, trench, and pumpback system and collects seepage on the southern side of the FTB.
Water management and discharge	*Tailings basin water* will be recycled back to the Beneficiation Plant and will not be discharged during operations. Seepage will be collected and either returned to the FTB Pond or routed to the Waste Water Treatment Plant (WWTP).
Estimated commission	Mine Year 1(1)
Reclamation plan	Upland areas will be revegetated. Exposed beach areas and the pond bottom will be amended with bentonite to limit oxygen infiltration into the tailings. The FTB seepage capture systems will continue to operate, pumping seepage to the WWTP for treatment. Overflow from the FTB Pond will be prevented by pumping any excess pond water to the WWTP.
Long-term closure plan	The FTB seepage capture systems will continue to operate, pumping seepage to the WWTP for treatment. Overflow from the FTB Pond will be prevented by pumping any excess pond water to the WWTP. The ultimate objective is to transition from mechanical water treatment to a non-mechanical water treatment system. During long-term closure, if it can be demonstrated that water in the FTB Pond is *stormwater* and that it complies with applicable standards, then PolyMet could seek approval to allow excess pond water to discharge through the FTB Closure Overflow structure.

(1) Mine Year 1 is the year when blasting commences to access ore at the Mine Site.

This volume is organized in four sections:

Section 1.0 Provides an overview of the Tailings Basin and Beneficiation Plant and provides the water definitions specific to the volume.

Section 2.0 Describes water management and infrastructure at the Beneficiation Plant and Tailings Basin, including existing conditions, tailings and stormwater management and infrastructure, adaptive management, chemical additives, and reclamation and long-term closure.

Section 3.0 Summarizes the proposed monitoring plan for the Tailings Basin and Beneficiation Plant.

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

In accordance with Minnesota Rules, part 6132.0200, the FTB 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." The design of the FTB, and the Tailings Basin as a whole, 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 (1)). 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 (Section 6.5 of Reference (1)) and contingency mitigation (Section 6.6 of Reference (1)) as deemed necessary to maintain compliance (refer to Section 2.5 of this volume for further discussion).

Water management at the Beneficiation Plant and the Tailings Basin includes collection and management of *process water, tailings basin water*, and *tailings basin seepage*. The flow of water associated with the Tailings Basin and Beneficiation Plant 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 *process water*, *tailings basin water*, *tailings basin seepage*, and *stormwater*.

Table 1-2 provides definitions for the terms *treated mine water*, *process water*, *tailings basin water, tailings basin seepage, plant reservoir water, industrial stormwater, construction stormwater,* and *non-contact stormwater*, as well as notes regarding the definitions' application to specific facets at the Tailings Basin and Beneficiation Plant.

As part of this application, PolyMet requests:

- authorization to discharge *stormwater* associated with construction activities occurring during Project operations at the Tailings Basin under the Minnesota NPDES/SDS Construction Stormwater General Permit (Permit No. MNR100001). (Note: A separate application is being submitted requesting authorization to discharge *stormwater* associated with pre-operation construction activities at the Tailings Basin under the Construction Stormwater General Permit.)
- authorization to discharge *stormwater* associated with industrial activities at the Tailings Basin under the Minnesota NPDES/SDS Industrial Stormwater General Permit (Permit No. MNR050000).

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]	Tailings Basin Specifics
Treated Mine Water	Water routed from the Mine Site to the Tailings Basin via the Treated Water Pipeline.	(no additions to Project-Wide Definition)
Process Water	Water that has been used in the beneficiation process or hydrometallurgical process.	Water that has been used in the beneficiation process.
Tailings Basin Water	Water in the Tailings Basin Pond or in pores of the tailings, which includes the following sources: • *process water* resulting from the beneficiation process • *treated mine water* routed from the Mine Site via the Treated Water Pipeline • *tailings basin seepage* collected by the FTB seepage capture systems and returned to the Pond • treated effluent from the Sewage Treatment System • precipitation and runoff from areas tributary to the FTB Pond	The primary water source for the Beneficiation Plant.
Tailings Basin Seepage	*Tailings basin water* that infiltrates through Flotation Tailings, LTV Steel Mining Company (LTVSMC) tailings, or Tailings Basin dams and migrates through the base or the external dam faces of the Tailings Basin.	(no additions to Project-Wide Definition)
Plant Reservoir Water	Water collected and stored within the Plant Reservoir, which includes the following: • water pumped from Colby Lake • precipitation that falls on the Plant Reservoir	The make-up water source for the Beneficiation Plant.
Industrial Stormwater	*Stormwater* associated with industrial activities[2].	Includes precipitation and runoff from the Tailings Basin dam exterior slopes and from the access roads surrounding the seepage capture systems, where not captured by the seepage capture systems.
Construction Stormwater	*Stormwater* associated with construction activities[3].	(no additions to Project-Wide Definition)
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].	Does not include runoff from reclaimed Tailings Basin dam exterior slopes (refer to *industrial stormwater*).

(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 *process water* is managed as *process 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, operation, reclamation, and long-term closure 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 permit applications and issued permits, will be incorporated into an operations plan for use during operations, reclamation, and long-term closure phases of the Project. Refer to Section 1.10 of Volume I for a description of the Project phases.

To help the reviewer navigate the supporting material for Volume V of this NPDES/SDS Permit Application, Table 1-3 cross references key Tailings Basin and Beneficiation Plant-related topics, PolyMet Management Plans and Data Packages, sections of this narrative, and permit application requirements.

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

Facility Topic		Location of Relevant Details: Management Plan / Data Package		NPDES/SDS Volume V	Permit Application Form	Application Question
Applicable Standard Industrial Classification (SIC) Code(s) and/or Narrative Activities					Individual Industrial Stormwater Multi-Sector NPDES/SDS Permit Application (wq-wwprm7-60a)	2 through 5
Applicable Federal Effluent Limitation Guideline(s)						
Existing Conditions		NorthMet Project: Geotechnical Data Package Volume 1 – Flotation Tailings Basin (Reference (2))	Section 3.0	Section 2.1		
Beneficiation Plant	Facility Description	NorthMet Project: Project Description (Reference (3))	Section 4.3.2	Table 1-1, Section 2.2.1	Individual Industrial Stormwater Multi-Sector NPDES/SDS Permit Application (wq-wwprm7-60a)	7
	Raw Material Consumed	NorthMet Project: Project Description (Reference (3))	Section 4.3.2.6	Section 2.2.1		
	Product Produced	NorthMet Project: Project Description (Reference (3))	Section 4.3.2.5	Section 2.2.1		
	Operation Initiated	NorthMet Project: Project Description (Reference (3))	Section 4.3.2	Table 1-1, Section 2.2.1		
	Water Supply Source	NorthMet Project: Water Modeling Data Package Volume 2 – Plant Site (Reference (4))	Section 6.1.1	Section 2.2.1		
	Water Balance	NorthMet Project: Water Modeling Data Package Volume 2 – Plant Site (Reference (4))	Section 6.1.1	Section 2.2.1		
	Chemical Additives			Section 2.2.3	Industrial Chemical Additives Attachment (wq-wwprm7-48)	All
Flotation Tailings Characterization	Geochemical Characteristics	NorthMet Project: Waste Characterization Data Package (Reference (5))	Sections 5.0 and 10.0	Section 2.2.2		
	Geotechnical Characteristics	NorthMet Project: Geotechnical Data Package Volume 1 – Flotation Tailings Basin (Reference (2))	Section 5.3			
	Expected Contribution to Sulfate and Metal Loading	NorthMet Project: Water Modeling Data Package Volume 2 – Plant Site (Reference (4))	Section 6.4.2.5			
	Estimated Volume	NorthMet Project: Project Description (Reference (3))	Section 4.3.2.5			
Process Water				Section 2.3		
Tailings Basin	Facility Description	NorthMet Project: Flotation Tailings Management Plan (Reference (6))	Section 1.0	Table 1-1, Section 2.3.1	Individual Industrial Stormwater Multi-Sector NPDES/SDS Permit Application (wq-wwprm7-60a)	7
	Operation Initiated	NorthMet Project: Flotation Tailings Management Plan (Reference (6))	Section 1.0	Table 1-1		
	FTB Permit Application Support Drawings	NorthMet Project: Flotation Tailings Management Plan (Reference (6))	Attachment A	Appendix A		
	Dams	NorthMet Project: Flotation Tailings Management Plan (Reference (6))	Section 2.2 and Large Table 1	Section 2.3.1		
	FTB South Seepage Management System	NorthMet Project: Water Management Plan – Plant (Reference (1))	Sections 2.1.3 and 4.1.3	Table 1-1, Sections 2.3.3 and 2.3.3.2		

Facility Topic		Location of Relevant Details: Management Plan / Data Package		NPDES/SDS Volume V	Permit Application Form	Application Question
Tailings Basin (continued)	FTB Seepage Containment System	NorthMet Project: Water Management Plan – Plant (Reference (1))	Sections 2.1.4 and 4.1.4	Table 1-1, Sections 2.3.3 and 2.3.3.1		
	FTB Seepage Containment System Permit Application Support Drawings	NorthMet Project: Water Management Plan – Plant (Reference (1))	Attachment B	Appendix A		
	Flotation Tailings Transport and Deposition System	NorthMet Project: Flotation Tailings Management Plan (Reference (6))	Sections 2.3 and 4.2	Section 2.3.2		
	Water Balance	NorthMet Project: Water Modeling Data Package Volume 2 – Plant Site (Reference (4))	Section 6.1.5	Section 2.3.1		
	Construction	NorthMet Project: Flotation Tailings Management Plan (Reference (6))	Section 2.2.4	Section 2.3.1		
	Operational Plan	NorthMet Project: Flotation Tailings Management Plan (Reference (6))	Section 4.0			
	Reclamation and Long-Term Closure	NorthMet Project: Flotation Tailings Management Plan (Reference (6))	Section 7.0	Table 1-1, Section 2.3.4		
		NorthMet Project: Adaptive Water Management Plan (Reference (7))	Sections 5.1, 6.4, and 6.5			
		NorthMet Project: Reclamation Plan (Reference (8))	Section 4.1			
Stormwater Management and Infrastructure	Overall	NorthMet Project: Water Management Plan – Plant (Reference (1))	Section 2.4	Section 2.4	Individual Industrial Stormwater Multi-Sector NPDES/SDS Permit Application (wq-wwprm7-60a)	1 through 12
		NorthMet Project: Flotation Tailings Management Plan (Reference (6))	Section 2.5			
	Significant Materials			Section 2.4.1, Table 2-2	Individual Industrial Stormwater Multi-Sector NPDES/SDS Permit Application (wq-wwprm7-60a)	7 and 8
	Drainage Swale	NorthMet Project: Water Management Plan – Plant (Reference (1))	Section 2.5	Section 2.4.3		
	Receiving Waters			Section 2.4.2	Individual Industrial Stormwater Multi-Sector NPDES/SDS Permit Application (wq-wwprm7-60a)	11
Adaptive Management and Contingency Mitigation		NorthMet Project: Water Management Plan – Plant (Reference (1))	Sections 6.5 and 6.6	Section 2.5		
		NorthMet Project: Adaptive Water Management Plan (Reference (7))	Sections 4.0 and 5.0			
Monitoring	Baseline Surface Water Monitoring	NorthMet Project: Water Modeling Data Package Volume 2 – Plant Site (Reference (4))	Sections 4.4.1 and 4.4.4	Section 3.1.1		
	Baseline Groundwater Monitoring	NorthMet Project: Water Modeling Data Package Volume 2 – Plant Site (Reference (4))	Sections 4.3.1 and 4.3.4	Section 3.1.2		
	Proposed Monitoring Plan			Section 3.2	Individual Industrial Stormwater Multi-Sector NPDES/SDS Permit Application (wq-wwprm7-60a)	12
Groundwater Nondegradation				Section 4.0		

Gray shading indicates no corresponding reference material

2.0 Beneficiation Plant and Tailings Basin Water Management and Infrastructure

This section focuses on water management associated with the Beneficiation Plant and Tailings Basin during operations, specifically during the period covered by this permit application (approximately Mine Years 1 through 5). The following sub-sections describe:

- the existing site conditions (Section 2.1)
- the Beneficiation Plant (Section 2.2), including chemical additives proposed for use at the Beneficiation Plant (Section 2.2.3)
- the systems for managing tailings and associated water (Section 2.3), including an overview of plans for reclamation and long-term closure (Section 2.3.4)
- the stormwater management systems (Section 2.4)
- the adaptive management approach that can be used to modify tailings basin water management systems in response to site-specific conditions encountered during operations (Section 2.5)

Permit application support drawings for tailings basin water management systems are included in Appendix A.

2.1 Existing Conditions

2.1.1 Historic Conditions

The LTVSMC tailings basin was used by LTVSMC (and its predecessor Erie Mining Company) for disposal of taconite tailings. The facility was constructed in stages beginning in the 1950s. It was configured as three adjacent cells, identified as Cell 1E, Cell 2E, and Cell 2W, and was developed by first constructing perimeter starter dams and placing tailings from the iron-ore process directly on native material. Perimeter dams were initially constructed from rock, and subsequent dams were constructed of coarse tailings using upstream construction methods. The existing cells and dams are unlined and do not have a core or cutoff other than the fine tailings and slimes that deposited upstream (on the pond side) of the coarse tailings dams.

Historically most seepage from the LTVSMC tailings basin followed the northwesterly gradient in the surficial aquifer and eventually upwelled over a broad area encompassing the toes of the Tailings Basin dams and the wetlands located north and west of the Tailings Basin (surface seepage). A portion of the seepage (estimated to be less than 10%) remained as groundwater flow to the north, northwest, and west of the Tailings Basin (groundwater seepage) (Section 6.4 of Reference (4)). During LTVSMC operations, a system of ditches, pumps, and pipelines captured surface seepage at select locations along the toe of the Tailings Basin dams and returned it to the pond, however some surface seepage was uncontained.

LTVSMC tailings basin operations were discontinued in January 2001 and the basin has been inactive since, except for reclamation activities consistent with the Minnesota Department of Natural Resources (MDNR)-approved Closure Plan currently managed by Cliffs Erie, LLC (Cliffs Erie), and more recently,

activities associated with the April 6, 2010 Consent Decree between Cliffs Erie and the Minnesota Pollution Control Agency (MPCA). Since LTVSMC shut down, the surface seepage flow has decreased and many of the seeps are no longer flowing.

2.1.2 Current Conditions

The LTVSMC tailings basin is in the Embarrass River watershed. *Stormwater* drains to the interior of the basin from a tributary area bounded by the perimeter dam crests, high ground east of Cell 2E, high ground southeast of Cell 1E, and the Spring Mine Lake subwatershed east of Cell 1E. *Stormwater* runoff from the exterior slopes of the West and North Dams drains west-northwest toward Unnamed Creek and north towards Trimble Creek and Unnamed (Mud Lake) Creek. The south dam of Cell 2W drains south and west to the Emergency Basin and out to Unnamed Creek. *Stormwater* from high ground southeast of Cell 1E drains south toward Second Creek in the Partridge River watershed. Large Figure 2 shows existing stormwater conditions at the Plant Site, including the LTVSMC tailings basin.

There is no water ponded in Cell 2W; current groundwater elevations in Cell 2W are below the Tailings Basin surface. Ponds of water remain in Cells 1E and 2E. As it has historically, most seepage, eventually upwells over a broad area encompassing the toes of the Tailings Basin dams and the wetlands located north and west of the Tailings Basin (Attachment C of Reference (1)). Six surface seeps remain active: Seeps 20, 22 (upstream of Cliffs Erie NPDES/SDS Permit MN0054089 monitoring station SD004), and 24 (North Side Seep) on the northwestern corner of Cell 2W; Seep 30 on the northern side of Cell 2E, and Seeps 32 and 33 on the southern side of Cell 1E (upstream of Cliffs Erie NPDES/SDS Permit MN0042536 monitoring station SD026).

Seepage from active seeps is currently collected at three locations and pumped back into Cell 1E by pumpback systems installed in 2011 under the 2010 Consent Decree between Cliffs Erie and the MPCA. The pumpback systems that collect seepage upgradient of existing Cliffs Erie NPDES/SDS Permit MN0054089 monitoring stations SD004 and SD006 will be replaced by the FTB Seepage Containment System (Section 2.1.4 of Reference (1)). PolyMet will continue to operate the existing pumpback system that collects seepage from the southern side of the Tailings Basin upgradient of existing Cliffs Erie NPDES/SDS Permit MN0042536 monitoring station SD026; the system will be referred to as the FTB South Seepage Management System (Section 2.1.3 of Reference (1)). Large Figure 2 shows current conditions at the Tailings Basin, including the location of active seeps and existing pumpback systems.

In the time period after issuance of a permit to PolyMet and before the FTB Seepage Containment System is operational, PolyMet will continue to operate the existing pumpback systems in accordance with the schedule of compliance established under the Consent Decree between Cliffs Erie and the MPCA. The construction schedule for the FTB Seepage Containment System is presented in Section 2.3.3.3 of this volume.

2.2 Beneficiation Plant

2.2.1 Facility Description

The Beneficiation Plant will process ore to produce nickel and copper concentrates. Ore will be crushed at the Coarse Crusher Building, ground in the semi-autogenous grinding mill and ball mill at the Concentrator Building, and then sent to the Flotation Building. In flotation, the minerals containing base and precious metals will be separated from the tailings using a combination of flotation reagents. Inputs to the Beneficiation Plant will include ore delivered by rail from the Mine Site, water from the Tailings Basin and/or Plant Reservoir (*tailings basin water* and/or *plant reservoir water*), various process consumables as detailed in Section 4.3.2.6 of Reference (3), and chemical additives as described in Section 2.2.3 of this volume.

The Beneficiation Plant will require an annual average of approximately 13,800 gpm of water for processing. Nearly all this water (99%) will be piped with the tailings to the FTB; less than 1% will be lost to evaporation in the plant or included with the concentrate (Table 2-1 of Reference (1)).

Water for Beneficiation Plant processes will come primarily from the FTB Pond (*tailings basin water*). Other minor sources of water will include water in the raw ore, reagents, gland seals of slurry pumps, and other processes. Make-up water, as needed, will be drawn from the Plant Reservoir (*plant reservoir water*). The Plant Reservoir will be supplied with raw water pumped from Colby Lake under terms of a water appropriation permit. Make-up water demand will vary depending on factors such as precipitation and Project operations. The Beneficiation Plant demand for make-up water from Colby Lake will average about 560 gpm and will vary from about 25 gpm to about 1,750 gpm depending on the Mine Year (Section 6.1.5 of Reference (4)). The water balance of the Beneficiation Plant is discussed further as part of the overall water balance of the FTB (Section 2.3.1 of this volume).

The Beneficiation Plant will process approximately 32,000 tons of ore per day, and produce approximately 660 tons per day of copper and nickel concentrates and approximately 31,340 tons per day of Flotation Tailings (Section 4.3.2.5 of Reference (3)). Copper concentrates will be dewatered and shipped to customers via rail. Nickel concentrates will be dewatered and shipped directly to customers until the Hydrometallurgical Plant is built to process them on-site. Flotation Tailings will be slurried to the FTB.

2.2.2 Flotation Tailings Characterization

Flotation Tailings representative of the tailings expected from the Beneficiation Plant were produced during pilot-plant processing of Project ore samples in 2006, 2008, and 2009 (Section 2.1.1 of Reference (6)). The Flotation Tailings are composed primarily of plagioclase with lesser amounts of olivine and pyroxenes, and only very small amounts of sulfide minerals, which are of interest because of their potential to release sulfate and metals (Attachment L of Reference (2)). The flotation process is fine-tuned to maximize the capture of sulfide minerals, which are the source of the valuable copper, nickel, and platinum group elements, and minimize the amount lost to tailings.

The Flotation Tailings' potential effect on water quality will depend not only on their composition, but also on the overall geochemical environment. The rate at which constituents, such as sulfate and metals, are

released from the Flotation Tailings will vary depending on factors such as pH level and oxygen availability.

Samples of the Flotation Tailings were submitted for laboratory testing to determine geotechnical and geochemical parameters for use in water quality modeling and FTB planning. Results of geotechnical testing are presented in Section 5.3 of Reference (2). Results of ongoing kinetic testing to measure the release rates of constituents from the Flotation Tailings are presented in Section 5.1 of Reference (5). Ongoing testing of Flotation Tailings samples collected starting in 2006 has shown that samples containing higher sulfur content exhibit lower pHs and higher oxidation rates than samples with lower sulfur content; however, these tests have shown that the tailings will not generate acid: in eight years of testing no pH levels below 6 have been recorded (Section 5.1.4 of Reference (5)). Kinetic testing generally shows that metals leaching is stable or decreases over time, and that within the pH range expected for the FTB (above pH of approximately 7.0), metals leaching is not significantly affected by changes in humidity cell pH (Section 5.1.4 of Reference (5)). The Tailings Basin and associated water management systems have been designed based on the results of the eight years of characterization work on samples of Flotation Tailings.

The NorthMet Waste Characterization Data Package reports how geochemical test results were used in water quality modeling; refer to Section 10 of Reference (5). The expected contribution of the Flotation Tailings to the load of sulfate and metals in *tailings basin seepage* is described in Section 6.4.2.5 of Reference (4). Sources other than the Flotation Tailings that will contribute to the load of sulfate and metals in *tailings basin seepage* include the *tailings basin water* and the existing LTVSMC tailings.

2.2.3 Chemical Additives

Chemical additives will be used during flotation at the Beneficiation Plant to improve recovery of base and precious metals. Specifically each chemical additive will serve as one of the following:

- a collector to promote the adsorption of certain minerals
- a frother to improve froth bubble stability
- an activator to increase mineral adsorption sites
- a flocculant to promote flocculation of suspended particles
- a depressant for gangue minerals to improve selectivity towards copper and nickel minerals
- a pH modifier to regulate pH within the flotation circuit

The amount of each chemical needed in the process can be calculated and adjusted for the amount and characteristics of the ore being processed. As such, in order to maintain system efficacy and monitor costs, the minimal amount of chemicals will be used to provide the maximum metal recoveries.

Chemical additives will, for the most part, report to the flotation concentrate. However, low levels of some additives are expected to be present in the tailings slurry piped to the FTB. Most of the chemical additive

components present within the tailings slurry will biodegrade within the Tailings Basin. Chemical additives that do not biodegrade and that are transported with seepage will be collected by the FTB seepage capture systems (Section 2.3.3 of this volume) and routed to the Waste Water Treatment Plant (WWTP) for treatment. However, by design the WWTP does not remove all constituents, including some cations (i.e., K and Na). WWTP effluent may contain insignificant amounts of a few constituents that originated as chemical additives. Plant Site water modeling includes those additives that are expected to be present in WWTP influent, and the WWTP will be designed to treat all constituents necessary to meet permit conditions.

Additional information regarding proposed chemical additives that may be used in the flotation process is included in Large Table 1. Additionally, Safety Data Sheets and product information labels for each proposed chemical additive are included in Appendix B. Based on project economics and the availability of specific products, the same chemical additive may be acquired from multiple manufacturers provided that the chemical additive is commensurate with the chemical additive proposed within this application.

2.3 Tailings and Associated Water Management and Infrastructure

This section describes the design and operation of the infrastructure that will be used to manage Flotation Tailings, *tailings basin water,* and *tailings basin seepage* in accordance with applicable regulations. This infrastructure will be constructed or upgraded from existing conditions as necessary prior to commencement of Project operations.

From flotation, a slurry composed of *process water* and Flotation Tailings will be pumped to the FTB, where tailings will settle on beaches and at the bottom of the pond. Most water from the FTB Pond will be recycled to the Beneficiation Plant and some will infiltrate into the tailings. The FTB will be the primary collection and distribution point for water used in the beneficiation process. The FTB will receive *process water* from the Beneficiation Plant, *treated mine water* from the Mine Site via the TWP, precipitation, and *tailings basin seepage* collected by the FTB seepage capture systems (the FTB Seepage Containment System and the FTB Seepage Management System), along with other minor sources, as described in Table 2-1 of this volume. Water from the FTB Pond will be recycled back to the Beneficiation Plant.

The FTB is designed as a closed system. No discharge is planned. An emergency overflow will be provided as standard engineering practice for dam safety, but the FTB will be designed and operated with sufficient freeboard that there is a low likelihood of a precipitation event causing an overflow during the lifetime of the basin (Section 2.5 of Reference (6)). *Tailings basin seepage* will be collected by the FTB seepage capture systems. Refer to Section 6.1 of Reference (4) for the details of the Plant Site water balance, including the Tailings Basin.

The following sections describe the design and operation of the major components of the tailings and water management systems, which include the FTB (Section 2.3.1), systems for transport and deposition of Flotation Tailings (Section 2.3.2), and the FTB seepage capture systems (Section 2.3.3). Plans for reclamation and long-term closure are summarized in Section 2.3.4.

2.3.1 Flotation Tailings Basin

The FTB is designed to contain Flotation Tailings generated over 20 years of operation (Section 1.0 of Reference (6)). The basin is sized with sufficient freeboard and emergency overflow infrastructure to safely accommodate the 72-hour probable maximum precipitation (PMP) rainfall event (Sections 2.2.3 and 2.5 of Reference (6)). The PMP, which is defined as "the theoretically greatest depth of precipitation for a given duration over a particular drainage area…" is specified by the Office of Hydrology of the National Oceanic and Atmospheric Administration.

Three basic management techniques will be used to minimize the potential water resource impacts of the Flotation Tailings. First, the ore will be processed using a bulk sulfide flotation process to minimize the amount of sulfide minerals in tailings reporting to the FTB. Second, Flotation Tailings will be deposited as bulk tailings, rather than allowing coarse and fine tailings to segregate, because bulk tailings exhibit lower release rates of metals and other constituents than segregated tailings (Section 5.2 of Reference (5)). Third, FTB design includes features to minimize oxidation of the tailings (Section 2.2.4 of Reference (6)) because oxidation increases release rates of metals from the tailings.

FTB perimeter dams will be raised in an upstream construction method using compacted LTVSMC coarse tailings. Vegetation will be removed from the surface of the existing Tailings Basin in areas where dams will be constructed and tailings will be placed. A bentonite amended oxygen barrier layer will be placed on exterior sides of the FTB dams to limit oxidation of the tailings. The FTB dams are designed to meet all required factors of safety (Section 8.0 of Reference (2)), and will be constructed and operated in accordance with Minnesota state dam safety regulations (Section 2.0 of Reference (2)).

The facility will be constructed in stages, gradually increasing in elevation and size, as documented in Large Table 1 of Reference (6). Initially, Flotation Tailings will be placed in Cell 2E. Three dam lifts are planned during the first five years of operations. In Mine Year 7, after Lift 5 is finished, Cell 2E will merge with Cell 1E. Large Figure 3 shows the configuration of the Tailings Basin at the end of Mine Year 1. A total of eight dam lifts will be constructed during operations. Large Figure 4 shows the footprint of the FTB at the end of operations (Mine Year 20). For additional detail on the design of the FTB, refer to Section 2.2 of Reference (6). The FTB Permit Application Support Drawings are included in Appendix A.

The FTB Pond will receive water from a total of six sources during operations. These inflows and their relative volumes are shown in Table 2-1. This water supply to the FTB Pond will be sufficient to supply most of the Beneficiation Plant water demand. The overall water balance for the Tailings Basin (Section 6.1.5 of Reference (4)) shows that during operations the Project is a net consumer of water.

Table 2-1 FTB Pond Water Inflows during Operations

Water source	Description	Approximate relative percent of total inflow(1)
Beneficiation Plant	*Process water* directly to FTB Pond *Process water* runoff from FTB beaches	72%
Mine Site	*Treated mine water* via the TWP	10%
Precipitation	Direct precipitation and runoff from the Tailings Basin watershed	10%
Seepage Capture Systems	*Tailings basin seepage*, groundwater, and *stormwater* runoff from upgradient Tailings Basin dams	7%
Waste Water Treatment Plant (WWTP)	Greensand filter backwash and clean-in-place (CIP) membrane waste	1%
Sewage Treatment System	Treated effluent pumped to FTB Pond twice a year	0.1%

(1) Representative inflow during operations, in Mine Year 10 (Section 6.1.2 of Reference (4)). The proportion of various inflows will vary depending on operational factors and weather.

Inflows to the FTB Pond will be managed to keep the water level as high as possible without exceeding dam safety criteria. Setting the pond level as high as safely possible minimizes environmental impacts: smaller beaches minimize fugitive dust generation and reduce the potential for oxidation of exposed Flotation Tailings. FTB Pond level management is detailed in Section 4.2 of Reference (6). Additional details on the FTB Pond water balance are available in Section 6.1 of Reference (4).

No direct discharge from the FTB Pond is planned during operations. Seepage from the FTB Pond will be collected by the FTB seepage capture systems and either returned to the pond or treated at the WWTP prior to discharge from the WWTP (Section 2.3.3 of this volume). Discharge from the WWTP is described in Volume III.

The FTB is designed to prevent overflow. Dam raises are planned to provide ample freeboard to accommodate water level bounce from routine precipitation events (Section 4.2 of Reference (6)). The FTB Pond water level will be managed to maintain adequate freeboard by adjusting the relative amount of water routed back to the pond and sent to the WWTP. An emergency overflow for the FTB during operations will be provided for protection of the dams in the rare event that freeboard within the FTB is not sufficient to contain all *stormwater* from a PMP rainfall event. This is standard practice in dam design, to accommodate overflows in a manner that protects the integrity of the dams. The emergency overflow channel outlet is located near the headwaters of Unnamed (Mud Lake) Creek, as shown on Large Figure 3 and Large Figure 4. However, PMP rainfall events are rare and such an event has a low likelihood of being experienced during the life of the basin (Section 2.2.3 of Reference (6)). Therefore, no discharge from the FTB Pond is expected.

A geotechnical and dam safety monitoring program will be conducted to support long-term performance of the FTB, under the terms of a MDNR Dam Safety Permit (Section 5.0 of Reference (6)).

2.3.2 Flotation Tailings Transport and Deposition

Flotation Tailings will be pumped to the FTB in slurry form through a system of pumps and pipes. For approximately the first seven years of operation, the Flotation Tailings will be placed in Cell 2E. The design of the tailings transport and deposition system will be integrated with FTB dam design to define tailings discharge locations and system head.

The locations of the pipelines used to place the tailings in the FTB will evolve as operations continue. The system can be configured to deposit tailings by gravity flow over beaches or subaqueously in the FTB Pond. Roughly 30% of the tailings will be deposited on the beaches and 70% will be deposited subaqueously in the FTB Pond. Subaqueous deposition will spread tailings across the bottom of the pond without mixing with the pond water and minimize particle size segregation during deposition (Section 2.3 of Reference (6)).

A return water system will be constructed to recycle water from the FTB Pond for use in the Beneficiation Plant. As the dams are raised, the process water return pipeline will be moved to maintain the pipeline at or near the surface of the dam. Additional information on the Flotation Tailings transport and deposition systems is available in Section 2.3 of Reference (6).

2.3.3 FTB Seepage Capture Systems

Seepage from the northern, northwestern, western, and eastern sides of the Tailings Basin will be captured by the FTB Seepage Containment System (Section 2.3.3.1), and seepage from the southern side of the Tailings Basin will be collected by the FTB South Seepage Management System (Section 2.3.3.2). Much of the water collected by the FTB seepage capture systems will be returned to the FTB Pond for reuse at the Beneficiation Plant (Section 6.1.4 of Reference (4)). Water in excess of what can be reused will be pumped to the WWTP for treatment and discharged from the surface water discharge outfalls to Unnamed Creek, Trimble Creek, and Second Creek, as described in Section 2.4.3 of Volume III. The locations of the FTB seepage capture systems and surface water discharge outfalls are shown on Large Figure 3 and Large Figure 4.

2.3.3.1 FTB Seepage Containment System

Seepage from the LTVSMC tailings basin currently flows to the north and west as surface seepage or groundwater seepage; however, this seepage will be managed (collected and treated) when the FTB Seepage Containment System begins operation. The FTB Containment System will collect seepage along the northern, northwestern, western, and eastern toes of the Tailings Basin Dams. Along most of the eastern side of the Tailings Basin, high bedrock will prevent groundwater seepage; no dams are needed in these areas. The FTB Seepage Containment System will collect water seeping from the Tailings Basin via surface and shallow groundwater flow, as well as runoff from the exteriors of the dams on the northern, northwestern, western, and eastern sides of the Tailings Basin, and from the small watershed area between the toes of the dams and the FTB Seepage Containment System.

PolyMet will not deposit tailings in the FTB until the FTB Seepage Containment System along the northern and western sides of the Tailings Basin is fully functional. The segment along the eastern side of the

Tailings Basin will be constructed concurrently with the East Dam, prior to the time that FTB Cells 2E and 1E will merge. No seepage is reasonably expected along the eastern side of the Tailings Basin prior to the merging of FTB Cells 2E and 1E.

The FTB Seepage Containment System will consist of a cutoff wall (a low permeability hydraulic barrier) placed into the existing surficial deposits, with a drainage collection system installed on the upgradient side, as shown in Figure 2-1 of Reference (1). The drainage collection system will have a collection trench filled with granular drainage material and a perforated drain pipe located near the bottom of the trench. Vertical risers extending above ground surface from the drain pipe will collect runoff and surface seepage discharging upgradient of the FTB Seepage Containment System. Refer to Sections 2.1.4 and 4.1.4 of Reference (1) for additional information on the design and operation of the FTB Seepage Containment System. The FTB Seepage Containment System Permit Application Support Drawings are included in Appendix A.

The FTB Seepage Containment System will draw down the water table on the Tailings Basin side of the cutoff wall, maintaining an inward gradient and mitigating the potential for seepage to pass through the cutoff wall (i.e., any seepage through the cutoff wall will be inward into the FTB Seepage Containment System). The cutoff wall will be extended to bedrock in order to minimize the amount of water drawn inward. Groundwater flow modeling indicates that the FTB Seepage Containment System will collect 100% of surface seepage and at least 93% of the groundwater seepage that would otherwise flow to the north, northwest, or west of the Tailings Basin (Attachment C of Reference (1)). Hydrologic assessment indicates that the eastern portion of the FTB Seepage Containment System will have 100% capture efficiency (Section 2.1.4 of Reference (1)). Monitoring wells and piezometers will be installed along the length of the FTB Seepage Containment system to demonstrate its performance, as described in Section 3.2.2.4 of Volume I.

Eliminating the current discharge to the wetlands north and west of the Tailings Basin will significantly reduce inflow to downstream tributaries. To avoid hydrologic impacts to these tributaries, stream flow in Trimble Creek and Unnamed Creek will be augmented with treated water from the WWTP (refer to Section 2.4.3 of Volume III), and stream flow in Unnamed (Mud Lake) Creek will be augmented with *non-contact stormwater* routed via a drainage swale (refer to Section 2.4.3 of this volume).

2.3.3.2 FTB South Seepage Management System

Seepage along the southern side of the Tailings Basin has historically been limited to surface seepage, and it is expected that this will continue. The existing SD026 pumpback system currently collects surface seepage from the southern side of the Tailings Basin as part of the Consent Decree between Cliffs Erie and the MPCA, as described in Section 2.1.2 of this volume. During Project operations, PolyMet will continue to operate this system to collect seepage: it will be known as the FTB South Seepage Management System. Refer to Sections 2.1.3 and 4.1.3 of Reference (1) for additional information on the design and operation of the FTB South Seepage Management System.

Prior to the installation of the SD026 pumpback system in 2011, surface seepage from the southern side of the Tailings Basin was a major contributor to the headwaters of Second Creek. The FTB South Seepage

Management System will continue to collect this seepage, thus continuing to reduce stream flow in Second Creek from pre-Consent Decree levels. To counteract this reduction, stream flow in Second Creek will be augmented with treated water from the WWTP (refer to Section 2.4.3 of Volume III).

2.3.3.3 Construction Schedule

PolyMet will not deposit Flotation Tailings in the FTB until the portion of the FTB Seepage Containment System surrounding the northern, northwestern, and western sides of the Tailings Basin is fully functional. No seepage is reasonably expected along the eastern side of the Tailings Basin prior to the merging of FTB Cells 2E and 1E in Mine Year 7. PolyMet will not merge cells 2E and 1E until the portion of the FTB Seepage Containment System on the eastern side of the Tailings Basin is fully functional. A network of monitoring wells and piezometers will be installed along the FTB Seepage Containment System to verify the performance of the FTB Seepage Containment System, as described in Section 3.2.2.4 of Volume I.

The construction schedule for the FTB Seepage Containment System and associated monitoring system will be based on the time of year the NPDES/SDS permit is issued, as well as receipt of all other necessary permits for this work to commence. Two construction seasons will be necessary to install the FTB Seepage Containment System and associated monitoring wells and test their performance.

2.3.4 Reclamation and Long-Term Closure

The Tailings Basin exterior slopes will be progressively reclaimed during operations. During construction, the exterior dam slopes will be amended with bentonite to limit oxygen infiltration and stabilized with vegetation (Section 7.1 of Reference (6)). For final reclamation, upland areas will be vegetated and exposed beaches will be amended with bentonite to limit oxygen infiltration (Section 7.2 of Reference (6)). The FTB Pond bottom will also be amended with bentonite. The bentonite-amended pond bottom will reduce the amount of water collected by the FTB seepage capture systems. It will also reduce the percolation from the FTB Pond, maintaining a permanent pond as an oxygen barrier above the Flotation Tailings to reduce oxidation, infiltration, and resultant production of chemical constituents (Section 5.1 of Reference (7)).

PolyMet will continue to operate the FTB seepage capture systems during reclamation and long-term closure. During reclamation, the WWTP will continue to treat water collected by the FTB seepage capture systems. FTB Pond overflow will be prevented by pumping any excess pond water to the WWTP. The long-term objective is to replace the WWTP with non-mechanical water treatment systems (Section 6.4 of Reference (7)); however the WWTP will be maintained operable through reclamation and long-term closure until non-mechanical systems are demonstrated and approved. During long-term closure, if it can be demonstrated that water in the FTB Pond is *stormwater* and that it complies with applicable standards, then PolyMet could seek approval to allow the pond to overflow (Section 6.5 of Reference (7)).

2.4 Stormwater Management and Infrastructure

This section describes the management of *stormwater* at the Tailings Basin, 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. *Stormwater* associated with the Beneficiation Plant is included in the discussion of Plant Site *stormwater* in Section 2.3 of Volume IV.

Consistent with the overall Project approach (Table 1-2 of this volume), *stormwater* at the Tailings Basin 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

Stormwater infrastructure will be constructed or upgraded from existing conditions as necessary 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 pre-operation construction activities at the Tailings Basin under the Construction Stormwater General Permit. Therefore, *stormwater* management during pre-operation construction is not discussed further in this section. 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 the Construction Stormwater Pollution Prevention Plan (SWPPP) and final engineering designs. If additional stormwater features are deemed necessary, additional site-specific information (e.g., depth to bedrock) will be required prior to final design. Such potential stormwater features have not yet been incorporated into the attached Permit Application Support Drawings.

Also as discussed in Section 1.0 of this volume, as part of this application PolyMet requests:

- authorization to discharge *stormwater* associated with construction activities occurring during Project operations at the Tailings Basin under the Construction Stormwater General Permit.
- authorization to discharge *stormwater* associated with industrial activities at the Tailings Basin under the Industrial Stormwater General Permit.

Stormwater associated with construction activities occurring during Project operations 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 SWPPP based on detailed construction plans and in accordance with Construction Stormwater General Permit requirements.

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. A draft outline of the Industrial SWPPP is included as Appendix C.

Relatively little precipitation or runoff associated with the Tailings Basin will be managed as *stormwater* (including *construction stormwater*, *industrial stormwater,* and *non-contact stormwater*). Most will be collected in the FTB Pond or the FTB seepage capture systems and managed as *tailings basin water* or *tailings basin seepage* as described in Section 2.3 of this volume. Precipitation that falls within the tributary area of the Tailings Basin will run off into the FTB Pond or infiltrate and be managed by the FTB seepage capture systems.

Stormwater drainage patterns at the Tailings Basin during operations are shown on Large Figure 4. Stormwater conditions during operations will be changed from existing conditions as follows:

- Precipitation that falls on the exterior dam faces on the northern, northwestern, western, and eastern sides of the Tailings Basin will be collected by the FTB Seepage Containment System.
- After the HRF is constructed, *stormwater* from a small drainage area on the southern exterior dam of Tailings Basin Cell 2W that currently flows northwest will be redirected to flow south and will be managed with Plant Site *industrial stormwater*, as described in Section 2.3.2 of Volume IV. Prior to the construction of the HRF, this *stormwater* will be collected by the FTB Seepage Containment System.
- After the South Dam of the FTB is constructed, runoff from the South Dam will flow to the south, into the depression at the base of the railroad embankment, and will be managed with Plant Site *stormwater*, as described in Section 2.3.2 of Volume IV.

Stormwater infrastructure associated with the Tailings Basin (described in Section 2.4.2) will take into account these changes to existing stormwater conditions, natural drainage patterns, and the potential for *stormwater* to contact significant materials (Section 2.4.1).

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 Tailings Basin and will be managed throughout of 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*.

Table 2-2 describes materials at the Tailings Basin that have the potential to come into contact with *stormwater*, indicates whether the corresponding *stormwater* will be managed as *tailings basin water*, *tailing basin seepage*, *construction stormwater*, or *industrial stormwater* (as defined in Table 1-2 of this

volume), and summarizes the associated management method(s). This information will also be included in the Industrial SWPPP that will be developed for the Plant Site, including the Tailings Basin.

Table 2-2 Significant Materials at the Tailings Basin that have the Potential to Contact Stormwater and Associated Management Methods

Material	Material description and stormwater pollution potential	Runoff will be managed as:	Management method(s)
Beneficiation Plant *Process Water*	*Process water* used to transport Tailings from the Beneficiation Plant to the FTB	*tailings basin water*	*Tailings basin water* will be contained within the FTB. Most *tailings basin water* from the FTB Pond will be recycled to the Beneficiation Plant and some will infiltrate into the tailings. The FTB seepage capture systems will prevent *tailings basin water* from migrating off-site.
Flotation Tailings	Materials remaining after metallic sulfide minerals are liberated and separated from the finely ground ore in the flotation process	*tailings basin water*	
Treated Mine Water	*Treated mine water* routed to the FTB from the Mine Site via the TWP	*tailings basin water*	
Tailings Basin Seepage	Water that has seeped from the Tailings Basin and is collected by the seepage capture systems	*tailings basin seepage*	
Waste Water Treatment Plant (WWTP) By-products	Clean-in-place (CIP) membrane waste and the greensand filter backwash	*tailings basin water*	
LTV Steel Mining Company (LTVSMC) Tailings	Existing tailings materials from the former LTVSMC tailings basin; may be used in construction of FTB dams	*tailings basin water, tailings basin seepage, construction stormwater,* and *industrial stormwater*	LTVSMC tailings may be used as construction materials at the Tailings Basin. Runoff from features constructed with tailings which drains into the Tailings Basin or is collected by the FTB seepage capture systems will be managed as *tailings basin water* or *tailings basin seepage*. Runoff from features constructed with tailings which does not become *tailings basin water* will be managed as *construction stormwater* until features are stabilized, at which time runoff will be managed as *industrial stormwater*.
Spills and Leaks	May include petroleum and petroleum-based products from vehicles that have the potential to contaminate drainage	*industrial stormwater, tailings basin water*	Non-structural best management practices (BMPs) will be employed to prevent spills and leaks. If spills and leaks occur at the Tailings Basin, clean-up will be managed in accordance with the Project Spill Prevention, Control, and Countermeasure (SPCC) Plan.

2.4.2 Stormwater Management System

The only areas associated with the Tailings Basin that will generate runoff to be managed as *industrial stormwater* will be the exterior slopes of the South Dam and the access roads which will be constructed to service the FTB Seepage Containment System. Runoff from the exterior slopes of the South Dam will drain south and be managed with Plant Site *industrial stormwater* as described in Section 2.3.2 of Volume IV. Prior to operation, management measures for runoff from Tailings Basin access roads will be incorporated into an Industrial SWPPP based on detailed construction plans. Additional information about *stormwater* management at the Tailings Basin is presented in Section 2.5 of Reference (6).

2.4.3 Drainage Swale

A drainage swale will be constructed east of the Tailings Basin to re-route toward Unnamed (Mud Lake) Creek the *non-contact stormwater* that currently flows into the Tailings Basin (Large Figure 3). This drainage swale will be constructed before the FTB Seepage Containment System is operational. The purposes of the drainage swale are to augment streamflow in Unnamed (Mud Lake) Creek, replacing inflow that will be reduced by the FTB Seepage Containment System, and to prevent water from ponding at the toe of the East Dam.

2.5 Adaptive Management

The tailings basin 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 Tailings Basin, 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 Tailings Basin is described in Section 6.5 of Reference (1) and Sections 4.0 and 5.0 of Reference (7).

Section 6.6 of Reference (1) presents feasible contingency mitigation actions available to address the following specific situations:

- new surface seeps emerge as the FTB is developed
- FTB Pond water quality is worse than expected
- potential groundwater or surface water concerns downgradient of the FTB

3.0 Tailings Basin Monitoring

Monitoring of baseline water quality and quantity has been ongoing in the vicinity of the Tailings Basin. 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 NorthMet Mining Project and Land Exchange Final Environmental Impact Statement (FEIS) (Reference (9)) (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 Tailings Basin.

3.1.1 Surface Water

Baseline monitoring has been conducted at numerous locations along tributaries to the Embarrass River and the Partridge River that could potentially be affected by the Project, including Unnamed (Mud Lake) Creek, Trimble Creek, Unnamed Creek, and Second Creek. Baseline monitoring stations associated with the Tailings Basin are shown on Large Figure 2 and Large Figure 5.

Daily flow data is available for the Embarrass River from the U.S. Geological Survey (USGS) gaging station 04017000 (Embarrass River at Embarrass, Minnesota) from 1942 to 1964. The hydrology data has been validated and adjusted for use on this Project, as described in Section 4.4.1 of Reference (4). Daily flow data is also available for Second Creek from the USGS gaging station 04015500 (Second Creek near Aurora, Minnesota) from 1955 to 1980; however, during that period flow at this location was heavily affected by mine pit dewatering, so this data has not been used for this Project (Section 1.4.1 of Reference (1)).

Several locations 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 2 and Large Figure 5.

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

Current Monitoring Station ID	Water Body		Water Quality Monitoring Years	Average Instantaneous Flow (cfs)	Number of Flow Measurements	Flow Measurement Monitoring Years
MLC-1	Embarrass River Tributaries	Unnamed (Mud Lake) Creek	2011-2015	N/A	N/A	N/A
MLC-2			2011-2015	2.7	4	2011
MLC-3A			2012	N/A	N/A	N/A
PM-19		Trimble Creek	2009-2015	1.7	13	2009-2011
TC-1			2012	N/A	N/A	N/A
TC-1a			2012-2015	N/A	N/A	N/A
PM-11/ SW003		Unnamed Creek	2004, 2006, 2008-2015	3	24	2004-2011
UC-1/PM-9			2004, 2006, 2012-2013	0	4	2004-2006
UC-1a			2013-2015	N/A	N/A	N/A
PM-12/ SW004(1)	Embarrass River		2004, 2006-2015	9	40	2004-2009
PM-12.2(1)			2010-2015	4.1	8	2010-2011
PM-12.3			2010-2015	12.8	8	2010-2011
PM-12.4			2010-2015	17.2	8	2010-2011
PM-13/ SW005			2004, 2006-2015	61.1	41	2004-2011
PM-7/ SD026	Partridge River Tributary	Second Creek	2004-2015	1.2	21	2004-2007

(1) This station represents existing conditions upstream of the potential influence of the Tailings Basin.

Refer to Large Table 2 for a summary of the baseline surface water quality monitoring results and Section 4.4.4 of Reference (4) and Reference (10) 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 fewer locations and a wider list of constituents to characterize the baseline conditions within the watersheds. Monitoring from 2008 through 2011 generally focused on a smaller list of constituents and locations to resolve specific issues with the data. More extensive baseline monitoring was resumed in 2012, including additional locations along Embarrass River tributaries and a wider list of constituents (Section 1.4.1 of Reference (1)). Other downstream water bodies monitored for water quality include Sabin Lake (2009-2013), Wynne Lake (2009-2013), and Embarrass Lake (2009-2011); the related water quality data is available in Section 4.4.4.4 of Reference (4).

Under Minnesota Rules, part 7050.0430, Embarrass River, Unnamed (Mud Lake) Creek, Trimble Creek, Unnamed Creek, and Second Creek are unlisted waters with the default classification of Class 2B, 3C, 4A, 5, and 6. Baseline conditions exceed applicable surface water quality standards for several parameters, as

summarized in Table 3-2 for the monitoring stations on the Embarrass River downstream of Spring Mine Creek, Unnamed (Mud Lake) Creek, Trimble Creek, Unnamed Creek, and Second Creek and Table 3-3 for the monitoring station on the Embarrass River upstream of Spring Mine Creek. The baseline water quality of the Embarrass River at PM-12 (upstream of Spring Mine Creek) represents natural background levels. The water quality of the Embarrass River at the other stations listed in Table 3-1, Unnamed (Mud Lake) Creek, Trimble Creek, Unnamed Creek, and Second Creek represents a mixture of natural background levels and the possible influence of past industrial operations.

Table 3-2 Baseline Exceedances of Surface Water Standards at Monitoring Stations on the Embarrass River Downstream of Spring Mine Creek, Unnamed (Mud Lake) Creek, Trimble Creek, Unnamed Creek, and Second Creek (2004 through 2015)

Parameter	Number of Samples	Water Quality Standard and Number of Exceedances[1]									
		2B[2]		3C		4A		4B		5	
Aluminum (dissolved)	466	125 µg/L	8	N/A	-	N/A	-	N/A	-	N/A	-
Aluminum (total)	523	125 µg/L	68	N/A	-	N/A	-	N/A	-	N/A	-
Cobalt (dissolved)	250	5 µg/L	1	N/A	-	N/A	-	N/A	-	N/A	-
Cobalt (total)	483	5 µg/L	1	N/A	-	N/A	-	N/A	-	N/A	-
Hardness as CaCO3	548	N/A	-	500 mg/L	104	N/A	-	N/A	-	N/A	-
pH (SU)[3]	756	6.5-9.0	11	6.0 – 9.0	0	6.0 – 8.5	2	6.0 – 9.0	0	6.0 – 9.0	0
Mercury (dissolved)	24	0.0013 µg/L[2]	22	N/A	-	N/A	-	N/A	-	N/A	-
Mercury (total)	264	0.0013 µg/L[2]	110	N/A	-	N/A	-	N/A	-	N/A	-
Solids, Total Dissolved	552	N/A	-	N/A	-	700 mg/L	103	1,000 mg/L	3	N/A	-
Specific Conductance	744	N/A	-	N/A	-	1,000 µmhos/cm	178	N/A	-	N/A	-
Sulfate, as SO_4[4]	733	N/A	-	N/A	-	N/A[4]	-	N/A	-	N/A	-
Thallium	290	0.56 µg/L	1	N/A	-	N/A	-	N/A	-	N/A	-

Note: This assessment includes stations on the Embarrass River downstream of Spring Mine Creek, Unnamed (Mud Lake) Creek, Trimble Creek, Unnamed Creek, and Second Creek identified in Table 3-1 (MLC-1, MLC-2, MLC-3A, PM-19, TC-1, TC-1a, PM-11/ SW003, UC-1/PM-9, UC-1a, PM-12/ SW004, PM-12.2, PM-12.3, PM-12.4, PM-13/ SW005, and PM-7/ SD026). 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 mercury.

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

(4) The waterbodies corresponding with these monitoring stations are not listed wild rice waters; therefore the Class 4A sulfate standard of 10 mg/L for waters "used for production of wild rice" is not applicable. Monitoring at these stations during the specified time period has observed 611 instances where baseline sulfate concentrations were greater than 10 mg/L.

Table 3-3 Baseline Exceedances of Surface Water Standards at the Monitoring Station on the Embarrass River Upstream of Spring Mine Creek (2004, 2006 through 2015)

Parameter	Number of Samples	Water Quality Standard and Number of Exceedances[1]									
		2B[2]		3C		4A		4B		5	
Aluminum (dissolved)	52	125 µg/L	7	N/A	-	N/A	-	N/A	-	N/A	-
Aluminum (total)	64	125 µg/L	18	N/A	-	N/A	-	N/A	-	N/A	-
pH (SU)[3]	85	6.5-9.0	13	6.0 – 9.0	2	6.0 – 8.5	2	6.0 – 9.0	2	6.0 – 9.0	2
Mercury (dissolved)	8	0.0013 µg/L[2]	8	N/A	-	N/A	-	N/A	-	N/A	-
Mercury (total)	42	0.0013 µg/L[2]	35	N/A	-	N/A	-	N/A	-	N/A	-
Sulfate, as SO_4[4]	89	N/A	-	N/A	-	N/A[4]	-	N/A	-	N/A	-

Note: This assessment includes the station on the Embarrass River upstream of Spring Mine Creek identified in Table 3-1 (PM-12/ SW004). This station is 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 mercury.

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

(4) The waterbodies corresponding with these monitoring stations are not listed wild rice waters; therefore the Class 4A sulfate standard of 10 mg/L for waters "used for production of wild rice" is not applicable. Monitoring at these stations during the specified time period has observed nine instances where baseline sulfate concentrations were greater than 10 mg/L.

The existing Cliffs Erie NPDES/SDS Permit for the former LTVSMC tailings basin (MN0054089) includes five surface water discharge monitoring stations (SD001, SD002, SD004, SD005, and SD006) and three surface water monitoring stations (SW003 [PM-11], SW004 [PM-12], and SW005 [PM-13]). There is currently no discharge at any of the five existing surface water discharge monitoring stations: no surface seepage is present at SD001, SD002, and SD005 and seepage upgradient of SD004 and SD006 is captured by the temporary pumpback systems installed in 2011 under the 2010 Cliffs Erie Consent Decree (which will be replaced by the FTB Seepage Containment System). The proposed monitoring plan for this Project includes monitoring of surface water monitoring stations SW003 and SW005, but will not include monitoring of SW004 or of any of the existing surface water discharge monitoring stations (refer to Section 3.2 of this volume).

The existing Cliffs Erie NPDES/SDS Permit for the Hoyt Lakes Mining Area (MN0042536) includes one surface water discharge monitoring station (SD026) related to the Tailings Basin. The existing pumpback system, which will continue during Project operations as the FTB South Seepage Management System, was installed in 2011 to collect surface seepage upstream of SD026 and pump it back into LTVSMC tailings basin Cell 1E. Cliffs Erie continues to monitor SD026 as part of their ongoing NPDES/SDS monitoring requirements (Section 1.4.1 of Reference (1)); additionally, for purposes of the Project, baseline surface water quality monitoring of Second Creek was performed at this location (also known as baseline surface water monitoring station PM-7) during 2004, 2006, and 2007. PM-7 is proposed as a surface water monitoring station for the Project (with proposed NPDES/SDS station ID SW020). Data collected at PM-7 is presented in Large Table 5 of Reference (4).

3.1.2 Groundwater

The surficial aquifer consists of a relatively thin mantle of peat, glacial till, and reworked sediments. Depth to bedrock along the containment system alignment to the north, northwest, and west of the Tailings Basin ranges from 3.5 to 42.5 feet. The average thickness of surficial deposits along these alignments is 19.5 feet. No substantial surficial deposits are present along the southern and much of the eastern sides of the Tailings Basin, where the basin abuts bedrock. Surficial deposits underlie a portion of the alignment of the East Dam. Although the thickness of the native sediments below the LTVSMC tailings is unknown, it is estimated that it is similar to the surrounding area. The underlying bedrock is the Giant's Range granite batholith (Section 4.3.1 of Reference (4)).

Groundwater elevations measured around the existing Tailings Basin indicate that groundwater flows to the north and northwest, toward the Embarrass River. As the Tailings Basin was built up over time, a groundwater mound formed beneath the basin due to seepage from the various ponds, which altered local flow directions and rates (Section 4.3.2.2.1 of Reference (4)). Groundwater flow to the south and east is generally constricted by the bedrock outcrops and the underlying bedrock unit of the Giant's Range granite batholith (Reference (11)), which outcrops as a ridge and drainage divide and makes up the highest topography in the area. However, there is a gap in the bedrock hills near the southern end of the Tailings Basin, which allows some seepage to flow south toward Cliffs Erie NPDES/SDS monitoring station SD026, forming the headwaters of Second Creek, a tributary to the lower Partridge River.

Baseline monitoring of groundwater quality and elevation at the existing Tailings Basin has been and continues to be assessed via a network of monitoring wells completed into the unconsolidated surficial aquifer. A summary of these existing wells is available as Large Table 3, and their locations are shown on Large Figure 2.

Sixteen existing monitoring wells provide information on groundwater quality in the surficial deposits in the area of the Tailings Basin. Some of the wells (GW001 through GW008, with the exception of GW003 and GW004, which have been dry in recent years) have been sampled regularly for more than 10 years as part of the NPDES/SDS Permit for the existing LTVSMC tailings basin (NPDES/SDS Permit No. MN0054089 held by Cliffs Erie). The groundwater monitoring well network also includes four wells installed in 2009 specifically for evaluation of baseline conditions for this Project, and three additional wells installed as part of the Cliffs Erie Consent Decree (Section 1.4.2 of Reference (1)). The wells are monitored quarterly, with the exception of the winter (first) quarter. For a complete tabulation of baseline groundwater quality data collected from 2007 through 2015 at the existing Tailings Basin, refer to Section 4.3.4 of Reference (4) and Reference (10). Refer also to Large Table 4, which provides a summary of these results.

Four of the wells, including one upgradient well, are uninfluenced by existing LTVSMC tailings basin seepage and represent natural background conditions (GW002, GW011, GW013, and GW015). Baseline condition exceedances of groundwater quality standards, specifically U.S. Environmental Protection Agency (USEPA) Maximum Concentration Limits (MCLs) and Secondary Maximum Concentration Limits (sMCLs), are summarized in Table 3-4 for these wells, which represent natural background conditions. 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".

The remaining wells at the Tailings Basin have been influenced by historic or current *tailings basin seepage*. Baseline condition exceedances of groundwater quality standards, specifically USEPA MCLs and sMCLs, are summarized in Table 3-5 for these wells. Additionally, exceedances of NPDES/SDS Permit No. MN0054089 groundwater intervention limits from 2007 to April 2014 are summarized in Table 3-6.

Table 3-4 Baseline Exceedances of Groundwater Standards at Uninfluenced Wells Identified in Large Table 3 (2007, 2009 through 2015)

Parameter	Number of Samples	Water Quality Standard and Number of Exceedances[1]			
		USEPA MCL[2]		USEPA sMCL[3]	
Aluminum (dissolved)	72	N/A	-	50 µg/L	28
Aluminum (total)	50	N/A	-	50 µg/L	46
Arsenic (total)	50	10 µg/L	1	N/A	-
Chromium (total)	50	100 µg/L	1	N/A	-
Cyanide	50	0.2 mg/L	1	N/A	-
Iron (dissolved)	65	N/A	-	300 µg/L	1
Iron (total)	50	N/A	-	300 µg/L	35
Lead (total)	50	15 µg/L	1	N/A	-
Manganese (dissolved)	67	N/A	-	50 µg/L	18
Manganese (total)	50	N/A	-	50 µg/L	30
pH	72	N/A	-	6.5-8.5 SU	24
Turbidity	71	5 NTU	42	N/A	-

Note: This assessment includes uninfluenced stations (GW002, GW011, GW013, and GW015) identified in Large Table 3. 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 Plant 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 Influenced Wells Identified in Large Table 3 (2007, 2009 through 2015)

Parameter	Number of Samples	Water Quality Standard and Number of Exceedances[1]			
		USEPA MCL[2]		USEPA sMCL[3]	
Aluminum (dissolved)	192	N/A	-	50 µg/L	2
Aluminum (total)	138	N/A	-	50 µg/L	83
Arsenic (dissolved)	168	10 µg/L	1	N/A	-
Arsenic (total)	136	10 µg/L	4	N/A	-
Barium (dissolved)	128	2,000 µg/L	4	N/A	-
Beryllium (total)	135	4 µg/L	1	N/A	-
Chromium (total)	135	100 µg/L	5	N/A	-
Fluoride	194	4.0 mg/L	0	2.0 mg/L	19
Iron (dissolved)	159	N/A	-	300 µg/L	95
Iron (total)	138	N/A	-	300 µg/L	105
Lead (total)	135	15 µg/L	5	N/A	-
Manganese (dissolved)	170	N/A	-	50 µg/L	154
Manganese (total)	138	N/A	-	50 µg/L	127
pH	206	N/A	-	6.5-8.5 SU	4
Sulfate, as SO4	195	N/A	-	250 mg/L	59
TDS	169	N/A	-	500 mg/L	99
Turbidity	200	5 NTU	83	N/A	-

Note: This assessment includes influenced stations (GW001, GW005, GW006, GW007, GW008, GW009, GW010, GW012, GW014, and GW016) identified in Large Table 3. 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 Plant 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 3-6 Baseline Exceedances of Cliffs Erie NPDES/SDS Permit No. MN0054089 Groundwater Intervention Limits at Existing NPDES/SDS Groundwater Monitoring Stations GW001 through GW008 (2007 through 2013)

Parameter	Number of Samples	Permit Limit and Number of Exceedances[1]			
		Instantaneous Maximum		Intervention Limit[2]	
Boron (dissolved)	74	600 µg/L	0	150 µg/L	51
Fluoride (total)	118	4.0 mg/L	0	1.0 mg/L	65
Manganese (dissolved)[3]	95	1000 µg/L	45	250 µg/L	61
Molybdenum (dissolved)[4]	117	30 µg/L	18	7.5 µg/L	80
Solids, total dissolved	91	N/A	-	500 mg/L	57
Sulfate, as SO_4	119	250 mg/L	35	250 mg/L	35

(1) These columns reflect the water quality standard and the number of exceedances for the standard.
(2) Instantaneous maximum intervention limit.
(3) 95 of the samples exceed the instantaneous maximum intervention limit. 45 of the samples exceed both the instantaneous maximum and instantaneous maximum intervention limit and have a concentration >1000 µg/L; 16 of the samples are >250 µg/L but <1000 µg/L, and thus only exceed the instantaneous maximum intervention limit.
(4) 80 of the samples exceed the instantaneous maximum intervention limit. 62 of the samples are >7.5 µg/L but <30 µg/L, and thus only exceed the instantaneous maximum intervention limit; the remaining 18 samples are >30 µg/L and thus exceed both the instantaneous maximum and instantaneous maximum intervention limit.

Natural background concentrations in groundwater are above the standards for aluminum and manganese at the Tailings Basin. During the environmental review process, site-specific criteria were developed for solutes where natural background is over the applicable standard (Section 4.3.4.2 of Reference (4)). PolyMet is requesting that MPCA consider a site-specific approach based on natural background conditions for solutes where natural background is over applicable standards where monitoring will be required. Consideration of the chosen approach should also address the spatial variability in background conditions.

3.2 Proposed Monitoring Plan

Monitoring proposed as part of permit requirements for the Tailings Basin and Beneficiation Plant is included in the integrated Plant Site monitoring plan presented in Section 3.0 of Volume I. The proposed Plant Site monitoring plan includes groundwater monitoring stations, surface water monitoring stations, and internal waste stream monitoring stations associated with the Tailings Basin and Beneficiation Plant; these proposed monitoring stations are shown on Large Figure 3 and Large Figure 4.

4.0 Groundwater Nondegradation

PolyMet evaluated the anticipated effects of the Tailings Basin on groundwater quality. Section 4.1 describes how Minnesota's rules governing protection of underground waters apply to groundwater downgradient of the Tailings Basin. Section 4.2 documents that groundwater downgradient of the Tailings Basin has been discernably impacted by previous mining activities and does not reflect natural quality. Section 4.3 summarizes Project activities, including the use of engineering controls and mitigation measures, designed to protect groundwater and abate existing groundwater impacts in accordance with Minnesota's groundwater protection requirements. Existing groundwater quality downgradient of the Tailings Basin 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 State's policy on groundwater further states that groundwater should be "protected as nearly as possible in its natural condition." (Minnesota Rules, part 7060.0200). The MPCA rules provide that "[n]atural conditions exist where there is no discernable impact from point or nonpoint source pollutants attributable to human activity or from a physical alteration of wetlands." (Minnesota Rules, part 7050.0170).

Downgradient of the LTVSMC tailings basin, groundwater does not exist in its natural condition, as a result of seepage of pollutants from decades of ferrous mining activities at the site, including in particular ferrous seepage from the LTVSMC tailings basin. Section 4.2 demonstrates, based on available water quality monitoring data, that these previous ferrous mining activities have had a discernable impact on groundwater at various locations downgradient of the LTVSMC tailings basin. Under these circumstances, the Minnesota nondegradation policy of maintaining the natural quality of groundwater to the maximum practicable extent is not applicable. Where groundwater in its "natural condition" is not present to be protected against degradation, the State's groundwater policy focuses instead on "abating [existing] pollution" and "maximiz[ing] the possibility of rehabilitating degraded waters."(Minnesota Rules, part 7060.0400). The Project's design will have the effect of rehabilitating currently degraded groundwater downgradient of the Tailings Basin in accordance with the policies set forth in Minnesota Rules, chapter 7060 (Section 4.3).

4.2 Existing Groundwater Quality

The existing LTVSMC tailings basin has affected downgradient groundwater quality. Effects of the previous ferrous mining activities at the site are observed in, for example, elevated concentrations of TDS (especially chloride, sulfate, and other major cations and anions) and certain trace constituents (such as fluoride and molybdenum) (Section 4.3.4.1 of Reference (4)). Four Plant Site wells, which are not

downgradient of the LTVSMC tailings basin, are uninfluenced by legacy seepage and represent natural background conditions (GW002, GW011, GW013, and GW015) (Section 3.1.2 of this volume). Monitoring locations downgradient of the LTVSMC tailings basin, however, exhibit discernable effects of legacy seepage, including exceedances of Class 1 Standards (Table 3-5) and exceedances of permit limits in Cliffs Erie NPDES/SDS Permit No. MN0054089 (Table 3-6). Existing groundwater quality is summarized in Large Table 4, and existing monitoring stations are shown on Large Figure 2.

4.3 Description of Engineering Controls to Protect Groundwater and Abate Existing Groundwater Impacts

PolyMet will construct the FTB seepage capture systems to capture *tailings basin seepage*, including both nonferrous seepage from the NorthMet Project as well as legacy ferrous seepage, from the northern, northwestern, western, eastern, and southern sides of the Tailings Basin (Sections 2.3.3.1 and 2.3.3.2 of this volume). Additional detail on these systems and their expected performance is presented in Sections 2.1.3 and 2.1.4 of Reference (1), and their locations are shown on Large Figure 4.

The FTB seepage capture systems will abate the existing flow of ferrous seepage to groundwater. Over time, these engineering controls are expected to rehabilitate existing groundwater impacts outside of the FTB seepage capture systems as existing impacts are attenuated. With respect to potential groundwater impacts associated with the Project, the effect of the engineering controls and tailings and water management plans (Flotation Tailings Management Plan [Reference (6)]) and the Plant Site Water Management Plan [Reference (1)]) will be that no exceedances of applicable groundwater quality standards are expected at the property boundary (Section 6.5 of Reference (4)). Groundwater concentrations of some parameters that currently exceed Class 1 standards or existing Cliffs Erie permit limits will decrease over time as a result of the Project engineering controls (for example iron, boron, fluoride, and sulfate, see Attachment H of Reference (4)). These actions by PolyMet will meet the groundwater protection and pollution abatement policies of Minnesota Rules, chapter 7060.

PolyMet will monitor the performance of the FTB seepage capture systems and the groundwater quality downgradient of the Tailings Basin (Section 3.2.2 of Volume I), and if the engineering controls are not achieving the desired outcomes, will implement adaptive management actions or contingency mitigation (Sections 6.5 and 6.6 of Reference (1)), as necessary to comply with all permit conditions.

5.0 References

1. **Poly Met Mining Inc.** NorthMet Project Water Management Plan - Plant (v5). July 2016.

2. —. NorthMet Project Geotechnical Data Package Vol 1 - Flotation Tailings Basin (v7). July 2016.

3. —. NorthMet Project Project Description (v9). February 2015.

4. —. NorthMet Project Water Modeling Data Package Volume 2 - Plant Site (v11). March 2015.

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

6. —. NorthMet Project Flotation Tailings Management Plan (v6). July 2016.

7. —. NorthMet Project Adaptive Water Management Plan (v10). July 2016.

8. —. NorthMet Project Reclamation Plan (v7). July 2016.

9. **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.

10. **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.

11. **Jirsa, M.A., Chandler, V.W. and Lively, R.S.** Bedrock Geology of the Mesabi Iron Range. [Map]. s.l. : Minnesota Geological Survey, 2005. Miscellaneous Map M-163.

Large Tables

Large Table 1 Tailings Basin and Beneficiation Plant 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
SIPX (Sodium Isopropyl Xanthate) (Primary)	Collector: Selectively adsorb minerals based on hydrophobicity of the collector and mineral	Flotation Circuit, specifically the Flotation Roughers, Scavengers, and Cleaner Circuits	Continuous	2.74 tons/day (1,000 tons/year)	4.79 tons/day (1,750 tons/year)	Flotation Reagents Building	Bulk (< 20 ton, 100% SIPX), AST (0.5% concentration in water)	25,000 gal AST	Building containment	Sodium will be transported to the WWTP and be discharged to the receiving water body. The alcohol component of SIPX will be biodegraded within the Flotation Tailings Basin (FTB). Xanthate primarily will be oxidized to sulfate and be removed by the WWTP. Some xanthate may be included within the concentrate. Decomposes to carbon disulfide, trithiocarbinate, isopropyl alcohol.
PAX (Potassium Amyl Xanthate) (Potential Substitute)	Collector: Selectively adsorb minerals based on hydrophobicity of the collector and mineral	Flotation Circuit, specifically the Flotation Roughers, Scavengers, and Cleaner Flotation Cells	Continuous	2.74 tons/day (1,000 tons/year)	4.79 tons/day (1,750 tons/year)	Flotation Reagents Building	Bulk (< 20 ton, 100% PAX), AST (0.5% concentration in water)	25,000 gal AST	Building containment	Potassium will be transported to the WWTP and be discharged to the receiving water body. The alcohol component of SIPX will be biodegraded within the FTB. Xanthate primarily will be oxidized to sulfate and be removed by the WWTP. Some xanthate may be included within the concentrate. Decomposes to carbon disulfide. Absorbs to concentrate particles and not the tailing.
MIBC (Methyl Isobutyl Carbinol, 100% Solution) (Primary)	Frother: Used to improve stability of froth bubbles as they rise through the flotation cells	Flotation Circuit, specifically the Flotation Roughers, Scavengers, and Cleaner Flotation Cells	Continuous	2.88 tons/day (1,050 tons/year)	4.11 tons/day (1,500 tons/year)	Flotation Reagents Building	AST (100% solution)	Two ASTs: 15,000 gal AST 3,000 gal AST	Building containment	This product will attach to the concentrate and collector. It is composed of alcohols, which will be biodegraded within the FTB. Decomposes to carbon monoxide and carbon dioxide.
F-160-05 Frother (Potential Substitute)	Frother: Used to improve stability of froth bubbles as they rise through the flotation cells	Flotation Circuit, specifically the Flotation Roughers, Scavengers, and Cleaner Flotation Cells	Continuous	2.88 tons/day (1,050 tons/year)	4.11 tons/day (1,500 tons/year)	Flotation Reagents Building	AST (100% solution)	Two ASTs: 15,000 gal AST 3,000 gal AST	Building containment	This product will attach to the concentrate and collector. It is not classified as dangerous to the environment (per the Safety Data Sheet) and will be readily biodegraded within the FTB. Decomposes to carbon monoxide, carbon dioxide, aldehydes, ketones, organic acids.
F-160-13 Frother (Potential Substitute)	Frother: Used to improve stability of froth bubbles as they rise through the flotation cells	Flotation Circuit, specifically the Flotation Roughers, Scavengers, and Cleaner Flotation Cells	Continuous	2.88 tons/day (1,050 tons/year)	4.11 tons/day (1,500 tons/year)	Flotation Reagents Building	AST (100% solution)	Two ASTs: 15,000 gal AST 3,000 gal AST	Building containment	This product will attach to the concentrate and collector. It is not classified as dangerous to the environment (per the Safety Data Sheet) and will be readily biodegraded within the FTB. Decomposes to carbon monoxide, carbon dioxide, aldehydes, ketones, organic acids.
NALCO DVS4U038 (Potential Substitute)	Frother: Used to improve stability of froth bubbles as they rise through the flotation cells	Flotation Circuit, specifically the Flotation Roughers, Scavengers, and Cleaner Flotation Cells	Continuous	2.88 tons/day (1,050 tons/year)	4.11 tons/day (1,500 tons/year)	Flotation Reagents Building	AST (100% solution)	Two ASTs: 15,000 gal AST 3,000 gal AST	Building containment	This product will attach to the concentrate and collector.This chemical additive is not classified as dangerous to the environment (per the Safety Data Sheet) and will be readily biodegraded within the FTB. Decomposes to carbon oxides.
Copper Sulfate Pentahydrate (Primary)	Activator: Used to increase the available adsorption sites on the mineral to allow for adsorption by the Collector	Flotation Circuit, specifically the Scavenger Cells	Continuous	1.71 tons/day (625 tons/year)	2.05 tons/day (750 tons/year)	Flotation Reagents Building	Bulk (< 30 ton pentahydrate crystals), AST (< 10% concentration in water)	17,000 gal AST	Building containment	The copper component of this chemical additive will precipitate with iron oxide or as an oxide. The sulfate will be precipitated as gypsum. These precipitates will be included in the sludge that will initially be transported to an off-site landfill. Following start-up of the HydroMet, the sludge will be transported to the Hydrometallurgical Residue Facility (HRF).
MagnaFloc 10 (Primary)	Flocculant: Promote flocculation of suspended particles in liquors	Flotation Circuit, specifically the Concentrate Thickeners	Continuous	0.082 tons/day (30 tons/year)	0.14 tons/day (50 tons/year)	Flotation Reagents Building	Bulk (< 5 ton, 100% solution), AST (< 1% concentration in water)	15,000 gal AST	Building containment	The flocculant chemical additives will adsorb to the solids material in several process thickeners to improve settling rates and productivity (concentrate and hydrometallurgical thickeners). The flocculants will be transported with the solids from these thickeners to intermediate and final products. These flocculants will not report with the Flotation Tailings to the FTB. All recovered water from these thickeners is reused in the process facility. This product is biodegradable within the process.

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
MagnaFloc 455 (Potential Substitute)	Flocculant: Promote flocculation of suspended particles in liquors	Flotation Circuit, specifically the Concentrate Thickeners	Continuous	0.07 tons/day (25 tons/year)	0.14 tons/day (50 tons/year)	Flotation Reagents Building	Bulk (< 5 ton, 100% solution), AST (< 1% concentration in water)	12,500 gal AST	Building containment	The flocculant chemical additives will adsorb to the solids material in several process thickeners to improve settling rates and productivity (concentrate and hydrometallurgical thickeners). The flocculants will be transported with the solids from these thickeners to intermediate and final products. These flocculants will not report with the Flotation Tailings to the FTB. All recovered water from these thickeners is reused in the process facility. This product is biodegradable within the process.
Neo NS 6655 (Potential Substitute)	Flocculant: Promote flocculation of suspended particles in liquors	Flotation Circuit, specifically the Concentrate Thickeners	Continuous	0.07 tons/day (25 tons/year)	0.14 tons/day (50 tons/year)	Flotation Reagents Building	Bulk (< 5 ton, 100% solution), AST (< 1% concentration in water)	12,500 gal AST	Building containment	The flocculant chemical additives will adsorb to the solids material in several process thickeners to improve settling rates and productivity (concentrate and hydrometallurgical thickeners). The flocculants will be transported with the solids from these thickeners to intermediate and final products. These flocculants will not report with theFlotation Tailings to the FTB. All recovered water from these thickeners is reused in the process facility. This product is biodegradable within the process.
NALCO 83949 (Potential Substitute)	Flocculant: Promote flocculation of suspended particles in liquors	Flotation Circuit, specifically the Concentrate Thickeners	Continuous	0.07 tons/day (25 tons/year)	0.14 tons/day (50 tons/year)	Flotation Reagents Building	Bulk (< 5 ton, 100% solution), AST (< 1% concentration in water)	12,500 gal AST	Building containment	The flocculant chemical additives will adsorb to the solids material in several process thickeners to improve settling rates and productivity (concentrate and hydrometallurgical thickeners). The flocculants will be transported with the solids from these thickeners to intermediate and final products. These flocculants will not report with the Flotation Tailings to the FTB. All recovered water from these thickeners is reused in the process facility. This product is biodegradable within the process.
NALCO 9877 PULV (Potential Substitute)	Flocculant: Promote flocculation of suspended particles in liquors	Flotation Circuit, specifically the Concentrate Thickeners	Continuous	0.07 tons/day (25 tons/year)	0.14 tons/day (50 tons/year)	Flotation Reagents Building	Bulk (< 5 ton, 100% solution), AST (< 1% concentration in water)	12,500 gal AST	Building containment	The flocculant chemical additives will adsorb to the solids material in several process thickeners to improve settling rates and productivity (concentrate and hydrometallurgical thickeners). The flocculants will be transported with the solids from these thickeners to intermediate and final products. These flocculants will not report with the FlotationTailings to the FTB. All recovered water from these thickeners is reused in the process facility. This product is biodegradable within the process.
CMC (Carboxyl Methyl Cellulose) (Tennapress PE26) (Primary)	Flocculant: Used to depress gangue minerals in flotation cells to improve selectivity towards Cu Ni minerals	Flotation Circuit, specifically Rougher and Pyrhotite Cleaner Flotation Cells	Continuous	3.29 tons/day (1,200 tons/year)	4.79 tons/day (1,750 tons/year)	Flotation Reagents Building	Bulk (< 25 ton, 100% CMC), AST (< 1% concentration in water)	70,000 gal AST	Building containment	This chemical additive is an organic compound, which will be broken down within the FTB. It is an anionoic water soluble polymer derived from cellulose and is mainly used for silicate gangue inhibitors.
Lime Slurry (Primary)	pH Modifier: Used to regulate pH in the Flotation Circuit	Flotation Circuit, specifically the Separation Cleaner Flotation Cells	Continuous	28.15 tons/day (10,274 tons/year)	41.10 tons/day (15,000 tons/year)	Flotation Reagents Building	Bulk (< 400 ton, 100% Hydrated Lime), AST (< 15% solution in water)	80,000 gal AST	Building containment	The calcium within this chemical additive will either be precipitated or neutralized. The calcium will be precipitated as gypsum and included in the sludge that will initially be transported to an off-site landfill. Following start-up of the HydroMet Plant, the sludge will be transported to the HRF.

Large Table 2 Tailings Basin Baseline Surface Water Quality Monitoring Summary

Water Quality Data for MLC-1 2011-2015						
Parameter	**Fraction**	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Average**
General Parameters						
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	29	90.7	653	246
Alkalinity, total, as CaCO3	NA	mg/l	15	97.7	404	238
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	NA	NA	NA	NA
Carbon, total organic	NA	mg/l	42	6.9	43.8	19.3
Chemical Oxygen Demand	NA	mg/l	8	37	80.2	56.5
Chloride	Dissolved	mg/l	NA	NA	NA	NA
Chloride	NA	mg/l	42	< 1	24.3	8.54
Chlorophyll a	NA	mg/l	NA	NA	NA	NA
Cyanide	NA	mg/l	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	40	< 0.1	11.13	6.79
Fluoride	NA	mg/l	2	0.15	0.31	0.23
Hardness, as CaCO3	NA	mg/l	42	83.5	616	220
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	9	< 0.1	0.16	0.06
Nitrogen, ammonia, as N	NA	mg/l	8	< 0.1	1.7	0.33
Nitrogen, total	NA	mg/l	NA	NA	NA	NA
Nitrogen, total kjeldahl (TKN)	NA	mg/l	NA	NA	NA	NA
Orthophosphate, as PO4	NA	mg/l	NA	NA	NA	NA
pH	NA	pH units	40	6.66	7.87	7.26
Phosphorus, total, as P	Dissolved	mg/l	NA	NA	NA	NA
Phosphorus, total, as P	NA	mg/l	8	0.0066	0.14	0.050
Redox (oxidation potential)	NA	mV	NA	NA	NA	NA
Solids, total dissolved	NA	mg/l	42	141	838	331
Solids, total suspended	NA	mg/l	2	2	4	3.00
Specific Conductance @ 25 ºC	NA	µmhos/cm	40	199	1362	492
Sulfate, as SO4	Dissolved	mg/l	NA	NA	NA	NA
Sulfate, as SO4	NA	mg/l	42	< 1	118	18.2
Sulfide, as S^{2}-	NA	mg/l	NA	NA	NA	NA
Temperature	NA	deg C	40	0.08	23.61	9.68
Turbidity	NA	NTU	40	0	80.3	9.95
Metals						
Aluminum	Dissolved	µg/l	42	< 10	51.1	19.3
Aluminum	Total	µg/l	42	< 10	80.1	29.7
Antimony	Total	µg/l	20	< 0.5	< 0.5	NA
Arsenic	Dissolved	µg/l	7	< 0.5	2	1.25
Arsenic	Total	µg/l	41	0.42	7	1.88
Barium	Total	µg/l	15	11	93.8	36.0
Beryllium	Total	µg/l	15	< 0.2	< 0.2	NA
Boron	Total	µg/l	15	< 50	< 100	53.7
Cadmium	Total	µg/l	15	< 0.03	< 0.2	NA
Calcium	Total	mg/l	42	12.9	88.9	33.9
Chromium	Total	µg/l	15	< 1	1.2	0.55
Cobalt	Dissolved	µg/l	28	< 0.2	1	0.35
Cobalt	Total	µg/l	42	< 0.2	1.1	0.31
Copper	Dissolved	µg/l	28	< 0.5	1.85	0.46
Copper	Total	µg/l	42	0.43	1.5	0.42
Iron	Dissolved	µg/l	28	302	35600	5705
Iron	Total	µg/l	42	265	37600	6111
Lead	Dissolved	µg/l	9	< 0.5	< 0.5	NA
Lead	Total	µg/l	42	< 0.02	< 0.5	0.24
Magnesium	Total	mg/l	42	12.5	95.8	32.9
Manganese	Dissolved	µg/l	28	14.3	1030	364
Manganese	Total	µg/l	42	5	1040	346
Mercury	Dissolved	ng/l	NA	NA	NA	NA
Mercury	Total	ng/l	15	0.655	4	1.74
Methyl Mercury	Dissolved	ng/l	NA	NA	NA	NA
Methyl Mercury	Total	ng/l	NA	NA	NA	NA
Molybdenum	Total	µg/l	8	< 0.3	1.06	0.60
Nickel	Dissolved	µg/l	28	< 0.5	1	0.37
Nickel	Total	µg/l	42	< 0.5	0.92	0.32
Palladium	Total	µg/l	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA
Potassium	Total	mg/l	15	0.615	4.6	2.10
Selenium	Total	µg/l	28	< 0.2	< 1	0.49
Silver	Total	µg/l	8	< 0.2	< 0.2	NA
Sodium	Total	mg/l	15	15.4	57.5	30.4
Strontium	Total	µg/l	2	68.8	270	169
Thallium	Total	µg/l	27	< 0.0004	< 0.02	0.0037
Tin	Total	µg/l	NA	NA	NA	NA
Titanium	Total	µg/l	NA	NA	NA	NA
Vanadium	Total	µg/l	6	< 3	3.7	1.87
Zinc	Dissolved	µg/l	26	< 6	9.5	4.03
Zinc	Total	µg/l	42	< 6	10.7	3.69

NA No data available.
Averages calculated with non-detects at half the detection limit. Averages not calculated if 100% non-detects.
Field duplicates not included in count of samples.

Water Quality Data for MLC-2 2011-2015						
Parameter	**Fraction**	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Average**
General Parameters						
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	36	60.5	210	130
Alkalinity, total, as CaCO3	NA	mg/l	22	76.5	210	133
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	NA	NA	NA	NA
Carbon, total organic	NA	mg/l	51	10.4	48	22.3
Chemical Oxygen Demand	NA	mg/l	15	34.8	111	70.5
Chloride	Dissolved	mg/l	NA	NA	NA	NA
Chloride	NA	mg/l	54	1.7	22.9	6.57
Chlorophyll a	NA	mg/l	NA	NA	NA	NA
Cyanide	NA	mg/l	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	53	< 0.1	11.5	4.80
Fluoride	NA	mg/l	4	0.2	0.33	0.25
Hardness, as CaCO3	NA	mg/l	51	56.8	199	119
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	15	< 0.1	0.12	0.06
Nitrogen, ammonia, as N	NA	mg/l	15	< 0.1	2.08	0.34
Nitrogen, total	NA	mg/l	NA	NA	NA	NA
Nitrogen, total kjeldahl (TKN)	NA	mg/l	NA	NA	NA	NA
Orthophosphate, as PO4	NA	mg/l	NA	NA	NA	NA
pH	NA	pH units	53	6.4	7.76	7.14
Phosphorus, total, as P	Dissolved	mg/l	NA	NA	NA	NA
Phosphorus, total, as P	NA	mg/l	15	< 0.004	0.25	0.048
Redox (oxidation potential)	NA	mV	1	NA	NA	456
Solids, total dissolved	NA	mg/l	51	110	335	210
Solids, total suspended	NA	mg/l	5	< 1	24	7.39
Specific Conductance @ 25 ºC	NA	µmhos/cm	53	58.4	454.9	263
Sulfate, as SO4	Dissolved	mg/l	NA	NA	NA	NA
Sulfate, as SO4	NA	mg/l	54	< 1	40.2	4.59
Sulfide, as S^{2}-	NA	mg/l	NA	NA	NA	NA
Temperature	NA	deg C	53	-0.01	21.25	8.83
Turbidity	NA	NTU	53	0	150.3	10.6
Metals						
Aluminum	Dissolved	µg/l	54	< 10	154	30.6
Aluminum	Total	µg/l	54	11.2	1420	77.8
Antimony	Total	µg/l	30	< 0.5	< 0.5	NA
Arsenic	Dissolved	µg/l	7	0.54	1.6	1.06
Arsenic	Total	µg/l	51	0.48	3.1	1.17
Barium	Total	µg/l	18	10.5	61.6	26.5
Beryllium	Total	µg/l	18	< 0.2	< 0.2	NA
Boron	Total	µg/l	18	< 50	< 100	NA
Cadmium	Total	µg/l	18	< 0.03	< 0.2	0.08
Calcium	Total	mg/l	51	9.1	32.7	19.9
Chromium	Total	µg/l	18	< 1	1.6	0.61
Cobalt	Dissolved	µg/l	37	< 0.2	1.13	0.39
Cobalt	Total	µg/l	51	< 0.2	1.2	0.39
Copper	Dissolved	µg/l	37	< 0.15	1.6	0.46
Copper	Total	µg/l	51	0.2	7.5	0.62
Iron	Dissolved	µg/l	37	212	26900	3454
Iron	Total	µg/l	51	160	27100	4117
Lead	Dissolved	µg/l	10	< 0.5	< 0.5	NA
Lead	Total	µg/l	47	0.06	0.57	0.25
Magnesium	Total	mg/l	51	8.2	30.1	16.9
Manganese	Dissolved	µg/l	36	7.2	1310	342
Manganese	Total	µg/l	51	3.5	1310	300
Mercury	Dissolved	ng/l	NA	NA	NA	NA
Mercury	Total	ng/l	22	0.9	6.9	2.98
Methyl Mercury	Dissolved	ng/l	NA	NA	NA	NA
Methyl Mercury	Total	ng/l	4	< 0.1	3.74	1.26
Molybdenum	Total	µg/l	15	0.21	0.92	0.46
Nickel	Dissolved	µg/l	37	< 0.5	2.2	0.50
Nickel	Total	µg/l	51	< 0.5	3	0.52
Palladium	Total	µg/l	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA
Potassium	Total	mg/l	22	0.33	4.4	1.39
Selenium	Total	µg/l	33	< 0.2	< 1	0.47
Silver	Total	µg/l	11	< 0.2	< 0.2	NA
Sodium	Total	mg/l	22	9.5	33.2	16.7
Strontium	Total	µg/l	4	60.9	136	102
Thallium	Total	µg/l	35	< 0.0004	0.03	0.0058
Tin	Total	µg/l	NA	NA	NA	NA
Titanium	Total	µg/l	4	< 10	< 10	NA
Vanadium	Total	µg/l	11	< 3	< 10	NA
Zinc	Dissolved	µg/l	37	< 6	47.4	6.01
Zinc	Total	µg/l	51	< 6	42.4	4.87

NA No data available.
Averages calculated with non-detects at half the detection limit. Averages not calculated if 100% non-detects.
Field duplicates not included in count of samples.

Water Quality Data for MLC-3A 2012						
Parameter	**Fraction**	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Average**
General Parameters						
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	1	NA	NA	448
Alkalinity, total, as CaCO3	NA	mg/l	1	NA	NA	448
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	NA	NA	NA	NA
Carbon, total organic	NA	mg/l	2	14.3	15	14.7
Chlorophyll a	NA	mg/l	NA	NA	NA	NA
Chemical Oxygen Demand	NA	mg/l	1	NA	NA	37.4
Chloride	Dissolved	mg/l	NA	NA	NA	NA
Chloride	NA	mg/l	2	13.2	22.8	18.0
Cyanide	NA	mg/l	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	2	4.8	5.2	5.00
Fluoride	NA	mg/l	NA	NA	NA	NA
Hardness, as CaCO3	NA	mg/l	2	236	394	315
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	1	< 0.1	NA	NA
Nitrogen, ammonia, as N	NA	mg/l	1	< 0.1	NA	NA
Nitrogen, total	NA	mg/l	NA	NA	NA	NA
Nitrogen, total kjeldahl (TKN)	NA	mg/l	NA	NA	NA	NA
Orthophosphate, as PO4	NA	mg/l	NA	NA	NA	NA
pH	NA	pH units	2	7.07	7.6	7.34
Phosphorus, total, as P	Dissolved	mg/l	NA	NA	NA	NA
Phosphorus, total, as P	NA	mg/l	1	NA	NA	0.005
Redox (oxidation potential)	NA	mV	NA	NA	NA	NA
Solids, total dissolved	NA	mg/l	2	369	613	491
Solids, total suspended	NA	mg/l	NA	NA	NA	NA
Specific Conductance @ 25 ºC	NA	µmhos/cm	2	506.1	885.2	696
Sulfate, as SO4	Dissolved	mg/l	NA	NA	NA	NA
Sulfate, as SO4	NA	mg/l	2	17.3	53.2	35.3
Sulfide, as S^{2}-	NA	mg/l	NA	NA	NA	NA
Temperature, ºC	NA	deg C	2	0.72	4.3	2.51
Turbidity	NA	NTU	2	0	0	NA
Metals						
Aluminum	Dissolved	µg/l	2	< 20	< 20	NA
Aluminum	Total	µg/l	2	< 20	< 20	NA
Antimony	Total	µg/l	2	< 0.5	< 0.5	NA
Arsenic	Dissolved	µg/l	NA	NA	NA	NA
Arsenic	Total	µg/l	2	< 0.5	0.59	0.42
Barium	Total	µg/l	1	NA	NA	37.3
Beryllium	Total	µg/l	1	< 0.2	NA	NA
Boron	Total	µg/l	1	NA	NA	160
Cadmium	Total	µg/l	1	< 0.2	NA	NA
Calcium	Total	mg/l	2	34.5	59.8	47.2
Chromium	Total	µg/l	1	< 1	NA	NA
Cobalt	Dissolved	µg/l	2	< 0.2	< 0.2	NA
Cobalt	Total	µg/l	2	< 0.2	0.2	0.15
Copper	Dissolved	µg/l	2	< 0.5	0.55	0.40
Copper	Total	µg/l	2	0.53	0.59	0.56
Iron	Dissolved	µg/l	2	136	231	184
Iron	Total	µg/l	2	275	284	280
Lead	Dissolved	µg/l	NA	NA	NA	NA
Lead	Total	µg/l	2	< 0.5	< 0.5	NA
Magnesium	Total	mg/l	2	36.4	59.4	47.9
Manganese	Dissolved	µg/l	2	19.2	397	208
Manganese	Total	µg/l	2	19.1	402	211
Mercury	Dissolved	ng/L	NA	NA	NA	NA
Mercury	Total	ng/L	1	0.99	1.3	1.15
Methyl Mercury	Dissolved	ng/L	NA	NA	NA	NA
Methyl Mercury	Total	ng/L	NA	NA	NA	NA
Molybdenum	Total	µg/l	1	NA	NA	1.7
Nickel	Dissolved	µg/l	2	< 0.5	< 0.5	NA
Nickel	Total	µg/l	2	< 0.5	0.59	0.42
Palladium	Total	µg/l	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA
Potassium	Total	mg/l	1	NA	NA	3
Selenium	Total	µg/l	2	< 1	< 1	NA
Silver	Total	µg/l	1	< 0.2	NA	NA
Sodium	Total	mg/l	1	NA	NA	63.9
Strontium	Total	µg/l	NA	NA	NA	NA
Thallium	Total	µg/l	2	< 0.0004	< 0.005	NA
Tin	Total	µg/l	NA	NA	NA	NA
Titanium	Total	µg/l	NA	NA	NA	NA
Vanadium	Total	µg/l	1	< 3	NA	NA
Zinc	Dissolved	µg/l	2	< 6	< 6	NA
Zinc	Total	µg/l	2	< 6	< 6	NA

NA No data available.
Averages calculated with non-detects at half the detection limit. Averages not calculated if 100% non-detects.
Field duplicates not included in count of samples.

Water Quality Data for PM-19 2009-2015						
Parameter	**Fraction**	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Average**
General Parameters						
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	36	123	535	337
Alkalinity, total, as CaCO3	NA	mg/l	25	161	514	339
Biochemical Oxygen Demand (5-day)	NA	mg/l	3	< 2.4	< 3	NA
Carbon, dissolved organic	NA	mg/l	11	11.1	24.5	16.5
Carbon, total organic	NA	mg/l	54	10.3	33.7	16.9
Chemical Oxygen Demand	NA	mg/l	18	29.8	79.7	48.9
Chloride	Dissolved	mg/l	1	NA	NA	9.59
Chloride	NA	mg/l	69	6.7	55.1	16.1
Chlorophyll a	NA	mg/l	NA	NA	NA	NA
Cyanide	NA	mg/l	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	59	< 0.1	11.68	6.04
Fluoride	NA	mg/l	2	0.87	0.95	0.91
Hardness, as CaCO3	NA	mg/l	54	121	530	310
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	18	< 0.1	< 0.1	NA
Nitrogen, ammonia, as N	NA	mg/l	15	< 0.1	0.39	0.11
Nitrogen, total	NA	mg/l	3	1.27	1.76	1.44
Nitrogen, total kjeldahl (TKN)	NA	mg/l	3	1.27	1.66	1.40
Orthophosphate, as PO4	NA	mg/l	8	< 0.02	< 0.07	0.02
pH	NA	pH units	59	6.1	7.77	7.30
Phosphorus, total, as P	Dissolved	mg/l	8	0.014	0.028	0.019
Phosphorus, total, as P	NA	mg/l	18	< 0.004	< 0.1	0.029
Redox (oxidation potential)	NA	mV	1	NA	NA	468
Solids, total dissolved	NA	mg/l	54	195	708	448
Solids, total suspended	NA	mg/l	14	< 1	19.5	4.39
Specific Conductance @ 25 ºC	NA	µmhos/cm	59	285.3	1229	685
Sulfate, as SO4	Dissolved	mg/l	1	NA	NA	8.30
Sulfate, as SO4	NA	mg/l	69	< 1	139	36.0
Sulfide, as S^{2}-	NA	mg/l	8	< 0.1	< 0.1	NA
Temperature	NA	deg C	59	0.01	22.23	8.91
Turbidity	NA	NTU	59	0	40.4	3.47
Metals						
Aluminum	Dissolved	µg/l	54	< 10	67.3	20.0
Aluminum	Total	µg/l	54	13.4	238	40.1
Antimony	Total	µg/l	31	< 0.5	< 0.5	NA
Arsenic	Dissolved	µg/l	7	< 0.5	1.1	0.64
Arsenic	Total	µg/l	54	0.45	3.9	0.94
Barium	Total	µg/l	19	52	154	83.4
Beryllium	Total	µg/l	19	< 0.2	< 0.2	NA
Boron	Total	µg/l	19	< 100	177	126
Cadmium	Total	µg/l	19	< 0.02	< 0.2	NA
Calcium	Total	mg/l	54	18.5	77.1	47.3
Chromium	Total	µg/l	19	< 1	1	0.53
Cobalt	Dissolved	µg/l	37	< 0.2	0.86	0.25
Cobalt	Total	µg/l	54	< 0.2	0.98	0.25
Copper	Dissolved	µg/l	37	< 0.15	1.9	0.57
Copper	Total	µg/l	54	0.29	2.4	0.61
Iron	Dissolved	µg/l	45	107	2560	541
Iron	Total	µg/l	54	226	5830	1086
Lead	Dissolved	µg/l	10	< 0.5	< 0.5	NA
Lead	Total	µg/l	48	< 0.02	< 0.5	0.24
Magnesium	Total	mg/l	54	18	81.8	46.6
Manganese	Dissolved	µg/l	37	36.2	4140	777
Manganese	Total	µg/l	54	24.2	3990	693
Mercury	Dissolved	ng/L	8	0.6	2.1	1.60
Mercury	Total	ng/L	22	0.5	4.2	1.72
Methyl Mercury	Dissolved	ng/L	8	< 0.1	0.67	0.35
Methyl Mercury	Total	ng/L	2	< 0.1	0.16	0.11
Molybdenum	Total	µg/l	18	0.39	2.45	1.28
Nickel	Dissolved	µg/l	37	< 0.5	3.3	0.48
Nickel	Total	µg/l	54	< 0.5	1.42	0.48
Palladium	Total	µg/l	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA
Potassium	Total	mg/l	25	1.4	5.2	3.04
Selenium	Total	µg/l	33	0.37	< 1	0.50
Silver	Total	µg/l	12	< 0.2	< 0.2	NA
Sodium	Total	mg/l	25	26.8	76.2	48.8
Strontium	Total	µg/l	2	220	242	231
Thallium	Total	µg/l	38	< 0.0004	< 0.2	0.01
Tin	Total	µg/l	2	< 0.5	< 0.5	NA
Titanium	Total	µg/l	2	< 10	< 10	NA
Vanadium	Total	µg/l	9	< 3	< 10	NA
Zinc	Dissolved	µg/l	37	< 6	21.7	4.66
Zinc	Total	µg/l	54	< 6	31.2	3.85

NA No data available.
Averages calculated with non-detects at half the detection limit. Averages not calculated if 100% non-detects.
Field duplicates not included in count of samples.

Water Quality Data for TC-1 2012						
Parameter	**Fraction**	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Average**
General Parameters						
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	1	NA	NA	335
Alkalinity, total, as CaCO3	NA	mg/l	1	NA	NA	335
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	NA	NA	NA	NA
Carbon, total organic	NA	mg/l	4	14.8	31.8	23.0
Chemical Oxygen Demand	NA	mg/l	1	NA	NA	45.8
Chloride	Dissolved	mg/l	NA	NA	NA	NA
Chloride	NA	mg/l	4	7.5	17.2	11.7
Chlorophyll a	NA	mg/l	NA	NA	NA	NA
Cyanide	NA	mg/l	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	4	1.46	6.43	4.08
Fluoride	NA	mg/l	NA	NA	NA	NA
Hardness, as CaCO3	NA	mg/l	4	231	299	273
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	1	< 0.1	NA	NA
Nitrogen, ammonia, as N	NA	mg/l	1	< 0.1	NA	NA
Nitrogen, total	NA	mg/l	NA	NA	NA	NA
Nitrogen, total kjeldahl (TKN)	NA	mg/l	NA	NA	NA	NA
Orthophosphate, as PO4	NA	mg/l	NA	NA	NA	NA
pH	NA	pH units	4	7.38	7.69	7.48
Phosphorus, total, as P	Dissolved	mg/l	NA	NA	NA	NA
Phosphorus, total, as P	NA	mg/l	1	NA	NA	0.028
Redox (oxidation potential)	NA	mV	NA	NA	NA	NA
Solids, total dissolved	NA	mg/l	4	366	416	400
Solids, total suspended	NA	mg/l	NA	NA	NA	NA
Specific Conductance @ 25 ºC	NA	µmhos/cm	4	492.2	651.9	600
Sulfate, as SO4	Dissolved	mg/l	NA	NA	NA	NA
Sulfate, as SO4	NA	mg/l	4	1.3	36.6	12.4
Sulfide, as S^{2}-	NA	mg/l	NA	NA	NA	NA
Temperature	NA	deg C	4	7.04	19.42	12.7
Turbidity	NA	NTU	4	0.7	15.3	5.45
Metals						
Aluminum	Dissolved	µg/l	4	25.6	48	36.7
Aluminum	Total	µg/l	4	26.5	82.5	44.9
Antimony	Total	µg/l	4	< 0.5	< 0.5	NA
Arsenic	Dissolved	µg/l	NA	NA	NA	NA
Arsenic	Total	µg/l	4	0.98	5.2	2.57
Barium	Total	µg/l	1	NA	NA	95.2
Beryllium	Total	µg/l	1	< 0.2	NA	NA
Boron	Total	µg/l	1	NA	NA	137
Cadmium	Total	µg/l	1	< 0.2	NA	NA
Calcium	Total	mg/l	4	38.2	49.8	43.6
Chromium	Total	µg/l	1	< 1	NA	NA
Cobalt	Dissolved	µg/l	4	< 0.2	1.2	0.55
Cobalt	Total	µg/l	4	0.25	1.4	0.62
Copper	Dissolved	µg/l	4	< 0.5	0.85	0.40
Copper	Total	µg/l	4	< 0.5	0.53	0.32
Iron	Dissolved	µg/l	4	329	3070	1481
Iron	Total	µg/l	4	941	8330	3255
Lead	Dissolved	µg/l	NA	NA	NA	NA
Lead	Total	µg/l	4	< 0.5	< 0.5	NA
Magnesium	Total	mg/l	4	33	42.3	39.9
Manganese	Dissolved	µg/l	4	111	3430	1218
Manganese	Total	µg/l	4	202	3670	1305
Mercury	Dissolved	ng/L	NA	NA	NA	NA
Mercury	Total	ng/L	1	NA	NA	1.10
Methyl Mercury	Dissolved	ng/L	NA	NA	NA	NA
Methyl Mercury	Total	ng/L	NA	NA	NA	NA
Molybdenum	Total	µg/l	1	NA	NA	0.89
Nickel	Dissolved	µg/l	4	< 0.5	0.84	0.40
Nickel	Total	µg/l	4	< 0.5	0.88	0.52
Palladium	Total	µg/l	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA
Potassium	Total	mg/l	1	NA	NA	2.30
Selenium	Total	µg/l	4	< 1	< 1	NA
Silver	Total	µg/l	1	< 0.2	NA	NA
Sodium	Total	mg/l	1	NA	NA	47.0
Strontium	Total	µg/l	NA	NA	NA	NA
Thallium	Total	µg/l	4	< 0.0004	< 0.005	NA
Tin	Total	µg/l	NA	NA	NA	NA
Titanium	Total	µg/l	NA	NA	NA	NA
Vanadium	Total	µg/l	1	< 3	NA	NA
Zinc	Dissolved	µg/l	4	< 6	< 6	NA
Zinc	Total	µg/l	4	< 6	8.9	4.48

NA No data available.
Averages calculated with non-detects at half the detection limit. Averages not calculated if 100% non-detects.
Field duplicates not included in count of samples.

Water Quality Data for TC-1a 2012-2015						
Parameter	**Fraction**	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Average**
General Parameters						
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	26	144	545	332
Alkalinity, total, as CaCO3	NA	mg/l	12	177	523	328
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	NA	NA	NA	NA
Carbon, total organic	NA	mg/l	38	10	27.2	14.9
Chemical Oxygen Demand	NA	mg/l	5	31	59.6	40.5
Chloride	Dissolved	mg/l	NA	NA	NA	NA
Chloride	NA	mg/l	38	6.6	33.5	17.3
Chlorophyll a	NA	mg/l	NA	NA	NA	NA
Cyanide	NA	mg/l	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	38	1.54	11.46	6.34
Fluoride	NA	mg/l	NA	NA	NA	NA
Hardness, as CaCO3	NA	mg/l	38	144	547	331
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	5	< 0.1	< 0.1	NA
Nitrogen, ammonia, as N	NA	mg/l	5	< 0.1	0.31	0.12
Nitrogen, total	NA	mg/l	NA	NA	NA	NA
Nitrogen, total kjeldahl (TKN)	NA	mg/l	NA	NA	NA	NA
Orthophosphate, as PO4	NA	mg/l	NA	NA	NA	NA
pH	NA	pH units	38	6.85	7.82	7.3721053
Phosphorus, total, as P	Dissolved	mg/l	NA	NA	NA	NA
Phosphorus, total, as P	NA	mg/l	5	< 0.004	0.048	0.02
Redox (oxidation potential)	NA	mV	NA	NA	NA	NA
Solids, total dissolved	NA	mg/l	38	231	722	474
Solids, total suspended	NA	mg/l	NA	NA	NA	NA
Specific Conductance @ 25 ºC	NA	µmhos/cm	38	345.6	1150	723
Sulfate, as SO4	Dissolved	mg/l	NA	NA	NA	NA
Sulfate, as SO4	NA	mg/l	38	1	132	51.4
Sulfide, as S^{2}-	NA	mg/l	NA	NA	NA	NA
Temperature	NA	deg C	38	-0.09	19.25	7.26
Turbidity	NA	NTU	38	0	42.4	4.77
Metals						
Aluminum	Dissolved	µg/l	38	< 10	< 50	16.1
Aluminum	Total	µg/l	38	10.2	76.4	22.4
Antimony	Total	µg/l	17	< 0.5	< 0.5	NA
Arsenic	Dissolved	µg/l	7	< 0.5	2.2	0.96
Arsenic	Total	µg/l	38	< 0.31	3.7	0.87
Barium	Total	µg/l	12	66.9	157	103
Beryllium	Total	µg/l	12	< 0.2	< 0.2	NA
Boron	Total	µg/l	12	< 100	185	138
Cadmium	Total	µg/l	12	< 0.2	< 0.2	NA
Calcium	Total	mg/l	38	21.8	81	49.2
Chromium	Total	µg/l	12	< 1	< 1	NA
Cobalt	Dissolved	µg/l	24	< 0.2	0.61	0.23
Cobalt	Total	µg/l	38	< 0.2	0.72	0.23
Copper	Dissolved	µg/l	24	< 0.5	1.2	0.47
Copper	Total	µg/l	38	< 0.5	3.6	0.52
Iron	Dissolved	µg/l	24	95.3	2990	542
Iron	Total	µg/l	38	226	6700	1162
Lead	Dissolved	µg/l	10	< 0.5	< 0.5	NA
Lead	Total	µg/l	38	< 0.5	< 0.5	NA
Magnesium	Total	mg/l	38	21.6	83.7	50.6
Manganese	Dissolved	µg/l	24	37	1960	637
Manganese	Total	µg/l	38	22.2	3210	686
Mercury	Dissolved	ng/L	NA	NA	NA	NA
Mercury	Total	ng/L	12	0.655	5.1	2.14
Methyl Mercury	Dissolved	ng/L	NA	NA	NA	NA
Methyl Mercury	Total	ng/L	NA	NA	NA	NA
Molybdenum	Total	µg/l	5	0.63	1.5	1.03
Nickel	Dissolved	µg/l	24	< 0.5	1.4	0.36
Nickel	Total	µg/l	38	< 0.5	1.2	0.38
Palladium	Total	µg/l	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA
Potassium	Total	mg/l	12	1.7	5	3.15
Selenium	Total	µg/l	24	< 1	< 1	NA
Silver	Total	µg/l	5	< 0.2	< 0.2	NA
Sodium	Total	mg/l	12	30.2	70	49.4
Strontium	Total	µg/l	NA	NA	NA	NA
Thallium	Total	µg/l	24	< 0.0004	< 0.02	NA
Tin	Total	µg/l	NA	NA	NA	NA
Titanium	Total	µg/l	NA	NA	NA	NA
Vanadium	Total	µg/l	5	< 3	< 3	NA
Zinc	Dissolved	µg/l	24	< 6	6.4	3.14
Zinc	Total	µg/l	38	< 6	11.5	3.32

NA No data available.
Averages calculated with non-detects at half the detection limit. Averages not calculated if 100% non-detects.
Field duplicates not included in count of samples.

Water Quality Data for PM-11 / SW003 2004-2015						
Parameter	**Fraction**	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Average**
General Parameters						
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	36	85.3	550	310
Alkalinity, total, as CaCO3	NA	mg/l	37	106	550	295
Biochemical Oxygen Demand (5-day)	NA	mg/l	3	< 3	< 3	NA
Carbon, dissolved organic	NA	mg/l	11	8.7	14.3	11.7
Carbon, total organic	NA	mg/l	68	6.5	44.6	13.0
Chemical Oxygen Demand	NA	mg/l	25	16.2	65.8	34.1
Chloride	Dissolved	mg/l	1	NA	NA	14.3
Chloride	NA	mg/l	81	3.1	34.1	17.0
Chlorophyll a	NA	mg/l	NA	NA	NA	NA
Cyanide	NA	mg/l	4	< 0.02	< 0.02	NA
Dissolved oxygen	NA	mg/l	63	< 0.1	12.69	6.27
Fluoride	NA	mg/l	11	0.84	2.2	1.49
Hardness, as CaCO3	NA	mg/l	66	109	705	373
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	25	< 0.1	0.11	0.05
Nitrogen, ammonia, as N	NA	mg/l	19	< 0.1	0.21	0.07
Nitrogen, total	NA	mg/l	3	1.17	1.28	1.22
Nitrogen, total kjeldahl (TKN)	NA	mg/l	3	1.11	1.28	1.19
Orthophosphate, as PO4	NA	mg/l	8	< 0.02	< 0.07	0.01
pH	NA	pH units	76	6.64	8.3	7.56
Phosphorus, total, as P	Dissolved	mg/l	9	0.005	< 0.02	0.009
Phosphorus, total, as P	NA	mg/l	32	< 0.004	< 1	0.047
Redox (oxidation potential)	NA	mV	1	NA	NA	493
Solids, total dissolved	NA	mg/l	66	186	927	492
Solids, total suspended	NA	mg/l	24	< 1	8	2.62
Specific Conductance @ 25 ºC	NA	umhos/cm	70	248	1386	793
Sulfate, as SO4	Dissolved	mg/l	1	NA	NA	123
Sulfate, as SO4	NA	mg/l	85	4.4	245	115
Sulfide, as S^{2}-	NA	mg/l	8	< 0.1	< 0.1	NA
Temperature	NA	deg C	69	0.24	24.4	10.2
Turbidity	NA	NTU	64	0	13.5	1.72
Metals						
Aluminum	Dissolved	µg/l	54	< 10	83.9	17.0
Aluminum	Total	µg/l	66	< 10	119	29.5
Antimony	Total	µg/l	35	< 0.5	< 3	NA
Arsenic	Dissolved	µg/l	7	< 0.5	3.9	1.14
Arsenic	Total	µg/l	58	< 0.5	4.1	0.87
Barium	Total	µg/l	26	13.4	67.9	35.5
Beryllium	Total	µg/l	23	< 0.2	< 0.2	NA
Boron	Total	µg/l	23	< 100	307	207
Cadmium	Total	µg/l	26	0.021	< 0.2	0.084
Calcium	Total	mg/l	66	15.5	78.4	44.6
Chromium	Total	µg/l	26	0.33	2.3	0.64
Cobalt	Dissolved	µg/l	37	< 0.2	7	0.34
Cobalt	Total	µg/l	64	0.16	7.6	0.30
Copper	Dissolved	µg/l	37	0.34	1.8	0.81
Copper	Total	µg/l	66	< 0.5	< 5	0.93
Iron	Dissolved	µg/l	45	80	17300	653
Iron	Total	µg/l	61	0.21	18000	890
Lead	Dissolved	µg/l	10	< 0.5	< 0.5	NA
Lead	Total	µg/l	60	0.03	< 1	0.25
Magnesium	Total	mg/l	66	18.9	124	63.8
Manganese	Dissolved	µg/l	37	17.3	1640	380
Manganese	Total	µg/l	64	19.3	1800	323
Mercury	Dissolved	ng/L	8	0.6	2.5	1.45
Mercury	Total	ng/L	38	< 0.5	< 10	2.00
Methyl Mercury	Dissolved	ng/L	8	< 0.1	0.55	0.20
Methyl Mercury	Total	ng/L	9	0.15	0.46	0.26
Molybdenum	Total	µg/l	28	3.7	29.3	11.9
Nickel	Dissolved	µg/l	37	< 0.5	1.8	0.41
Nickel	Total	µg/l	66	< 0.5	< 5	0.68
Palladium	Total	µg/l	5	< 0.3	< 25	NA
Platinum	Total	µg/l	5	< 0.25	< 250	NA
Potassium	Total	mg/l	32	1	8.41	4.89
Selenium	Total	µg/l	42	0.24	< 3.6	0.67
Silver	Total	µg/l	21	< 0.2	< 1	NA
Sodium	Total	mg/l	34	12.6	62.2	40.6
Strontium	Total	µg/l	6	95.1	327	207
Thallium	Total	µg/l	47	< 0.0004	< 2	0.116
Tin	Total	µg/l	2	< 0.5	< 0.5	NA
Titanium	Total	µg/l	3	< 10	< 10	NA
Vanadium	Total	µg/l	9	< 3	< 10	NA
Zinc	Dissolved	µg/l	37	< 6	7.9	3.52
Zinc	Total	µg/l	66	1.6	41.2	4.15

NA No data available.
Averages calculated with non-detects at half the detection limit. Averages not calculated if 100% non-detects.
Field duplicates not included in count of samples.

Water Quality Data for UC-1 / PM-9 2004-2006, 2012-2013						
Parameter	**Fraction**	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Average**
General Parameters						
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	3	399	471	437
Alkalinity, total, as CaCO3	NA	mg/l	12	186	471	336
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	NA	NA	NA	NA
Carbon, total organic	NA	mg/l	18	5.8	18.5	10.6
Chemical Oxygen Demand	NA	mg/l	10	5.1	84.4	28.7
Chloride	Dissolved	mg/l	NA	NA	NA	NA
Chloride	NA	mg/l	20	11	43.9	25.3
Chlorophyll a	NA	mg/l	NA	NA	NA	NA
Cyanide	NA	mg/l	4	< 0.02	< 0.02	NA
Dissolved oxygen	NA	mg/l	13	0.68	12.03	6.68
Fluoride	NA	mg/l	9	1.12	1.9	1.52
Hardness, as CaCO3	NA	mg/l	20	213	844	461
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	10	< 0.1	0.12	0.06
Nitrogen, ammonia, as N	NA	mg/l	7	< 0.1	0.24	0.09
Nitrogen, total	NA	mg/l	NA	NA	NA	NA
Nitrogen, total kjeldahl (TKN)	NA	mg/l	NA	NA	NA	NA
Orthophosphate, as PO4	NA	mg/l	NA	NA	NA	NA
pH	NA	pH units	21	6.97	8.2	7.62
Phosphorus, total, as P	Dissolved	mg/l	1	< 0.02	NA	NA
Phosphorus, total, as P	NA	mg/l	10	0.008	< 0.1	0.043
Redox (oxidation potential)	NA	mV	NA	NA	NA	NA
Solids, total dissolved	NA	mg/l	20	325	1030	615
Solids, total suspended	NA	mg/l	7	< 1	12	4.43
Specific Conductance @ 25 ºC	NA	µmhos/cm	21	569	1558	951
Sulfate, as SO4	Dissolved	mg/l	NA	NA	NA	NA
Sulfate, as SO4	NA	mg/l	20	67.5	380	169
Sulfide, as S^{2}-	NA	mg/l	NA	NA	NA	NA
Temperature	NA	deg C	20	0.3	21.19	9.24
Turbidity	NA	NTU	14	0	3.4	1.60
Metals						
Aluminum	Dissolved	µg/l	11	< 20	30.3	19.7
Aluminum	Total	µg/l	20	< 20	52.4	26.7
Antimony	Total	µg/l	15	< 0.5	< 3	NA
Arsenic	Dissolved	µg/l	NA	NA	NA	NA
Arsenic	Total	µg/l	15	< 0.5	< 2	0.84
Barium	Total	µg/l	10	18.3	59.5	36.3
Beryllium	Total	µg/l	7	< 0.2	< 0.2	NA
Boron	Total	µg/l	7	228	395	309
Cadmium	Total	µg/l	7	< 0.2	< 0.2	NA
Calcium	Total	mg/l	20	33.8	91.7	57.9
Chromium	Total	µg/l	7	< 1	1.4	0.80
Cobalt	Dissolved	µg/l	11	< 0.2	0.34	0.21
Cobalt	Total	µg/l	18	< 0.2	< 1	0.32
Copper	Dissolved	µg/l	11	0.54	3.7	1.38
Copper	Total	µg/l	20	< 0.5	< 5	1.43
Iron	Dissolved	µg/l	11	65.4	1050	257
Iron	Total	µg/l	18	0.3	1590	369
Lead	Dissolved	µg/l	NA	NA	NA	NA
Lead	Total	µg/l	20	< 0.3	< 1	NA
Magnesium	Total	mg/l	20	39.7	149	78.4
Manganese	Dissolved	µg/l	11	27.9	1520	326
Manganese	Total	µg/l	18	40	1520	259
Mercury	Dissolved	ng/L	NA	NA	NA	NA
Mercury	Total	ng/L	12	1	< 10	2.73
Methyl Mercury	Dissolved	ng/L	NA	NA	NA	NA
Methyl Mercury	Total	ng/L	NA	NA	NA	NA
Molybdenum	Total	µg/l	10	4.4	30	17.4
Nickel	Dissolved	µg/l	11	< 0.5	1.1	0.45
Nickel	Total	µg/l	20	< 0.5	< 5	1.12
Palladium	Total	µg/l	5	< 0.3	< 250	NA
Platinum	Total	µg/l	5	< 0.25	< 125	NA
Potassium	Total	mg/l	10	4.1	9.1	6.27
Selenium	Total	µg/l	20	< 1	< 3.6	NA
Silver	Total	µg/l	12	< 0.2	< 1	NA
Sodium	Total	mg/l	12	35.1	61.4	49.0
Strontium	Total	µg/l	4	179	326	258
Thallium	Total	µg/l	20	< 0.0004	< 2	0.25
Tin	Total	µg/l	NA	NA	NA	NA
Titanium	Total	µg/l	1	< 10	NA	NA
Vanadium	Total	µg/l	3	< 3	< 3	NA
Zinc	Dissolved	µg/l	11	< 6	30.4	7.81
Zinc	Total	µg/l	20	< 6	64	9.55

NA No data available.
Averages calculated with non-detects at half the detection limit. Averages not calculated if 100% non-detects.
Field duplicates not included in count of samples.

Water Quality Data for PM-12 / SW004 2004-2015						
Parameter	**Fraction**	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Average**
General Parameters						
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	28	13.3	122	57.1
Alkalinity, total, as CaCO3	NA	mg/l	41	15.2	152	51.8
Biochemical Oxygen Demand (5-day)	NA	mg/l	2	< 3	< 3	NA
Carbon, dissolved organic	NA	mg/l	10	15.6	32.3	23.7
Carbon, total organic	NA	mg/l	72	6.2	44.7	22.0
Chemical Oxygen Demand	NA	mg/l	16	25.2	122	61.3
Chloride	Dissolved	mg/l	1	NA	NA	5.90
Chloride	NA	mg/l	85	1.3	22.3	4.82
Chlorophyll a	NA	mg/l	NA	NA	NA	NA
Cyanide	NA	mg/l	4	< 0.02	< 0.02	NA
Dissolved oxygen	NA	mg/l	72	< 0.1	11.8	5.53
Fluoride	NA	mg/l	21	< 0.1	0.2	0.10
Hardness, as CaCO3	NA	mg/l	70	17.8	171	61.7
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	16	< 0.1	0.12	0.05
Nitrogen, ammonia, as N	NA	mg/l	11	< 0.1	0.56	0.14
Nitrogen, total	NA	mg/l	2	1.56	1.76	1.66
Nitrogen, total kjeldahl (TKN)	NA	mg/l	2	1.56	1.66	1.61
Orthophosphate, as PO4	NA	mg/l	8	< 0.02	< 0.07	0.03
pH	NA	pH units	86	5.84	8.45	7.04
Phosphorus, total, as P	Dissolved	mg/l	9	0.01	0.035	0.02
Phosphorus, total, as P	NA	mg/l	36	0.009	0.22	0.06
Redox (oxidation potential)	NA	mV	NA	NA	NA	NA
Solids, total dissolved	NA	mg/l	70	46	258	133
Solids, total suspended	NA	mg/l	20	< 1	4	2.09
Specific Conductance @ 25 ºC	NA	µmhos/cm	79	0	777	138
Sulfate, as SO4	Dissolved	mg/l	1	NA	NA	1.07
Sulfate, as SO4	NA	mg/l	89	0.5	116	5.74
Sulfide, as S^{2}-	NA	mg/l	8	< 0.1	< 0.1	NA
Temperature	NA	deg C	79	0.22	25.3	10.3
Turbidity	NA	NTU	61	0	3000	59.2
Metals						
Aluminum	Dissolved	µg/l	52	23.2	184	73.6
Aluminum	Total	µg/l	64	44.3	280	109
Antimony	Total	µg/l	27	< 0.5	< 3	NA
Arsenic	Dissolved	µg/l	7	< 0.5	2	1.12
Arsenic	Total	µg/l	49	0.38	< 10	1.44
Barium	Total	µg/l	23	< 10	57.9	22.4
Beryllium	Total	µg/l	20	< 0.2	1.4	0.17
Boron	Total	µg/l	21	< 35	< 100	NA
Cadmium	Total	µg/l	23	< 0.02	1.1	0.14
Calcium	Total	mg/l	70	4.1	29.9	14.5
Chromium	Total	µg/l	23	0.48	2.3	0.76
Cobalt	Dissolved	µg/l	29	< 0.2	3.7	1.41
Cobalt	Total	µg/l	70	0.13	4.1	1.01
Copper	Dissolved	µg/l	29	< 0.5	1.5	0.71
Copper	Total	µg/l	72	< 0.5	< 5	1.08
Iron	Dissolved	µg/l	37	541	9800	3066
Iron	Total	µg/l	52	1.66	11200	3991
Lead	Dissolved	µg/l	10	< 0.5	< 0.5	NA
Lead	Total	µg/l	57	0.08	1.1	0.27
Magnesium	Total	mg/l	70	1.8	27.3	6.28
Manganese	Dissolved	µg/l	29	13.6	1390	530
Manganese	Total	µg/l	55	6.7	1550	418
Mercury	Dissolved	ng/L	8	1.5	5	3.49
Mercury	Total	ng/L	42	0.877	< 10	4.36
Methyl Mercury	Dissolved	ng/L	8	0.12	2.7	0.72
Methyl Mercury	Total	ng/L	13	0.16	1.38	0.53
Molybdenum	Total	µg/l	19	0.094	< 5	1.28
Nickel	Dissolved	µg/l	29	< 0.5	2.1	1.09
Nickel	Total	µg/l	72	< 0.5	< 5	1.34
Palladium	Total	µg/l	5	< 0.3	< 25	NA
Platinum	Total	µg/l	5	< 0.25	< 25	NA
Potassium	Total	mg/l	23	0.29	4	1.23
Selenium	Total	µg/l	39	0.085	< 10	0.80
Silver	Total	µg/l	18	< 0.2	< 1	NA
Sodium	Total	mg/l	25	2.2	11.8	4.01
Strontium	Total	µg/l	4	17.6	61.9	35.2
Thallium	Total	µg/l	40	< 0.0004	< 2	0.13
Tin	Total	µg/l	1	< 0.5	NA	NA
Titanium	Total	µg/l	1	< 10	NA	NA
Vanadium	Total	µg/l	7	< 3	< 3	NA
Zinc	Dissolved	µg/l	29	< 6	13.7	5.26
Zinc	Total	µg/l	72	2.7	104	7.72

NA No data available.
Averages calculated with non-detects at half the detection limit. Averages not calculated if 100% non-detects.
Field duplicates not included in count of samples.

Water Quality Data for UC-1A 2013-2015						
Parameter	**Fraction**	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Average**
General Parameters						
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	24	104	551	318
Alkalinity, total, as CaCO3	NA	mg/l	10	173	551	319
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	NA	NA	NA	NA
Carbon, total organic	NA	mg/l	31	6.7	21.4	11.4
Chemical Oxygen Demand	NA	mg/l	3	22.9	60.7	39.7
Chloride	Dissolved	mg/l	NA	NA	NA	NA
Chloride	NA	mg/l	31	4.4	33.1	17.5
Chlorophyll a	NA	mg/l	NA	NA	NA	NA
Cyanide	NA	mg/l	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	31	4.58	11.91	8.12
Fluoride	NA	mg/l	NA	NA	NA	NA
Hardness, as CaCO3	NA	mg/l	31	146	698	402
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	3	< 0.1	< 0.1	NA
Nitrogen, ammonia, as N	NA	mg/l	3	< 0.1	0.12	0.07
Nitrogen, total	NA	mg/l	NA	NA	NA	NA
Nitrogen, total kjeldahl (TKN)	NA	mg/l	NA	NA	NA	NA
Orthophosphate, as PO4	NA	mg/l	NA	NA	NA	NA
pH	NA	pH units	31	7.13	7.84	7.55
Phosphorus, total, as P	Dissolved	mg/l	NA	NA	NA	NA
Phosphorus, total, as P	NA	mg/l	3	0.02	0.076	0.041
Redox (oxidation potential)	NA	mV	NA	NA	NA	NA
Solids, total dissolved	NA	mg/l	31	198	932	517
Solids, total suspended	NA	mg/l	NA	NA	NA	NA
Specific Conductance @ 25 ºC	NA	µmhos/cm	31	313	1385	802
Sulfate, as SO4	Dissolved	mg/l	NA	NA	NA	NA
Sulfate, as SO4	NA	mg/l	31	2.8	255	111
Sulfide, as S^{2}-	NA	mg/l	NA	NA	NA	NA
Temperature	NA	deg C	31	0.61	19.81	9.22
Turbidity	NA	NTU	32	0	10.7	2.78
Metals						
Aluminum	Dissolved	µg/l	31	< 10	< 50	13.0
Aluminum	Total	µg/l	31	< 10	74.7	19.5
Antimony	Total	µg/l	10	< 0.5	< 0.5	NA
Arsenic	Dissolved	µg/l	7	< 0.5	1.6	0.74
Arsenic	Total	µg/l	31	< 0.5	2.8	0.79
Barium	Total	µg/l	10	29	61.9	42.1
Beryllium	Total	µg/l	10	< 0.2	< 0.2	NA
Boron	Total	µg/l	10	141	305	208
Cadmium	Total	µg/l	10	< 0.2	< 0.2	NA
Calcium	Total	mg/l	31	19	75.9	47.2
Chromium	Total	µg/l	10	< 1	< 1	NA
Cobalt	Dissolved	µg/l	17	< 0.2	0.35	0.15
Cobalt	Total	µg/l	31	< 0.2	0.4	0.18
Copper	Dissolved	µg/l	17	< 0.5	1.1	0.64
Copper	Total	µg/l	31	< 0.5	2	0.65
Iron	Dissolved	µg/l	17	71.4	1660	422
Iron	Total	µg/l	31	220	2730	871
Lead	Dissolved	µg/l	10	< 0.5	< 0.5	NA
Lead	Total	µg/l	31	< 0.5	< 0.5	NA
Magnesium	Total	mg/l	31	24	124	69.1
Manganese	Dissolved	µg/l	17	45.6	927	461
Manganese	Total	µg/l	31	34	2430	540
Mercury	Dissolved	ng/L	NA	NA	NA	NA
Mercury	Total	ng/L	10	0.527	5.7	1.94
Methyl Mercury	Dissolved	ng/L	NA	NA	NA	NA
Methyl Mercury	Total	ng/L	NA	NA	NA	NA
Molybdenum	Total	µg/l	3	5.1	7	5.77
Nickel	Dissolved	µg/l	17	< 0.5	1.3	0.43
Nickel	Total	µg/l	31	< 0.5	1.5	0.35
Palladium	Total	µg/l	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA
Potassium	Total	mg/l	10	1.7	7.2	4.02
Selenium	Total	µg/l	17	< 1	< 1	NA
Silver	Total	µg/l	3	< 0.2	< 0.2	NA
Sodium	Total	mg/l	10	17.6	62.9	34.5
Strontium	Total	µg/l	NA	NA	NA	NA
Thallium	Total	µg/l	17	< 0.002	< 0.02	0.004
Tin	Total	µg/l	NA	NA	NA	NA
Titanium	Total	µg/l	NA	NA	NA	NA
Vanadium	Total	µg/l	3	< 3	< 3	NA
Zinc	Dissolved	µg/l	17	< 6	9.7	3.58
Zinc	Total	µg/l	31	< 6	10.8	3.25

NA No data available.
Averages calculated with non-detects at half the detection limit. Averages not calculated if 100% non-detects.
Field duplicates not included in count of samples.

Water Quality Data for PM-12.2 2010-2015						
Parameter	**Fraction**	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Average**
General Parameters						
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	21	23	219	103
Alkalinity, total, as CaCO3	NA	mg/l	7	71.2	192	104
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	NA	NA	NA	NA
Carbon, total organic	NA	mg/l	43	4.7	46.6	20.6
Chemical Oxygen Demand	NA	mg/l	NA	NA	NA	NA
Chloride	Dissolved	mg/l	NA	NA	NA	NA
Chloride	NA	mg/l	51	1.3	10.3	3.69
Chlorophyll a	NA	mg/l	NA	NA	NA	NA
Cyanide	NA	mg/l	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	50	< 0.1	12.19	5.60
Fluoride	NA	mg/l	NA	NA	NA	NA
Hardness, as CaCO3	NA	mg/l	21	57.2	711	261
Nitrate + Nitrite, as N	NA	mg/l	NA	NA	NA	NA
Nitrogen, ammonia as N	NA	mg/l	NA	NA	NA	NA
Nitrogen, total	NA	mg/l	NA	NA	NA	NA
Nitrogen, total kjeldahl (TKN)	NA	mg/l	NA	NA	NA	NA
Orthophosphate, as PO4	NA	mg/l	NA	NA	NA	NA
pH	NA	pH units	50	6.08	8.32	7.19
Phosphorus, total, as P	Dissolved	mg/l	NA	NA	NA	NA
Phosphorus, total, as P	NA	mg/l	NA	NA	NA	NA
Redox (oxidation potential)	NA	mV	1	NA	NA	437
Solids, total dissolved	NA	mg/l	21	114	1020	413
Solids, total suspended	NA	mg/l	NA	NA	NA	NA
Specific Conductance @ 25 ºC	NA	µmhos/cm	50	11.5	1600	539
Sulfate, as SO4	Dissolved	mg/l	NA	NA	NA	NA
Sulfate, as SO4	NA	mg/l	51	30.4	595	171
Sulfide, as S^{2}-	NA	mg/l	NA	NA	NA	NA
Temperature	NA	deg C	50	0.07	456	19.1
Turbidity	NA	NTU	51	0	3000	66.0
Metals						
Aluminum	Dissolved	µg/l	47	15.5	160	46.4
Aluminum	Total	µg/l	47	< 20	197	77.3
Antimony	Total	µg/l	7	< 0.5	< 0.5	NA
Arsenic	Dissolved	µg/l	7	< 0.5	2.1	1.03
Arsenic	Total	µg/l	21	< 0.31	3	0.97
Barium	Total	µg/l	7	21.6	49.4	28.0
Beryllium	Total	µg/l	7	< 0.2	2.4	0.43
Boron	Total	µg/l	7	< 100	< 100	NA
Cadmium	Total	µg/l	7	< 0.2	2.1	0.39
Calcium	Total	mg/l	21	7.4	60.7	26.5
Chromium	Total	µg/l	7	< 1	1.9	0.80
Cobalt	Dissolved	µg/l	7	0.38	1.2	0.66
Cobalt	Total	µg/l	21	< 0.2	2.8	0.58
Copper	Dissolved	µg/l	7	0.74	1.2	0.93
Copper	Total	µg/l	21	0.55	3.2	1.21
Iron	Dissolved	µg/l	29	272	5710	1525
Iron	Total	µg/l	43	475	6940	2082
Lead	Dissolved	µg/l	NA	NA	NA	NA
Lead	Total	µg/l	21	< 0.5	2	0.33
Magnesium	Total	mg/l	21	9.4	136	47.3
Manganese	Dissolved	µg/l	29	75.3	1390	560
Manganese	Total	µg/l	43	19.8	1440	479
Mercury	Dissolved	ng/L	NA	NA	NA	NA
Mercury	Total	ng/L	7	0.522	7	3.13
Methyl Mercury	Dissolved	ng/L	NA	NA	NA	NA
Methyl Mercury	Total	ng/L	NA	NA	NA	NA
Molybdenum	Total	µg/l	NA	NA	NA	NA
Nickel	Dissolved	µg/l	7	0.55	2.9	1.32
Nickel	Total	µg/l	21	< 0.5	3.1	1.18
Palladium	Total	µg/l	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA
Potassium	Total	mg/l	7	4	17.4	8.41
Selenium	Total	µg/l	7	< 1	3.2	0.89
Silver	Total	µg/l	NA	NA	NA	NA
Sodium	Total	mg/l	7	8.3	32.5	16.8
Strontium	Total	µg/l	NA	NA	NA	NA
Thallium	Total	µg/l	7	< 0.005	< 0.02	0.01
Tin	Total	µg/l	NA	NA	NA	NA
Titanium	Total	µg/l	NA	NA	NA	NA
Vanadium	Total	µg/l	NA	NA	NA	NA
Zinc	Dissolved	µg/l	7	< 6	< 6	NA
Zinc	Total	µg/l	21	< 6	7.2	3.20

NA No data available.
Averages calculated with non-detects at half the detection limit. Averages not calculated if 100% non-detects.
Field duplicates not included in count of samples.

Water Quality Data for PM-12.3 2010-2015						
Parameter	**Fraction**	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Average**
General Parameters						
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	NA	NA	NA	NA
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	NA	NA	NA	NA
Carbon, total organic	NA	mg/l	43	9.7	46.3	21.4
Chemical Oxygen Demand	NA	mg/l	NA	NA	NA	NA
Chloride	Dissolved	mg/l	NA	NA	NA	NA
Chloride	NA	mg/l	51	1.5	13	4.96
Chlorophyll a	NA	mg/l	NA	NA	NA	NA
Cyanide	NA	mg/l	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	50	< 0.1	12.35	7.36
Fluoride	NA	mg/l	NA	NA	NA	NA
Hardness, as CaCO3	NA	mg/l	NA	NA	NA	NA
Nitrate + Nitrite, as N	NA	mg/l	NA	NA	NA	NA
Nitrogen, ammonia as N	NA	mg/l	NA	NA	NA	NA
Nitrogen, total	NA	mg/l	NA	NA	NA	NA
Nitrogen, total kjeldahl (TKN)	NA	mg/l	NA	NA	NA	NA
Orthophosphate, as PO4	NA	mg/l	NA	NA	NA	NA
pH	NA	pH units	50	6.27	8.25	7.28
Phosphorus, total, as P	Dissolved	mg/l	NA	NA	NA	NA
Phosphorus, total, as P	NA	mg/l	NA	NA	NA	NA
Redox (oxidation potential)	NA	mV	1	NA	NA	463
Solids, total dissolved	NA	mg/l	NA	NA	NA	NA
Solids, total suspended	NA	mg/l	NA	NA	NA	NA
Specific Conductance @ 25 ºC	NA	µmhos/cm	50	95.7	802.6	308
Sulfate, as SO4	Dissolved	mg/l	NA	NA	NA	NA
Sulfate, as SO4	NA	mg/l	51	5.64	221	58.2
Sulfide, as S^{2}-	NA	mg/l	NA	NA	NA	NA
Temperature	NA	deg C	50	-0.01	22.72	10.2
Turbidity	NA	NTU	51	0	3000	64.2
Metals						
Aluminum	Dissolved	µg/l	26	< 20	133	43.4
Aluminum	Total	µg/l	26	26.8	433	125
Antimony	Total	µg/l	NA	NA	NA	NA
Arsenic	Dissolved	µg/l	NA	NA	NA	NA
Arsenic	Total	µg/l	NA	NA	NA	NA
Barium	Total	µg/l	NA	NA	NA	NA
Beryllium	Total	µg/l	NA	NA	NA	NA
Boron	Total	µg/l	NA	NA	NA	NA
Cadmium	Total	µg/l	NA	NA	NA	NA
Calcium	Total	mg/l	NA	NA	NA	NA
Chromium	Total	µg/l	NA	NA	NA	NA
Cobalt	Dissolved	µg/l	NA	NA	NA	NA
Cobalt	Total	µg/l	NA	NA	NA	NA
Copper	Dissolved	µg/l	NA	NA	NA	NA
Copper	Total	µg/l	NA	NA	NA	NA
Iron	Dissolved	µg/l	43	380	6240	1780
Iron	Total	µg/l	43	472	6620	2391
Lead	Dissolved	µg/l	NA	NA	NA	NA
Lead	Total	µg/l	NA	NA	NA	NA
Magnesium	Total	mg/l	NA	NA	NA	NA
Manganese	Dissolved	µg/l	22	30.5	1640	543
Manganese	Total	µg/l	22	43.3	1660	562
Mercury	Dissolved	ng/L	NA	NA	NA	NA
Mercury	Total	ng/L	NA	NA	NA	NA
Methyl Mercury	Dissolved	ng/L	NA	NA	NA	NA
Methyl Mercury	Total	ng/L	NA	NA	NA	NA
Molybdenum	Total	µg/l	NA	NA	NA	NA
Nickel	Dissolved	µg/l	NA	NA	NA	NA
Nickel	Total	µg/l	NA	NA	NA	NA
Palladium	Total	µg/l	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA
Potassium	Total	mg/l	NA	NA	NA	NA
Selenium	Total	µg/l	NA	NA	NA	NA
Silver	Total	µg/l	NA	NA	NA	NA
Sodium	Total	mg/l	NA	NA	NA	NA
Strontium	Total	µg/l	NA	NA	NA	NA
Thallium	Total	µg/l	NA	NA	NA	NA
Tin	Total	µg/l	NA	NA	NA	NA
Titanium	Total	µg/l	NA	NA	NA	NA
Vanadium	Total	µg/l	NA	NA	NA	NA
Zinc	Dissolved	µg/l	NA	NA	NA	NA
Zinc	Total	µg/l	NA	NA	NA	NA

NA No data available.
Averages calculated with non-detects at half the detection limit. Averages not calculated if 100% non-detects.
Field duplicates not included in count of samples.

Water Quality Data for PM-12.4 2010-2015						
Parameter	**Fraction**	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Average**
General Parameters						
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	NA	NA	NA	NA
Alkalinity, total, as CaCO3	NA	mg/l	NA	NA	NA	NA
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	NA	NA	NA	NA
Carbon, total organic	NA	mg/l	43	9.4	44.6	20.3
Chemical Oxygen Demand	NA	mg/l	NA	NA	NA	NA
Chloride	Dissolved	mg/l	NA	NA	NA	NA
Chloride	NA	mg/l	51	1.6	17.1	5.44
Chlorophyll a	NA	mg/l	NA	NA	NA	NA
Cyanide	NA	mg/l	NA	NA	NA	NA
Dissolved oxygen	NA	mg/l	50	< 0.1	12.4	7.81
Fluoride	NA	mg/l	NA	NA	NA	NA
Hardness, as CaCO3	NA	mg/l	NA	NA	NA	NA
Nitrate + Nitrite, as N	NA	mg/l	NA	NA	NA	NA
Nitrogen, ammonia as N	NA	mg/l	NA	NA	NA	NA
Nitrogen, total	NA	mg/l	NA	NA	NA	NA
Nitrogen, total kjeldahl (TKN)	NA	mg/l	NA	NA	NA	NA
Orthophosphate, as PO4	NA	mg/l	NA	NA	NA	NA
pH	NA	pH units	50	6.44	8.52	7.40
Phosphorus, total, as P	Dissolved	mg/l	NA	NA	NA	NA
Phosphorus, total, as P	NA	mg/l	NA	NA	NA	NA
Redox (oxidation potential)	NA	mV	1	NA	NA	441
Solids, total dissolved	NA	mg/l	NA	NA	NA	NA
Solids, total suspended	NA	mg/l	NA	NA	NA	NA
Specific Conductance @ 25 ºC	NA	µmhos/cm	50	91.3	664.5	298
Sulfate, as SO4	Dissolved	mg/l	NA	NA	NA	NA
Sulfate, as SO4	NA	mg/l	51	5.67	181	50.1
Sulfide, as S^{2}-	NA	mg/l	NA	NA	NA	NA
Temperature	NA	deg C	50	0.02	22.95	10.2
Turbidity	NA	NTU	51	0	3000	68.4
Metals						
Aluminum	Dissolved	µg/l	26	< 20	133	43.2
Aluminum	Total	µg/l	26	< 25	349	116
Antimony	Total	µg/l	NA	NA	NA	NA
Arsenic	Dissolved	µg/l	NA	NA	NA	NA
Arsenic	Total	µg/l	NA	NA	NA	NA
Barium	Total	µg/l	NA	NA	NA	NA
Beryllium	Total	µg/l	NA	NA	NA	NA
Boron	Total	µg/l	NA	NA	NA	NA
Cadmium	Total	µg/l	NA	NA	NA	NA
Calcium	Total	mg/l	NA	NA	NA	NA
Chromium	Total	µg/l	NA	NA	NA	NA
Cobalt	Dissolved	µg/l	NA	NA	NA	NA
Cobalt	Total	µg/l	NA	NA	NA	NA
Copper	Dissolved	µg/l	NA	NA	NA	NA
Copper	Total	µg/l	NA	NA	NA	NA
Iron	Dissolved	µg/l	43	388	5540	1657
Iron	Total	µg/l	43	486	5790	2128
Lead	Dissolved	µg/l	NA	NA	NA	NA
Lead	Total	µg/l	NA	NA	NA	NA
Magnesium	Total	mg/l	NA	NA	NA	NA
Manganese	Dissolved	µg/l	22	35.2	1020	385
Manganese	Total	µg/l	22	53.7	1050	405
Mercury	Dissolved	ng/L	NA	NA	NA	NA
Mercury	Total	ng/L	NA	NA	NA	NA
Methyl Mercury	Dissolved	ng/L	NA	NA	NA	NA
Methyl Mercury	Total	ng/L	NA	NA	NA	NA
Molybdenum	Total	µg/l	NA	NA	NA	NA
Nickel	Dissolved	µg/l	NA	NA	NA	NA
Nickel	Total	µg/l	NA	NA	NA	NA
Palladium	Total	µg/l	NA	NA	NA	NA
Platinum	Total	µg/l	NA	NA	NA	NA
Potassium	Total	mg/l	NA	NA	NA	NA
Selenium	Total	µg/l	NA	NA	NA	NA
Silver	Total	µg/l	NA	NA	NA	NA
Sodium	Total	mg/l	NA	NA	NA	NA
Strontium	Total	µg/l	NA	NA	NA	NA
Thallium	Total	µg/l	NA	NA	NA	NA
Tin	Total	µg/l	NA	NA	NA	NA
Titanium	Total	µg/l	NA	NA	NA	NA
Vanadium	Total	µg/l	NA	NA	NA	NA
Zinc	Dissolved	µg/l	NA	NA	NA	NA
Zinc	Total	µg/l	NA	NA	NA	NA

NA No data available.
Averages calculated with non-detects at half the detection limit. Averages not calculated if 100% non-detects.
Field duplicates not included in count of samples.

Water Quality Data for PM-13 / SW005 2004-2015						
Parameter	**Fraction**	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Average**
General Parameters						
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	28	27	210	111
Alkalinity, total, as CaCO3	NA	mg/l	39	26	202	96.2
Biochemical Oxygen Demand (5-day)	NA	mg/l	NA	NA	NA	NA
Carbon, dissolved organic	NA	mg/l	8	16.3	29.6	22.5
Carbon, total organic	NA	mg/l	70	9.1	46.6	20.6
Chemical Oxygen Demand	NA	mg/l	14	< 10	120	49.7
Chloride	Dissolved	mg/l	1	NA	NA	4.55
Chloride	NA	mg/l	83	2	94.8	7.28
Chlorophyll a	NA	mg/l	NA	NA	NA	NA
Cyanide	NA	mg/l	4	< 0.02	< 0.02	NA
Dissolved oxygen	NA	mg/l	70	2.1	12.62	7.7
Fluoride	NA	mg/l	21	< 0.1	2.28	0.37
Hardness, as CaCO3	NA	mg/l	68	35.6	337	139
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	14	< 0.1	0.23	0.09
Nitrogen, ammonia, as N	NA	mg/l	11	< 0.1	0.2	0.09
Nitrogen, total	NA	mg/l	NA	NA	NA	NA
Nitrogen, total kjeldahl (TKN)	NA	mg/l	NA	NA	NA	NA
Orthophosphate, as PO4	NA	mg/l	8	< 0.02	< 0.07	0.03
pH	NA	pH units	84	6.3	8.6	7.42
Phosphorus, total, as P	Dissolved	mg/l	9	0.009	0.028	0.016
Phosphorus, total, as P	NA	mg/l	34	< 0.004	0.18	0.045
Redox (oxidation potential)	NA	mV	NA	NA	NA	NA
Solids, total dissolved	NA	mg/l	68	48	494	227
Solids, total suspended	NA	mg/l	18	< 1	13	6.8
Specific Conductance @ 25 ºC	NA	µmhos/cm	78	42	698.2	284
Sulfate, as SO4	Dissolved	mg/l	1	NA	NA	31.4
Sulfate, as SO4	NA	mg/l	87	7.55	688	53.9
Sulfide, as S^{2}-	NA	mg/l	8	< 0.1	< 0.1	NA
Temperature	NA	deg C	77	-0.01	24.6	10.8
Turbidity	NA	NTU	58	0	3000	58.3
Metals						
Aluminum	Dissolved	µg/l	52	15.3	138	49
Aluminum	Total	µg/l	64	43.9	1150	187
Antimony	Total	µg/l	26	< 0.5	< 3	NA
Arsenic	Dissolved	µg/l	7	< 0.5	2.2	1.09
Arsenic	Total	µg/l	47	0.39	2.9	1.1
Barium	Total	µg/l	21	14.3	57.5	37.4
Beryllium	Total	µg/l	18	< 0.2	0.27	0.10
Boron	Total	µg/l	18	< 35	< 100	40.4
Cadmium	Total	µg/l	21	0.044	0.26	0.10
Calcium	Total	mg/l	68	7	44.8	22.7
Chromium	Total	µg/l	21	0.71	4.3	0.80
Cobalt	Dissolved	µg/l	29	< 0.2	0.91	0.34
Cobalt	Total	µg/l	68	< 0.2	1.1	0.44
Copper	Dissolved	µg/l	29	0.56	1.7	1.02
Copper	Total	µg/l	70	0.62	< 5	1.32
Iron	Dissolved	µg/l	36	504	5000	1773
Iron	Total	µg/l	50	2.08	5740	2191
Lead	Dissolved	µg/l	10	< 0.5	< 0.5	NA
Lead	Total	µg/l	55	0.15	< 1	0.27
Magnesium	Total	mg/l	68	5.9	54.7	20.1
Manganese	Dissolved	µg/l	29	< 0.5	720	346
Manganese	Total	µg/l	53	< 0.5	757	301
Mercury	Dissolved	ng/L	8	1.5	4.1	3.11
Mercury	Total	ng/L	43	0.84	12.4	3.57
Methyl Mercury	Dissolved	ng/L	8	0.23	0.76	0.41
Methyl Mercury	Total	ng/L	13	0.074	1.1	0.38
Molybdenum	Total	µg/l	17	< 0.3	< 5	1.65
Nickel	Dissolved	µg/l	29	< 0.5	2.2	1.01
Nickel	Total	µg/l	70	< 0.5	< 5	1.46
Palladium	Total	µg/l	5	< 0.3	< 25	NA
Platinum	Total	µg/l	5	< 0.25	< 25	NA
Potassium	Total	mg/l	21	1.5	7.4	2.99
Selenium	Total	µg/l	38	< 1	< 3.6	NA
Silver	Total	µg/l	16	< 0.2	< 1	NA
Sodium	Total	mg/l	23	5.2	29.8	13.5
Strontium	Total	µg/l	4	29.1	104	58.3
Thallium	Total	µg/l	38	< 0.0004	< 2	0.135
Tin	Total	µg/l	NA	NA	NA	NA
Titanium	Total	µg/l	1	NA	NA	13
Vanadium	Total	µg/l	7	< 3	< 3	NA
Zinc	Dissolved	µg/l	29	< 6	10.2	3.51
Zinc	Total	µg/l	70	3.2	61	6.97

NA No data available.
Averages calculated with non-detects at half the detection limit. Averages not calculated if 100% non-detects.
Field duplicates not included in count of samples.

Water Quality Data for PM-7 / SD026 1999-2015						
Parameter	**Fraction**	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Average**
General Parameters						
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	63	182	687	393
Alkalinity, bicarbonate, as HCO3	NA		82	181	716	399
Alkalinity, total, as CaCO3	NA	mg/l	55	< 10	536	390
Biochemical Oxygen Demand (5-day)	NA	mg/l	5	2	< 3	1.52
Carbon, dissolved organic	NA	mg/l	4	4.7	5.7	5.10
Carbon, total organic	NA	mg/l	58	3.6	7.8	5.40
Cations	NA	meq/l	15	8.9	16	13.2
Chemical Oxygen Demand	NA	mg/l	27	< 2	183	22.6
Chloride	Dissolved	mg/l	NA	NA	NA	NA
Chloride	NA	mg/l	155	3.1	21.5	11.5
Cyanide	NA	mg/l	4	< 0.02	< 0.02	NA
Dissolved oxygen	NA	mg/l	49	3.3	13.88	8.94
Fluoride	NA	mg/l	81	0.41	4.2	2.30
Hardness, as CaCO3	NA	mg/l	220	175	780	439
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	16	< 0.1	0.11	0.06
Nitrogen, ammonia, as N	NA	mg/l	11	< 0.01	0.25	0.07
Nitrogen, total	NA	mg/l	4	0.61	1.5	0.93
Nitrogen, total kjeldahl (TKN)	NA	mg/l	5	0.51	1.5	0.90
Nitrogen, total organic, as N	NA	mg/l	1	NA	NA	1
Nitrogen, unionized ammonia, as N	NA	mg/l	15	< 0.01	0.02	0.01
pH	NA	pH units	296	6.77	8.7	7.83
Phosphorus, total, as P	Dissolved	mg/l	1	< 0.02	NA	NA
Phosphorus, total, as P	NA	mg/l	17	0.006	0.11	0.041
Redox (oxidation potential)	NA	mV	NA	NA	NA	NA
Salinity	NA	mg/l	26	300	600	496
Sodium, % of total cations	NA	%	15	10.3	24.1	17.6
Solids, total dissolved	NA	mg/l	155	350	1540	650
Solids, total suspended	NA	mg/l	240	0.6	26.5	2.78
Specific Conductance @ 25 ºC	NA	µmhos/cm	299	1	1393	997
Sulfate, as SO4	Dissolved	mg/l	NA	NA	NA	NA
Sulfate, as SO4	NA	mg/l	154	< 1	360	173
Sulfide, as S^{2}-	NA	mg/l	1	NA	NA	2.00
Temperature	NA	deg C	117	0.3	22.7	9.01
Turbidity	NA	NTU	79	0	328	9.17
Metals						
Aluminum	Dissolved	µg/l	31	< 10	38.4	11.1
Aluminum	Total	µg/l	55	< 0.4	63.7	18.4
Antimony	Total	µg/l	16	< 0.5	3	0.86
Arsenic	Dissolved	µg/l	17	< 0.31	0.69	0.35
Arsenic	Total	µg/l	41	< 0.31	2	0.62
Barium	Total	µg/l	35	15.5	51.2	27.3
Beryllium	Total	µg/l	19	< 0.2	0.2	0.11
Boron	Total	µg/l	98	92	311	210
Cadmium	Total	µg/l	27	0.05	< 0.2	0.10
Calcium	Total	mg/l	102	49.2	90.3	75.5
Chromium	Total	µg/l	20	< 1	1.7	0.63
Cobalt	Dissolved	µg/l	17	< 0.2	0.45	0.29
Cobalt	Total	µg/l	102	0.17	< 5	0.54
Copper	Dissolved	µg/l	17	0.6	1.8	1.00
Copper	Total	µg/l	68	< 0.5	< 10	1.11
Iron	Dissolved	µg/l	17	< 50	726	303
Iron	Total	µg/l	57	0.18	1980	645
Lead	Dissolved	µg/l	NA	NA	NA	NA
Lead	Total	µg/l	54	< 0.03	1	0.31
Lithium	Total	µg/l	1	NA	NA	25.6
Magnesium	Total	mg/l	104	46.6	120	84.5
Manganese	Dissolved	µg/l	17	336	1210	777
Manganese	Total	µg/l	114	0.73	2190	595
Mercury	Dissolved	ng/l	NA	NA	NA	NA
Mercury	Total	ng/l	89	< 0.1	< 25	1.02
Methyl Mercury	Dissolved	ng/l	NA	NA	NA	NA
Methyl Mercury	Total	ng/l	7	< 0.025	< 25	3.03
Molybdenum	Total	µg/l	87	4	53	22.1
Nickel	Dissolved	µg/l	17	< 0.5	< 1	0.33
Nickel	Total	µg/l	60	< 0	5	1.32
Palladium	Total	µg/l	5	< 0.3	< 250	NA
Platinum	Total	µg/l	5	< 0.25	< 250	NA
Potassium	Total	mg/l	52	3.29	14.8	7.66
Selenium	Total	µg/l	31	0.037	< 3.6	0.814
Silver	Total	µg/l	17	< 0.2	1	0.25
Sodium	Total	mg/l	52	13	62.7	41.3
Strontium	Total	µg/l	18	232	361	297
Thallium	Total	µg/l	31	< 0.002	2	0.26
Tin	Total	µg/l	4	< 0.5	10	2.73
Titanium	Total	µg/l	2	< 10	10	7.50
Vanadium	Total	µg/l	4	< 3	4	2.13
Zinc	Dissolved	µg/l	17	< 6	14.6	7.66
Zinc	Total	µg/l	68	< 0.24	82.5	8.20

NA No data available.
Averages calculated with non-detects at half the detection limit. Averages not calculated if 100% non-detects.
Field duplicates not included in count of samples.

Large Table 3 Tailings Basin Groundwater Monitoring Well Locations

Current Monitoring Station ID	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]		
GW001	--		Surficial Aquifer	2007, 2009-2015	566028.67	5276003.26	60	14	33	NESE	Not applicable	2.56	Unknown
GW002	GW002		Surficial Aquifer	2007, 2009-2015	561841.00	5271962.00	59	14	18	SWNW	Not applicable	20.93	Unknown
GW003	--	597383	Within FTB	--	564488.00	5273378.00	59	14	8	SENE	Not applicable	Dry	July 1998
GW004	--	551772	Within FTB	--	564410.00	5273298.00	59	14	8	SENE	Not applicable	Dry	October 1994
GW005	--	597384	Within FTB	2009-2015	564361.00	5273427.00	59	14	8	SENE	Not applicable	133.86	July 1998
GW006	--	625042	Surficial Aquifer	2007, 2009-2015	563873.49	5275683.25	60	14	32	SESW	Not applicable	11.15	April 2001
GW007	--	625043	Surficial Aquifer	2007, 2009-2015	563453.89	5274725.57	59	14	5	SWNW	Not applicable	7.32	April 2001
GW008	--	625044	Surficial Aquifer	2007, 2009-2015	563699.00	5273110.00	59	14	8	SENW	Not applicable	4.52	April 2001
GW009	GW009		Surficial Aquifer	2009-2015	566084.33	5277751.94	60	14	28	NESE	Not applicable	4.36	February 2009
GW010	GW010	767967	Surficial Aquifer	2009-2015	564680.49	5276976.61	60	14	32	NENE	Not applicable	2.49	May 2009
GW011	--	767966	Surficial Aquifer	2009-2015	563440.54	5276749.89	60	14	32	NWNW	Not applicable	20.73	May 2009
GW012	--	767968	Surficial Aquifer	2009-2015	565469.07	5275974.94	60	14	33	NESW	Not applicable	4.87	May 2009
GW013	--		Surficial Aquifer	2010-2015	562342.02	5276625.05	60	14	31	SWNE	Not applicable	2.46	July 2010
GW014	--		Surficial Aquifer	2010-2014	561168.69	5276123.59	60	15	36	NESE	Not applicable	4.32	July 2010
GW015	GW015		Surficial Aquifer	2010-2015	558718.00	5273855.46	59	15	11	NWNW	Not applicable	2.98	July 2010
GW016	GW016		Surficial Aquifer	2013-2015	561551.38	5276343.72	60	14	31	SWNW	Not applicable	5.06	August 2013

(1) Whether wells are upgradient or downgradient of Project features will change following permit issuance and initiation of activities at the FTB. For information regarding well locations following Mine Year 1, refer to Volume I.

Large Table 4 Tailings Basin Baseline Groundwater Quality Monitoring Summary

Water Quality Data for GW001 2007 - 2015						
Parameter	**Fraction**	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Average**
General Parameters						
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	12	339	405	387
Alkalinity, carbonate, as CaCO3	NA	mg/l	11	< 10	< 20	NA
Alkalinity, total, as CaCO3	NA	mg/l	22	339	428	395
Biochemical Oxygen Demand (5-day)	NA	mg/l	11	< 2.4	< 8	NA
Carbon, dissolved organic	NA	mg/l	12	8.3	9.8	8.97
Carbon, total organic	NA	mg/l	22	7.3	9.8	8.75
Chemical Oxygen Demand	NA	mg/l	15	23.2	52.9	34.2
Chloride	NA	mg/l	21	25.3	28.1	26.9
Cyanide	NA	mg/l	15	< 0.01	0.0219	0.0085
Dissolved oxygen	NA	mg/l	24	0.01	5.36	1.40
Fluoride	NA	mg/l	21	< 0.1	0.19	0.14
Hardness, as CaCO3	NA	mg/l	21	328	418	371
Nitrogen, Nitrate, as N	NA	mg/l	2	< 0.1	< 0.1	NA
Nitrogen, Nitrite, as N	NA	mg/l	2	< 0.05	< 0.1	NA
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	20	< 0.1	0.14	0.06
Nitrogen, ammonia, as N	NA	mg/l	22	< 0.1	0.21	0.14
Orthophosphate, as PO4	NA	mg/l	1	< 0.02	NA	NA
pH	NA	pH units	45	4.1	8	7.05
Phosphorus, total, as P	Dissolved	mg/l	1	< 0.0003	NA	NA
Phosphorus, total, as P	NA	mg/l	16	< 0.1	0.11	0.05
Redox (oxidation potential)	NA	mV	24	2	591	242
Silica, as SiO2	NA	mg/l	1	NA	NA	23.7
Silica, Reactive as (SiO2)	NA	mg/l	5	23.1	24.4	23.7
Solids, total dissolved	NA	mg/l	18	455	586	516
Solids, total suspended	NA	mg/l	1	NA	NA	42
Specific Conductance @ 25 ºC	NA	umhos/cm	25	640	902	854
Sulfate, as SO4	NA	mg/l	21	28.8	41.5	33.3
Sulfide, as S^{2}-	NA	mg/l	1	< 5	NA	NA
Temperature	NA	deg C	23	3.5	11.01	7.64
Turbidity	NA	NTU	24	0	187	25.4
Metals						
Aluminum	Dissolved	µg/l	21	< 10	25	12.6
Aluminum	Total	µg/l	16	< 20	3060	637
Antimony	Dissolved	µg/l	7	< 0.5	< 0.5	NA
Antimony	Total	µg/l	15	< 0.5	< 0.5	NA
Arsenic	Dissolved	µg/l	18	< 0.31	< 2	0.39
Arsenic	Total	µg/l	15	< 0.5	< 10	0.81
Barium	Dissolved	µg/l	14	228	267	247
Barium	Total	µg/l	16	229	300	267
Beryllium	Dissolved	µg/l	7	< 0.2	< 2	NA
Beryllium	Total	µg/l	15	< 0.2	< 2	NA
Boron	Dissolved	µg/l	15	256	308	277
Boron	Total	µg/l	16	254	312	273
Cadmium	Dissolved	µg/l	21	< 0.2	< 0.2	NA
Cadmium	Total	µg/l	15	< 0.2	0.98	0.22
Calcium	Dissolved	mg/l	1	NA	NA	71
Calcium	Total	mg/l	22	61.8	81.4	73.9
Chromium	Dissolved	µg/l	21	< 1	< 2	NA
Chromium	Total	µg/l	15	< 1	7.7	1.96
Cobalt	Dissolved	µg/l	14	< 0.2	0.37	0.17
Cobalt	Total	µg/l	15	0.21	2.5	0.74
Copper	Dissolved	µg/l	21	< 0.5	5.41	0.80
Copper	Total	µg/l	15	0.55	13.6	4.26
Iron	Dissolved	µg/l	18	4750	11000	8719
Iron	Total	µg/l	16	8690	14700	11418
Lead	Dissolved	µg/l	14	< 0.5	< 0.6	NA
Lead	Total	µg/l	15	< 0.5	5.6	1.23
Magnesium	Dissolved	mg/l	1	NA	NA	42
Magnesium	Total	mg/l	22	41.3	52.2	45.2
Manganese	Dissolved	µg/l	18	2200	4260	3544
Manganese	Total	µg/l	16	2300	3890	3221
Mercury	Total	ng/l	19	< 0.5	4.6	1.41
Methyl Mercury	Total	ng/l	13	< 0.03	0.14	0.05
Molybdenum	Dissolved	µg/l	21	8	10.2	9.06
Molybdenum	Total	µg/l	15	8	10.1	9.19
Nickel	Dissolved	µg/l	21	< 0.5	4.4	1.12
Nickel	Total	µg/l	15	< 0.5	10.9	3.14
Palladium	Total	µg/l	15	< 0.3	< 0.5	NA
Platinum	Dissolved	µg/l	1	< 0.3	NA	NA
Platinum	Total	µg/l	15	< 0.3	< 0.5	NA
Potassium	Dissolved	mg/l	1	NA	NA	3.2
Potassium	Total	mg/l	22	2.52	4	3.09
Selenium	Dissolved	µg/l	21	< 1	< 1	NA
Selenium	Total	µg/l	15	< 1	< 10	0.89
Silicon, as Si	Dissolved	mg/l	5	11.5	12.7	12.1
Silicon, as Si	Total	mg/l	5	11.8	12.4	12.1
Silver	Dissolved	µg/l	15	< 0.2	< 0.2	NA
Silver	Total	µg/l	15	< 0.2	< 0.2	NA
Sodium	Dissolved	mg/l	1	NA	NA	60
Sodium	Total	mg/l	22	48.8	65	52.8
Strontium	Dissolved	µg/l	1	NA	NA	240
Strontium	Total	µg/l	16	240	289	264
Thallium	Dissolved	µg/l	7	< 0.02	< 0.4	NA
Thallium	Total	µg/l	15	< 0.017	0.53	0.16
Titanium	Dissolved	µg/l	1	NA	NA	2.8
Titanium	Total	µg/l	15	< 10	160	31.3
Zinc	Dissolved	µg/l	21	< 6	50.8	7.65
Zinc	Total	µg/l	15	< 6	74.9	13.2

NA No data available.
Averages calculated with non-detects at half the detection limit. Averages not calculated if 100% non-detects.
Field duplicates not included in count of samples.

Water Quality Data for GW002 2007 - 2015						
Parameter	**Fraction**	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Average**
General Parameters						
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	12	17.6	54.6	31.7
Alkalinity, carbonate, as CaCO3	NA	mg/l	12	< 10	< 10	NA
Alkalinity, total, as CaCO3	NA	mg/l	21	17.6	54.6	31.8
Biochemical Oxygen Demand (5-day)	NA	mg/l	12	< 2.4	< 8	NA
Carbon, dissolved organic	NA	mg/l	12	1.8	7.1	4.27
Carbon, total organic	NA	mg/l	21	1.5	7.4	3.75
Chemical Oxygen Demand	NA	mg/l	15	< 10	38	20.3
Chloride	NA	mg/l	21	< 0.5	1.4	0.62
Cyanide	NA	mg/l	15	0.0054	< 0.02	0.0064
Dissolved oxygen	NA	mg/l	21	1.75	16.21	9.19
Fluoride	NA	mg/l	21	< 0.1	< 0.1	NA
Hardness, as CaCO3	NA	mg/l	21	28.9	73.9	43.2
Nitrogen, Nitrate, as N	NA	mg/l	1	< 0.1	NA	NA
Nitrogen, Nitrite, as N	NA	mg/l	1	< 0.05	NA	NA
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	20	< 0.1	< 0.1	NA
Nitrogen, ammonia, as N	NA	mg/l	21	< 0.05	0.44	0.07
Orthophosphate, as PO4	NA	mg/l	NA	NA	NA	NA
pH	NA	pH units	41	5.3	8.3	7.23
Phosphorus, total, as P	Dissolved	mg/l	1	< 0.0003	NA	NA
Phosphorus, total, as P	NA	mg/l	15	< 0.1	0.48	0.22
Redox (oxidation potential)	NA	mV	21	171	638	409
Silica, as SiO2	NA	mg/l	NA	NA	NA	NA
Silica, Reactive as (SiO2)	NA	mg/l	NA	NA	NA	NA
Solids, total dissolved	NA	mg/l	17	81	142	98.1
Solids, total suspended	NA	mg/l	NA	NA	NA	NA
Specific Conductance @ 25 ºC	NA	umhos/cm	21	0	225	78.5
Sulfate, as SO4	NA	mg/l	21	4.7	7.74	6.19
Sulfide, as S^{2}-	NA	mg/l	NA	NA	NA	NA
Temperature	NA	deg C	20	5.85	21.72	12.5
Turbidity	NA	NTU	21	1	786	130
Metals						
Aluminum	Dissolved	µg/l	21	< 25	682	116
Aluminum	Total	µg/l	15	413	16000	5682
Antimony	Dissolved	µg/l	7	< 0.5	< 0.5	NA
Antimony	Total	µg/l	15	< 0.5	< 0.5	NA
Arsenic	Dissolved	µg/l	17	< 0.5	< 2	NA
Arsenic	Total	µg/l	15	< 0.5	< 10	1.12
Barium	Dissolved	µg/l	15	5.96	11.7	7.04
Barium	Total	µg/l	15	10.9	110	48.5
Beryllium	Dissolved	µg/l	7	< 0.2	< 2	NA
Beryllium	Total	µg/l	15	< 0.2	< 2	0.19
Boron	Dissolved	µg/l	16	< 50	< 200	NA
Boron	Total	µg/l	15	< 50	< 200	NA
Cadmium	Dissolved	µg/l	21	< 0.2	1.33	0.19
Cadmium	Total	µg/l	15	< 0.2	1.72	0.32
Calcium	Dissolved	mg/l	1	NA	NA	11
Calcium	Total	mg/l	21	8.4	17.8	11.8
Chromium	Dissolved	µg/l	21	< 1	2.4	1.14
Chromium	Total	µg/l	15	2	31	14.1
Cobalt	Dissolved	µg/l	15	< 0.2	0.32	0.11
Cobalt	Total	µg/l	15	0.27	7.9	3.27
Copper	Dissolved	µg/l	21	1.1	784	39.7
Copper	Total	µg/l	15	1.8	32	12.9
Iron	Dissolved	µg/l	17	< 50	678	114
Iron	Total	µg/l	15	458	18000	6428
Lead	Dissolved	µg/l	15	< 0.5	< 0.6	NA
Lead	Total	µg/l	15	< 0.5	4	1.79
Magnesium	Dissolved	mg/l	1	NA	NA	1.8
Magnesium	Total	mg/l	21	1.6	7.88	3.49
Manganese	Dissolved	µg/l	18	1.3	12	4.23
Manganese	Total	µg/l	15	11.1	340	119
Mercury	Total	ng/L	20	0.685	9.3	3.99
Methyl Mercury	Total	ng/L	14	< 0.03	< 0.1	0.04
Molybdenum	Dissolved	µg/l	21	< 0.2	0.41	0.16
Molybdenum	Total	µg/l	15	< 0.2	< 5	0.47
Nickel	Dissolved	µg/l	21	0.61	2.2	1.14
Nickel	Total	µg/l	15	1.4	32	12.2
Palladium	Total	µg/l	15	< 0.03	< 0.5	NA
Platinum	Dissolved	µg/l	1	< 0.3	NA	NA
Platinum	Total	µg/l	15	< 0.009	< 0.5	NA
Potassium	Dissolved	mg/l	1	NA	NA	0.41
Potassium	Total	mg/l	21	0.3	4	1.13
Selenium	Dissolved	µg/l	21	< 1	< 1	NA
Selenium	Total	µg/l	15	< 1	< 5	NA
Silicon, as Si	Dissolved	µg/l	NA	NA	NA	NA
Silicon, as Si	Total	µg/l	NA	NA	NA	NA
Silver	Dissolved	µg/l	15	< 0.2	< 0.2	NA
Silver	Total	µg/l	15	< 0.2	< 0.2	NA
Sodium	Dissolved	mg/l	1	NA	NA	2.5
Sodium	Total	mg/l	21	2.1	5.5	3.19
Strontium	Dissolved	µg/l	1	NA	NA	42
Strontium	Total	µg/l	15	38.3	110	62.7
Thallium	Dissolved	µg/l	7	< 0.02	< 0.4	NA
Thallium	Total	µg/l	15	< 0.017	0.59	0.16
Titanium	Dissolved	µg/l	1	NA	NA	5.2
Titanium	Total	µg/l	15	17.8	820	341
Zinc	Dissolved	µg/l	21	< 6	< 30	5.96
Zinc	Total	µg/l	15	< 6	48	19.5

NA No data available.
Averages calculated with non-detects at half the detection limit. Averages not calculated if 100% non-detects.
Field duplicates not included in count of samples.

Water Quality Data for GW005 2009 - 2015						
Parameter	**Fraction**	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Average**
General Parameters						
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	13	300	439	349
Alkalinity, carbonate, as CaCO3	NA	mg/l	13	< 10	< 20	NA
Alkalinity, total, as CaCO3	NA	mg/l	20	300	439	352
Biochemical Oxygen Demand (5-day)	NA	mg/l	13	< 3	< 24	5.4
Carbon, dissolved organic	NA	mg/l	13	1.6	5.1	2.75
Carbon, total organic	NA	mg/l	20	1.4	4.4	2.10
Chemical Oxygen Demand	NA	mg/l	14	< 10	66.3	29.1
Chloride	NA	mg/l	20	28.2	31.9	30.0
Cyanide	NA	mg/l	14	< 0.0035	< 0.02	NA
Dissolved oxygen	NA	mg/l	21	< 0.1	10	3.99
Fluoride	NA	mg/l	20	1.9	3.2	2.26
Hardness, as CaCO3	NA	mg/l	20	399	815	530
Nitrogen, Nitrate as N	NA	mg/l	NA	NA	NA	NA
Nitrogen, Nitrite as N	NA	mg/l	NA	NA	NA	NA
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	20	< 0.1	0.16	0.07
Nitrogen, ammonia, as N	NA	mg/l	20	< 0.1	< 1	0.21
Orthophosphate, as PO4	NA	mg/l	NA	NA	NA	NA
pH	NA	pH units	40	7.2	8.5	7.87
Phosphorus, total, as P	NA	mg/l	14	< 0.1	0.72	0.20
Phosphorus, total, as P	NA	mg/l	14	< 0.1	0.62	0.20
Redox (oxidation potential)	NA	mV	21	58	535	324
Silica, as SiO2	NA	mg/l	NA	NA	NA	NA
Silica, Reactive as (SiO2)	NA	mg/l	NA	NA	NA	NA
Solids, total dissolved	NA	mg/l	18	694	886	780
Solids, total suspended	NA	mg/l	NA	NA	NA	NA
Specific Conductance @ 25 ºC	NA	umhos/cm	21	512	1359	1156
Sulfate, as SO4	NA	mg/l	21	209	353	287
Sulfide, as S^{2}-	NA	mg/l	1	NA	NA	8
Temperature	NA	deg C	21	3.83	22.59	11.5
Turbidity	NA	NTU	21	1	702	181
Metals						
Aluminum	Dissolved	µg/l	20	< 10	40.6	14.4
Aluminum	Total	µg/l	14	387	21500	4170
Antimony	Dissolved	µg/l	6	< 0.5	< 0.5	NA
Antimony	Total	µg/l	14	< 0.5	< 2.5	0.37
Arsenic	Dissolved	µg/l	17	< 0.5	1.2	0.42
Arsenic	Total	µg/l	15	1.18	27.1	6.51
Barium	Dissolved	µg/l	13	7.6	29.4	21.5
Barium	Total	µg/l	14	36.2	193	72.7
Beryllium	Dissolved	µg/l	6	< 0.2	< 0.2	NA
Beryllium	Total	µg/l	14	< 0.2	2.17	0.58
Boron	Dissolved	µg/l	15	408	551	471
Boron	Total	µg/l	14	390	569	441
Cadmium	Dissolved	µg/l	20	< 0.2	< 0.2	NA
Cadmium	Total	µg/l	14	< 0.2	1.98	0.45
Calcium	Dissolved	mg/l	NA	NA	NA	NA
Calcium	Total	mg/l	20	55.6	167	79.9
Chromium	Dissolved	µg/l	20	< 1	1.6	0.61
Chromium	Total	µg/l	14	4.3	71.3	21.8
Cobalt	Dissolved	µg/l	13	< 0.2	0.95	0.39
Cobalt	Total	µg/l	14	1.2	23.4	7.04
Copper	Dissolved	µg/l	20	0.62	5.09	1.53
Copper	Total	µg/l	14	4.7	89.4	24.7
Iron	Dissolved	µg/l	17	< 50	816	198
Iron	Total	µg/l	14	6100	190000	48568
Lead	Dissolved	µg/l	13	< 0.5	< 0.5	NA
Lead	Total	µg/l	14	0.7	20.9	5.54
Magnesium	Dissolved	mg/l	NA	NA	NA	NA
Magnesium	Total	mg/l	20	61.9	97.8	80.3
Manganese	Dissolved	µg/l	18	92.9	480	258
Manganese	Total	µg/l	14	601	8820	2749
Mercury	Total	ng/L	20	< 0.5	71.2	9.15
Methyl Mercury	Total	ng/L	14	< 0.03	0.27	0.07
Molybdenum	Dissolved	µg/l	20	14.2	39.7	27.6
Molybdenum	Total	µg/l	14	18.2	49.8	30.5
Nickel	Dissolved	µg/l	20	< 0.5	7.2	2.95
Nickel	Total	µg/l	14	8.5	108	34.1
Palladium	Total	µg/l	14	< 0.03	0.63	0.30
Platinum	Dissolved	µg/l	NA	NA	NA	NA
Platinum	Total	µg/l	14	0.026	< 0.5	0.24
Potassium	Dissolved	mg/l	NA	NA	NA	NA
Potassium	Total	mg/l	20	10.4	17.8	13.5
Selenium	Dissolved	µg/l	20	< 1	< 1	NA
Selenium	Total	µg/l	14	< 1	< 5	NA
Silicon, as Si	Dissolved	µg/l	NA	NA	NA	NA
Silicon, as Si	Total	µg/l	NA	NA	NA	NA
Silver	Dissolved	µg/l	14	< 0.2	< 0.2	NA
Silver	Total	µg/l	14	< 0.2	< 1	0.15
Sodium	Dissolved	mg/l	NA	NA	NA	NA
Sodium	Total	mg/l	20	58.7	128	102
Strontium	Dissolved	µg/l	NA	NA	NA	NA
Strontium	Total	µg/l	14	290	396	337
Thallium	Dissolved	µg/l	6	< 0.02	< 0.2	NA
Thallium	Total	µg/l	14	< 0.017	< 1	0.17
Titanium	Dissolved	µg/l	NA	NA	NA	NA
Titanium	Total	µg/l	14	< 10	190	38.4
Zinc	Dissolved	µg/l	20	< 6	22.7	4.89
Zinc	Total	µg/l	14	< 6	78.2	24.3

NA No data available.
Averages calculated with non-detects at half the detection limit. Averages not calculated if 100% non-detects.
Field duplicates not included in count of samples.

Water Quality Data for GW006 2007 - 2015						
Parameter	**Fraction**	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Average**
General Parameters						
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	14	605	852	695
Alkalinity, carbonate, as CaCO3	NA	mg/l	13	< 10	< 50	NA
Alkalinity, total, as CaCO3	NA	mg/l	24	521	973	732
Biochemical Oxygen Demand (5-day)	NA	mg/l	13	< 2.4	< 8	NA
Carbon, dissolved organic	NA	mg/l	14	2.6	4.4	3.31
Carbon, total organic	NA	mg/l	24	2	3.8	3.04
Chemical Oxygen Demand	NA	mg/l	17	< 10	23	11.27
Chloride	NA	mg/l	24	8.26	22.7	14.76
Cyanide	NA	mg/l	17	< 0.0035	< 0.02	0.0077
Dissolved oxygen	NA	mg/l	25	0.05	4.38	1.09
Fluoride	NA	mg/l	24	1.3	2.56	1.8
Hardness, as CaCO3	NA	mg/l	23	757	1810	1268
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	22	< 0.1	< 0.1	NA
Nitrogen, ammonia, as N	NA	mg/l	24	< 0.1	0.43	0.195
Nitrogen, Nitrate, as N	NA	mg/l	2	< 0.1	< 0.1	NA
Nitrogen, Nitrite, as N	NA	mg/l	2	< 0.05	< 0.1	NA
Orthophosphate, as PO4	NA	mg/l	1	< 0.02	NA	NA
pH	NA	pH units	47	6.7	8.6	7.33
Phosphorus, total, as P	Dissolved	mg/l	1	< 0.0003	NA	NA
Phosphorus, total, as P	NA	mg/l	18	< 0.1	0.19	0.091
Redox (oxidation potential)	NA	mV	25	-17	553	250
Silica, as SiO2	NA	mg/l	1	NA	NA	38
Silica, Reactive as (SiO2)	NA	mg/l	5	28.2	40	35.0
Solids, total dissolved	NA	mg/l	19	1204	1860	1508
Solids, total suspended	NA	mg/l	1	NA	NA	20
Specific Conductance @ 25 ºC	NA	umhos/cm	26	559	2606	1942
Sulfate, as SO4	NA	mg/l	25	217	749	551
Sulfide, as S^{2}-	NA	mg/l	2	< 2	< 5	NA
Temperature	NA	deg C	24	4.3	15.97	9.93
Turbidity	NA	NTU	25	0	11.2	1.12
Metals						
Aluminum	Dissolved	µg/l	23	< 10	31.2	13.2
Aluminum	Total	µg/l	18	< 20	572	88.7
Antimony	Dissolved	µg/l	7	< 0.5	< 0.5	NA
Antimony	Total	µg/l	17	< 0.5	< 0.5	NA
Arsenic	Dissolved	µg/l	19	0.52	6.5	2.6
Arsenic	Total	µg/l	18	0.66	6.62	3.89
Barium	Dissolved	µg/l	15	68.5	133	105.9
Barium	Total	µg/l	18	66	127	106
Beryllium	Dissolved	µg/l	7	< 0.2	< 2	NA
Beryllium	Total	µg/l	17	< 0.2	< 2	NA
Boron	Dissolved	µg/l	16	350	558	475
Boron	Total	µg/l	18	330	554	477
Cadmium	Dissolved	µg/l	23	< 0.2	0.34	0.12
Cadmium	Total	µg/l	17	< 0.2	< 0.2	NA
Calcium	Dissolved	mg/l	1	NA	NA	84
Calcium	Total	mg/l	24	81.9	139	112.0
Chromium	Dissolved	µg/l	23	< 1	< 2	NA
Chromium	Total	µg/l	17	< 1	2.06	0.68
Cobalt	Dissolved	µg/l	15	1.6	5.2	3.32
Cobalt	Total	µg/l	17	1.6	3.8	2.66
Copper	Dissolved	µg/l	23	1	11	2.96
Copper	Total	µg/l	17	1.24	7.27	2.51
Iron	Dissolved	µg/l	19	126	9400	4024
Iron	Total	µg/l	18	148	6730	3717
Lead	Dissolved	µg/l	15	< 0.5	< 0.6	NA
Lead	Total	µg/l	17	< 0.5	< 0.6	NA
Magnesium	Dissolved	mg/l	1	NA	NA	140
Magnesium	Total	mg/l	24	134	356	240
Manganese	Dissolved	µg/l	19	495	1260	1053
Manganese	Total	µg/l	18	541	1420	1066
Mercury	Total	ng/l	21	0.512	4.5	1.32
Methyl Mercury	Total	ng/l	15	< 0.03	0.27	0.049
Molybdenum	Dissolved	µg/l	23	20.3	45	26.6
Molybdenum	Total	µg/l	17	22	47	28.2
Nickel	Dissolved	µg/l	23	< 0.5	7	3.32
Nickel	Total	µg/l	17	< 0.5	7	3.34
Palladium	Total	µg/l	17	< 0.03	0.81	0.26
Platinum	Dissolved	µg/l	1	< 0.3	NA	NA
Platinum	Total	µg/l	17	< 0.009	< 0.5	0.23
Potassium	Dissolved	mg/l	1	NA	NA	9.9
Potassium	Total	mg/l	24	6.84	16	11.2
Selenium	Dissolved	µg/l	23	< 1	< 1	NA
Selenium	Total	µg/l	17	< 1	< 1	NA
Silicon, as Si	Dissolved	mg/l	5	7.4	17.6	15
Silicon, as Si	Total	mg/l	5	7.4	18.2	15.1
Silver	Dissolved	µg/l	17	< 0.2	< 0.2	NA
Silver	Total	µg/l	17	< 0.2	< 0.2	NA
Sodium	Dissolved	mg/l	1	NA	NA	37
Sodium	Total	mg/l	24	33	80	58
Strontium	Dissolved	µg/l	1	NA	NA	360
Strontium	Total	µg/l	18	350	721	581
Thallium	Dissolved	µg/l	7	< 0.02	< 0.4	NA
Thallium	Total	µg/l	17	< 0.017	0.51	0.15
Titanium	Dissolved	µg/l	1	NA	NA	2.6
Titanium	Total	µg/l	17	4.1	47	9.2
Zinc	Dissolved	µg/l	23	< 6	< 30	6.6
Zinc	Total	µg/l	17	< 6	< 30	4.6

NA No data available.
Averages calculated with non-detects at half the detection limit. Averages not calculated if 100% non-detects.
Field duplicates not included in count of samples.

Water Quality Data for GW007 2007 - 2015						
Parameter	**Fraction**	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Average**
General Parameters						
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	13	274	307	291
Alkalinity, carbonate, as CaCO3	NA	mg/l	13	< 10	< 20	NA
Alkalinity, total, as CaCO3	NA	mg/l	23	250	316	291
Biochemical Oxygen Demand (5-day)	NA	mg/l	13	< 2.4	< 8	NA
Carbon, dissolved organic	NA	mg/l	13	1.4	3.1	2.0
Carbon, total organic	NA	mg/l	23	< 1	2.4	1.65
Chemical Oxygen Demand	NA	mg/l	17	6.75	95.4	13.59
Chloride	NA	mg/l	23	27.7	30.5	29.14
Cyanide	NA	mg/l	17	< 0.0035	< 0.02	0.0069
Dissolved oxygen	NA	mg/l	24	0.08	5	1.28
Fluoride	NA	mg/l	23	1.7	2.04	1.9
Hardness, as CaCO3	NA	mg/l	23	375	440	415
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	22	< 0.1	0.33	0.062
Nitrogen, ammonia, as N	NA	mg/l	23	0.06	0.19	0.069
Nitrogen, Nitrate, as N	NA	mg/l	1	< 0.1	NA	NA
Nitrogen, Nitrite, as N	NA	mg/l	1	< 0.05	< 0.05	NA
Orthophosphate, as PO4	NA	mg/l	NA	NA	NA	NA
pH	NA	pH units	46	6.6	8.7	7.67
Phosphorus, total, as P	Dissolved	mg/l	1	< 0.0003	NA	NA
Phosphorus, total, as P	NA	mg/l	17	< 0.1	0.1	0.05
Redox (oxidation potential)	NA	mV	24	144	561	403
Silica, as SiO2	NA	mg/l	1	17	17	17
Silica, Reactive as (SiO2)	NA	mg/l	5	16.1	18	17.0
Solids, total dissolved	NA	mg/l	18	517	608	566
Solids, total suspended	NA	mg/l	NA	NA	NA	NA
Specific Conductance @ 25 ºC	NA	umhos/cm	24	531	981	895
Sulfate, as SO4	NA	mg/l	24	151	183	169
Sulfide, as S^{2}-	NA	mg/l	1	< 2	NA	NA
Temperature	NA	deg C	23	2.38	13.49	8.62
Turbidity	NA	NTU	24	0	82.4	10.11
Metals						
Aluminum	Dissolved	µg/l	23	< 10	25.6	10.9
Aluminum	Total	µg/l	17	12	284	43
Antimony	Dissolved	µg/l	7	< 0.5	< 0.5	NA
Antimony	Total	µg/l	17	< 0.5	< 0.5	NA
Arsenic	Dissolved	µg/l	19	< 0.5	2.6	1.26
Arsenic	Total	µg/l	18	0.84	7.64	2.15
Barium	Dissolved	µg/l	15	1.2	4.5	1.8
Barium	Total	µg/l	17	1.2	< 10	2.9
Beryllium	Dissolved	µg/l	7	< 0.2	< 2	NA
Beryllium	Total	µg/l	17	< 0.2	< 2	NA
Boron	Dissolved	µg/l	16	371	467	410
Boron	Total	µg/l	17	353	450	402
Cadmium	Dissolved	µg/l	23	< 0.2	< 0.2	NA
Cadmium	Total	µg/l	17	< 0.2	0.23	0.10
Calcium	Dissolved	mg/l	1	NA	NA	54
Calcium	Total	mg/l	23	45	53.4	50.5
Chromium	Dissolved	µg/l	23	< 1	< 2	0.54
Chromium	Total	µg/l	17	< 1	2.5	0.7
Cobalt	Dissolved	µg/l	15	0.56	0.91	0.74
Cobalt	Total	µg/l	17	0.56	3.94	1.08
Copper	Dissolved	µg/l	23	0.56	5.16	1.10
Copper	Total	µg/l	17	< 0.7	11.6	2.2
Iron	Dissolved	µg/l	18	< 50	132	33
Iron	Total	µg/l	17	< 50	5970	724
Lead	Dissolved	µg/l	15	< 0.5	< 0.6	NA
Lead	Total	µg/l	17	< 0.5	2.09	0.42
Magnesium	Dissolved	mg/l	1	NA	NA	75
Magnesium	Total	mg/l	23	63.6	75.7	70.3
Manganese	Dissolved	µg/l	19	1000	1400	1247
Manganese	Total	µg/l	17	1070	4130	1565
Mercury	Total	ng/l	21	< 0.5	6.8	0.89
Methyl Mercury	Total	ng/l	15	< 0.03	0.15	0.05
Molybdenum	Dissolved	µg/l	23	< 0.3	34.2	29.3
Molybdenum	Total	µg/l	17	27.1	35	30.6
Nickel	Dissolved	µg/l	23	< 0.5	4	0.93
Nickel	Total	µg/l	17	< 0.5	4	1.4
Palladium	Total	µg/l	17	0.032	< 0.5	0.23
Platinum	Dissolved	µg/l	1	< 0.3	NA	NA
Platinum	Total	µg/l	17	0.01	< 0.5	0.23
Potassium	Dissolved	mg/l	1	NA	NA	9.1
Potassium	Total	mg/l	23	6.7	9.8	8.2
Selenium	Dissolved	µg/l	23	< 1	< 1	NA
Selenium	Total	µg/l	17	< 1	1.1	0.52
Silicon, as Si	Dissolved	mg/l	5	7.3	8.1	7.6
Silicon, as Si	Total	mg/l	5	7.1	8.3	7.69
Silver	Dissolved	µg/l	17	< 0.2	< 0.2	NA
Silver	Total	µg/l	17	< 0.2	< 0.2	NA
Sodium	Dissolved	mg/l	1	NA	NA	46
Sodium	Total	mg/l	23	46	65.7	50.0
Strontium	Dissolved	µg/l	1	NA	NA	330
Strontium	Total	µg/l	17	278	330	308
Thallium	Dissolved	µg/l	7	< 0.02	< 0.4	NA
Thallium	Total	µg/l	17	< 0.017	< 0.4	0.13
Titanium	Dissolved	µg/l	1	NA	NA	2.0
Titanium	Total	µg/l	17	< 2	< 10	4.64
Zinc	Dissolved	µg/l	23	< 6	< 30	5.3
Zinc	Total	µg/l	17	< 6	< 30	4.2

NA No data available.
Averages calculated with non-detects at half the detection limit. Averages not calculated if 100% non-detects.
Field duplicates not included in count of samples.

Water Quality Data for GW008 2007 - 2015						
Parameter	**Fraction**	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Average**
General Parameters						
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	13	115	148	129
Alkalinity, carbonate, as CaCO3	NA	mg/l	13	< 10	< 20	NA
Alkalinity, total, as CaCO3	NA	mg/l	22	115	158	131
Biochemical Oxygen Demand (5-day)	NA	mg/l	13	< 2.4	< 8	NA
Carbon, dissolved organic	NA	mg/l	13	1.1	3	1.9
Carbon, total organic	NA	mg/l	22	1	3.2	1.45
Chemical Oxygen Demand	NA	mg/l	16	< 10	26.5	9.56
Chloride	NA	mg/l	22	0.56	1.3	0.76
Cyanide	NA	mg/l	16	< 0.0035	< 0.02	0.0080
Dissolved oxygen	NA	mg/l	23	0.64	11.98	3.17
Fluoride	NA	mg/l	22	< 0.1	0.12	0.1
Hardness, as CaCO3	NA	mg/l	22	130	195	148
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	21	< 0.1	0.12	0.053
Nitrogen, ammonia, as N	NA	mg/l	22	< 0.05	0.14	0.050
Nitrogen, Nitrate, as N	NA	mg/l	1	< 0.1	NA	NA
Nitrogen, Nitrite, as N	NA	mg/l	1	< 0.05	NA	NA
Orthophosphate, as PO4	NA	mg/l	NA	NA	NA	NA
pH	NA	pH units	44	5.2	8.5	6.9
Phosphorus, total, as P	Dissolved	mg/l	1	< 0.0003	NA	NA
Phosphorus, total, as P	NA	mg/l	16	< 0.1	0.86	0.15
Redox (oxidation potential)	NA	mV	23	208	563	439
Silica, as SiO2	NA	mg/l	1	30	30	30
Silica, Reactive as (SiO2)	NA	mg/l	5	29.2	35.7	32.5
Solids, total dissolved	NA	mg/l	18	151	235	193
Specific Conductance @ 25 ºC	NA	umhos/cm	23	222	321	272
Sulfate, as SO4	NA	mg/l	22	10.1	23.5	15
Sulfide, as S^{2}-	NA	mg/l	NA	NA	NA	NA
Temperature	NA	deg C	22	2.69	13.8	8.53
Turbidity	NA	NTU	23	0	886	87.5
Metals						
Aluminum	Dissolved	µg/l	22	< 10	29.6	12.3
Aluminum	Total	µg/l	16	23.5	24300	3549
Antimony	Dissolved	µg/l	7	< 0.5	< 0.5	NA
Antimony	Total	µg/l	16	< 0.5	< 0.5	NA
Arsenic	Dissolved	µg/l	18	< 0.5	< 2	NA
Arsenic	Total	µg/l	16	< 0.5	4.17	0.92
Barium	Dissolved	µg/l	14	27.1	35	32.1
Barium	Total	µg/l	16	28.7	234	62.0
Beryllium	Dissolved	µg/l	7	< 0.2	< 2	NA
Beryllium	Total	µg/l	16	< 0.2	< 2	0.23
Boron	Dissolved	µg/l	16	< 50	< 200	NA
Boron	Total	µg/l	16	< 50	< 200	NA
Cadmium	Dissolved	µg/l	22	< 0.2	< 0.2	NA
Cadmium	Total	µg/l	16	< 0.2	0.39	0.13
Calcium	Dissolved	mg/l	1	NA	NA	24
Calcium	Total	mg/l	22	21	31.8	24.1
Chromium	Dissolved	µg/l	22	< 1	2.9	1.51
Chromium	Total	µg/l	16	1.06	65.1	10.1
Cobalt	Dissolved	µg/l	14	< 0.2	0.2	0.11
Cobalt	Total	µg/l	16	< 0.2	16.8	2.47
Copper	Dissolved	µg/l	22	0.7	16.8	2.13
Copper	Total	µg/l	16	0.76	50	8.3
Iron	Dissolved	µg/l	18	24	106	31
Iron	Total	µg/l	16	< 50	31000	4364
Lead	Dissolved	µg/l	14	< 0.5	< 0.6	NA
Lead	Total	µg/l	16	< 0.5	8.49	1.36
Magnesium	Dissolved	mg/l	1	NA	NA	21
Magnesium	Total	mg/l	22	18.3	28	21.4
Manganese	Dissolved	µg/l	19	2.6	84	24
Manganese	Total	µg/l	16	10	866	171
Mercury	Total	ng/l	21	< 0.5	22.4	2.44
Methyl Mercury	Total	ng/l	15	< 0.03	0.28	0.06
Molybdenum	Dissolved	µg/l	22	< 0.2	0.59	0.2
Molybdenum	Total	µg/l	16	< 0.2	< 5	0.5
Nickel	Dissolved	µg/l	22	0.63	2.5	1.13
Nickel	Total	µg/l	16	0.71	67.5	10.7
Palladium	Total	µg/l	16	< 0.03	< 0.5	NA
Platinum	Dissolved	µg/l	1	< 0.3	NA	NA
Platinum	Total	µg/l	16	< 0.009	< 0.5	NA
Potassium	Dissolved	mg/l	1	NA	NA	1.9
Potassium	Total	mg/l	22	1.25	4.62	1.9
Selenium	Dissolved	µg/l	22	< 1	< 1	NA
Selenium	Total	µg/l	16	< 1	< 1	NA
Silicon, as Si	Dissolved	mg/l	5	12.3	14.9	13.8
Silicon, as Si	Total	mg/l	5	12.2	14.8	13.6
Silver	Dissolved	µg/l	16	< 0.2	< 0.2	NA
Silver	Total	µg/l	16	< 0.2	< 0.2	NA
Sodium	Dissolved	mg/l	1	NA	NA	6
Sodium	Total	mg/l	22	4.8	8.64	5.7
Strontium	Dissolved	µg/l	1	NA	NA	91
Strontium	Total	µg/l	16	74.3	149	94
Thallium	Dissolved	µg/l	7	< 0.02	< 0.4	NA
Thallium	Total	µg/l	16	< 0.017	0.44	0.13
Titanium	Dissolved	µg/l	1	NA	NA	3.0
Titanium	Total	µg/l	16	< 10	1100	151
Zinc	Dissolved	µg/l	22	< 6	< 30	5.4
Zinc	Total	µg/l	16	< 6	77.8	13.5

NA No data available.
Averages calculated with non-detects at half the detection limit. Averages not calculated if 100% non-detects.
Field duplicates not included in count of samples.

Water Quality Data for GW009 2009 - 2015						
Parameter	**Fraction**	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Average**
General Parameters						
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	13	168	239	207
Alkalinity, carbonate, as CaCO3	NA	mg/l	13	< 10	< 10	NA
Alkalinity, total, as CaCO3	NA	mg/l	21	141	239	197
Biochemical Oxygen Demand (5-day)	NA	mg/l	13	< 2.4	< 8	NA
Carbon, dissolved organic	NA	mg/l	13	10.1	22.9	15.9
Carbon, total organic	NA	mg/l	21	10.3	25.5	16.8
Chemical Oxygen Demand	NA	mg/l	15	39.5	154	64.7
Chloride	NA	mg/l	21	2.08	17.1	7.05
Cyanide	NA	mg/l	15	< 0.01	0.0446	0.0093
Dissolved oxygen	NA	mg/l	21	< 0.1	7.6	1.66
Fluoride	NA	mg/l	21	< 0.1	0.28	0.2
Hardness, as CaCO3	NA	mg/l	21	174	346	223
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	21	< 0.1	0.19	0.06
Nitrogen, ammonia, as N	NA	mg/l	21	< 0.1	0.36	0.17
Nitrogen, Nitrate as N	NA	mg/l	NA	NA	NA	NA
Nitrogen, Nitrite as N	NA	mg/l	NA	NA	NA	NA
Orthophosphate, as PO4	NA	mg/l	NA	NA	NA	NA
pH	NA	pH units	41	6.31	8.2	6.9
Phosphorus, total, as P	Dissolved	mg/l	NA	NA	NA	NA
Phosphorus, total, as P	NA	mg/l	15	< 0.1	3.92	0.65
Redox (oxidation potential)	NA	mV	21	-13	651	251
Silica, as SiO2	NA	mg/l	NA	NA	NA	NA
Silica, Reactive as (SiO2)	NA	mg/l	NA	NA	NA	NA
Solids, total dissolved	NA	mg/l	18	314	443	359
Solids, total suspended	NA	mg/l	NA	NA	NA	NA
Specific Conductance @ 25 ºC	NA	µmhos/cm	21	450.3	981	577
Sulfate, as SO4	NA	mg/l	21	15.6	235	75.7
Sulfide, as S^{2}-	NA	mg/l	NA	NA	NA	NA
Temperature	NA	deg C	21	3.06	19.4	8.67
Turbidity	NA	NTU	21	0	2543	301
Metals						
Aluminum	Dissolved	µg/l	21	14.8	< 250	27.7
Aluminum	Total	µg/l	15	< 40	47800	10952
Antimony	Dissolved	µg/l	6	< 0.5	< 0.5	NA
Antimony	Total	µg/l	15	< 0.5	< 0.5	NA
Arsenic	Dissolved	µg/l	18	< 0.5	< 2	0.88
Arsenic	Total	µg/l	15	< 0.5	9.97	2.10
Barium	Dissolved	µg/l	13	52.6	74	62.2
Barium	Total	µg/l	15	62.7	594	162.8
Beryllium	Dissolved	µg/l	6	< 0.2	< 0.2	NA
Beryllium	Total	µg/l	15	< 0.2	2.72	0.42
Boron	Dissolved	µg/l	14	75.1	< 500	125
Boron	Total	µg/l	15	65.8	< 500	139
Cadmium	Dissolved	µg/l	21	< 0.2	0.2	0.10
Cadmium	Total	µg/l	15	< 0.2	0.95	0.28
Calcium	Dissolved	mg/l	NA	NA	NA	NA
Calcium	Total	mg/l	21	33.6	66	43.2
Chromium	Dissolved	µg/l	21	< 1	3.3	0.96
Chromium	Total	µg/l	15	< 1	344	41.9
Cobalt	Dissolved	µg/l	13	3.1	6.8	4.63
Cobalt	Total	µg/l	15	3.5	81.3	13.6
Copper	Dissolved	µg/l	21	1.19	20.7	4.21
Copper	Total	µg/l	15	2.4	252	35.5
Iron	Dissolved	µg/l	17	1140	16400	10302
Iron	Total	µg/l	15	3060	83900	25394
Lead	Dissolved	µg/l	13	< 0.5	< 0.5	NA
Lead	Total	µg/l	15	< 0.5	44.6	5.81
Magnesium	Dissolved	mg/l	NA	NA	NA	NA
Magnesium	Total	mg/l	21	20.3	43.9	27.8
Manganese	Dissolved	µg/l	18	17.3	3910	3026
Manganese	Total	µg/l	15	2690	4220	3461
Mercury	Total	ng/l	21	2.5	69.7	15.4
Methyl Mercury	Total	ng/l	14	< 0.03	0.11	0.05
Molybdenum	Dissolved	µg/l	21	0.26	9	3.98
Molybdenum	Total	µg/l	15	1.9	11.1	5.86
Nickel	Dissolved	µg/l	21	2.6	9.2	4.24
Nickel	Total	µg/l	15	2.8	294	38.7
Palladium	Total	µg/l	15	0.24	2.11	0.42
Platinum	Dissolved	µg/l	NA	NA	NA	NA
Platinum	Total	µg/l	15	< 0.009	< 0.5	NA
Potassium	Dissolved	mg/l	NA	NA	NA	NA
Potassium	Total	mg/l	21	1.56	8.1	3.23
Selenium	Dissolved	µg/l	21	< 1	< 1	NA
Selenium	Total	µg/l	15	< 1	1.98	0.59
Silicon, as Si	Dissolved	mg/l	NA	NA	NA	NA
Silicon, as Si	Total	mg/l	NA	NA	NA	NA
Silver	Dissolved	µg/l	15	< 0.2	< 0.2	NA
Silver	Total	µg/l	15	< 0.2	0.42	0.12
Sodium	Dissolved	mg/l	NA	NA	NA	NA
Sodium	Total	mg/l	21	24.4	77.6	43.6
Strontium	Dissolved	µg/l	NA	NA	NA	NA
Strontium	Total	µg/l	15	146	301	208
Thallium	Dissolved	µg/l	6	< 0.02	< 0.2	NA
Thallium	Total	µg/l	15	< 0.017	0.74	0.20
Titanium	Dissolved	µg/l	NA	NA	NA	NA
Titanium	Total	µg/l	15	< 10	3350	561
Zinc	Dissolved	µg/l	21	< 6	26.7	6.39
Zinc	Total	µg/l	15	< 6	348	44.5

NA No data available.
Averages calculated with non-detects at half the detection limit. Averages not calculated if 100% non-detects.
Field duplicates not included in count of samples.

Water Quality Data for GW010 2009 - 2013						
Parameter	**Fraction**	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Average**
General Parameters						
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	12	277	379	318
Alkalinity, carbonate, as CaCO3	NA	mg/l	12	< 10	< 20	NA
Alkalinity, total, as CaCO3	NA	mg/l	19	259	421	337
Biochemical Oxygen Demand (5-day)	NA	mg/l	12	< 2.4	9.3	2.6
Carbon, dissolved organic	NA	mg/l	12	8.6	15.3	12.7
Carbon, total organic	NA	mg/l	19	5.4	14.9	12.5
Chemical Oxygen Demand	NA	mg/l	13	16.3	70	39.4
Chloride	NA	mg/l	19	15.5	19.9	17.4
Cyanide	NA	mg/l	13	< 0.01	< 0.02	0.007
Dissolved oxygen	NA	mg/l	18	0.02	5.5	0.95
Fluoride	NA	mg/l	19	< 0.1	0.13	0.1
Hardness, as CaCO3	NA	mg/l	19	232	387	302
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	19	< 0.1	0.1	0.05
Nitrogen, ammonia, as N	NA	mg/l	19	< 0.05	0.38	0.11
Nitrogen, Nitrate as N	NA	mg/l	NA	NA	NA	NA
Nitrogen, Nitrite as N	NA	mg/l	NA	NA	NA	NA
Orthophosphate, as PO4	NA	mg/l	NA	NA	NA	NA
pH	NA	pH units	36	5.8	8.4	6.9
Phosphorus, total, as P	Dissolved	mg/l	NA	NA	NA	NA
Phosphorus, total, as P	NA	mg/l	13	< 0.1	< 0.1	NA
Redox (oxidation potential)	NA	mV	18	-70	597	205
Silica, as SiO2	NA	mg/l	NA	NA	NA	NA
Silica, Reactive as (SiO2)	NA	mg/l	NA	NA	NA	NA
Solids, total dissolved	NA	mg/l	18	248	477	399
Solids, total suspended	NA	mg/l	NA	NA	NA	NA
Specific Conductance @ 25 ºC	NA	umhos/cm	18	535	837	687
Sulfate, as SO4	NA	mg/l	19	1.6	31.7	4.58
Sulfide, as S^{2}-	NA	mg/l	NA	NA	NA	NA
Temperature	NA	deg C	18	6.13	11.09	8.29
Turbidity	NA	NTU	18	0	14.1	2.29
Metals						
Aluminum	Dissolved	µg/l	19	< 10	37.6	16.5
Aluminum	Total	µg/l	13	< 20	463	96.3
Antimony	Dissolved	µg/l	6	< 0.5	< 0.5	NA
Antimony	Total	µg/l	13	< 0.5	< 0.5	NA
Arsenic	Dissolved	µg/l	18	1.18	10.7	4.70
Arsenic	Total	µg/l	13	1.16	6.4	3.32
Barium	Dissolved	µg/l	13	1200	2200	1732
Barium	Total	µg/l	13	442	1930	1484
Beryllium	Dissolved	µg/l	6	< 0.2	< 0.2	NA
Beryllium	Total	µg/l	13	< 0.2	< 0.2	NA
Boron	Dissolved	µg/l	14	84.6	142	118
Boron	Total	µg/l	13	81.8	150	104
Cadmium	Dissolved	µg/l	19	< 0.2	< 0.2	NA
Cadmium	Total	µg/l	13	< 0.2	< 0.2	NA
Calcium	Dissolved	mg/l	NA	NA	NA	NA
Calcium	Total	mg/l	19	48.4	81.5	63.0
Chromium	Dissolved	µg/l	19	< 1	2.7	1.44
Chromium	Total	µg/l	13	< 1	3.54	1.65
Cobalt	Dissolved	µg/l	13	0.73	2.9	1.48
Cobalt	Total	µg/l	13	1.1	4.4	2.24
Copper	Dissolved	µg/l	19	< 0.5	8.11	1.66
Copper	Total	µg/l	13	1.2	6.7	2.86
Iron	Dissolved	µg/l	17	5900	21900	12041
Iron	Total	µg/l	13	1150	13900	9695
Lead	Dissolved	µg/l	13	< 0.5	0.57	0.27
Lead	Total	µg/l	13	< 0.5	0.68	0.32
Magnesium	Dissolved	mg/l	NA	NA	NA	NA
Magnesium	Total	mg/l	19	27.1	44.6	35
Manganese	Dissolved	µg/l	18	254	600	422
Manganese	Total	µg/l	13	272	641	416
Mercury	Total	ng/l	18	1.41	5.8	3.53
Methyl Mercury	Total	ng/l	12	< 0.03	0.51	0.07
Molybdenum	Dissolved	µg/l	19	0.24	1.2	0.70
Molybdenum	Total	µg/l	13	0.22	1.2	0.61
Nickel	Dissolved	µg/l	19	< 0.5	6.9	1.65
Nickel	Total	µg/l	13	< 0.5	6.8	2.28
Palladium	Total	µg/l	13	< 0.3	< 0.5	NA
Platinum	Dissolved	µg/l	NA	NA	NA	NA
Platinum	Total	µg/l	13	< 0.3	< 0.5	NA
Potassium	Dissolved	mg/l	NA	NA	NA	NA
Potassium	Total	mg/l	19	1.93	2.91	2.44
Selenium	Dissolved	µg/l	19	< 1	< 1	NA
Selenium	Total	µg/l	13	< 1	< 1	NA
Silicon, as Si	Dissolved	mg/l	NA	NA	NA	NA
Silicon, as Si	Total	mg/l	NA	NA	NA	NA
Silver	Dissolved	µg/l	13	< 0.2	< 0.2	NA
Silver	Total	µg/l	13	< 0.2	< 0.2	NA
Sodium	Dissolved	mg/l	NA	NA	NA	NA
Sodium	Total	mg/l	19	29.9	44.1	38.5
Strontium	Dissolved	µg/l	NA	NA	NA	NA
Strontium	Total	µg/l	13	180	250	213
Thallium	Dissolved	µg/l	6	< 0.02	< 0.2	NA
Thallium	Total	µg/l	13	< 0.017	< 0.4	NA
Titanium	Dissolved	µg/l	NA	NA	NA	NA
Titanium	Total	µg/l	13	< 10	34	9.66
Zinc	Dissolved	µg/l	19	< 6	9.51	3.75
Zinc	Total	µg/l	13	< 6	6.1	3.12

NA No data available.
Averages calculated with non-detects at half the detection limit. Averages not calculated if 100% non-detects.
Field duplicates not included in count of samples.

Water Quality Data for GW011 2009 - 2015						
Parameter	**Fraction**	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Average**
General Parameters						
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	10	23.9	96.1	46.2
Alkalinity, carbonate, as CaCO3	NA	mg/l	10	< 10	< 20	NA
Alkalinity, total, as CaCO3	NA	mg/l	15	23.9	96.1	43.4
Biochemical Oxygen Demand (5-day)	NA	mg/l	10	< 2.4	< 8	NA
Carbon, dissolved organic	NA	mg/l	10	< 1	3.1	1.59
Carbon, total organic	NA	mg/l	15	< 1	< 2	1.16
Chemical Oxygen Demand	NA	mg/l	11	< 10	75.1	15.5
Chloride	NA	mg/l	15	< 0.5	2.78	1.16
Cyanide	NA	mg/l	11	< 0.0035	< 0.02	0.007
Dissolved oxygen	NA	mg/l	14	1.34	11.84	9.02
Fluoride	NA	mg/l	15	< 0.1	0.11	0.05
Hardness, as CaCO3	NA	mg/l	15	32.8	236	72.8
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	15	< 0.1	0.31	0.17
Nitrogen, ammonia, as N	NA	mg/l	15	< 0.05	0.14	0.05
Nitrogen, Nitrate as N	NA	mg/l	NA	NA	NA	NA
Nitrogen, Nitrite as N	NA	mg/l	NA	NA	NA	NA
Orthophosphate, as PO4	NA	mg/l	NA	NA	NA	NA
pH	NA	pH units	28	5.5	8.33	6.74
Phosphorus, total, as P	Dissolved	mg/l	11	< 0.1	6	0.96
Phosphorus, total, as P	NA	mg/l	11	< 0.1	6	0.97
Redox (oxidation potential)	NA	mV	14	271	616	461
Silica, as SiO2	NA	mg/l	NA	NA	NA	NA
Silica, Reactive as (SiO2)	NA	mg/l	NA	NA	NA	NA
Solids, total dissolved	NA	mg/l	13	65	116	97.3
Solids, total suspended	NA	mg/l	NA	NA	NA	NA
Specific Conductance @ 25 ºC	NA	umhos/cm	14	71	1103	169
Sulfate, as SO4	NA	mg/l	15	5.54	20.8	10.5
Sulfide, as S^{2}-	NA	mg/l	NA	NA	NA	NA
Temperature	NA	deg C	14	5.1	19.4	11.0
Turbidity	NA	NTU	14	0	2458	360
Metals						
Aluminum	Dissolved	µg/l	15	10.2	27.8	12.4
Aluminum	Total	µg/l	11	28.1	63500	11988
Antimony	Dissolved	µg/l	4	< 0.5	< 0.5	NA
Antimony	Total	µg/l	11	< 0.5	< 0.5	NA
Arsenic	Dissolved	µg/l	13	< 0.31	< 2	NA
Arsenic	Total	µg/l	11	< 0.5	18	3.22
Barium	Dissolved	µg/l	11	14.7	27.4	20.3
Barium	Total	µg/l	11	18.5	703	140
Beryllium	Dissolved	µg/l	4	< 0.2	< 0.2	NA
Beryllium	Total	µg/l	11	< 0.2	2.72	0.45
Boron	Dissolved	µg/l	9	< 50	< 100	NA
Boron	Total	µg/l	11	< 50	< 100	NA
Cadmium	Dissolved	µg/l	15	< 0.2	< 0.2	NA
Cadmium	Total	µg/l	11	< 0.2	0.67	0.17
Calcium	Dissolved	mg/l	NA	NA	NA	NA
Calcium	Total	mg/l	15	7.6	41.4	14.5
Chromium	Dissolved	µg/l	15	< 1	2.2	1.26
Chromium	Total	µg/l	11	< 1	258	41.0
Cobalt	Dissolved	µg/l	11	< 0.2	< 0.2	NA
Cobalt	Total	µg/l	11	< 0.2	87.1	12.9
Copper	Dissolved	µg/l	15	< 0.5	6.2	1.12
Copper	Total	µg/l	11	1.2	300	43.8
Iron	Dissolved	µg/l	12	< 50	56.6	29.3
Iron	Total	µg/l	11	< 50	82600	15635
Lead	Dissolved	µg/l	11	< 0.5	< 0.5	NA
Lead	Total	µg/l	11	< 0.5	56.2	8.02
Magnesium	Dissolved	mg/l	NA	NA	NA	NA
Magnesium	Total	mg/l	15	3.3	32.2	8.87
Manganese	Dissolved	µg/l	13	0.85	17	4.29
Manganese	Total	µg/l	11	5.5	2140	388
Mercury	Total	ng/l	14	< 0.5	43.1	5.76
Methyl Mercury	Total	ng/l	9	< 0.03	< 0.1	0.04
Molybdenum	Dissolved	µg/l	15	< 0.2	1.4	0.33
Molybdenum	Total	µg/l	11	< 0.2	2.87	0.82
Nickel	Dissolved	µg/l	15	2.1	5.64	3.57
Nickel	Total	µg/l	11	2.7	316	48.7
Palladium	Total	µg/l	11	0.045	1.64	0.36
Platinum	Dissolved	µg/l	NA	NA	NA	NA
Platinum	Total	µg/l	11	< 0.009	< 0.5	NA
Potassium	Dissolved	mg/l	NA	NA	NA	NA
Potassium	Total	mg/l	15	0.85	6.13	2.10
Selenium	Dissolved	µg/l	15	< 1	< 1	NA
Selenium	Total	µg/l	11	< 1	1.19	0.56
Silicon, as Si	Dissolved	mg/l	NA	NA	NA	NA
Silicon, as Si	Total	mg/l	NA	NA	NA	NA
Silver	Dissolved	µg/l	11	< 0.2	< 0.2	NA
Silver	Total	µg/l	11	< 0.2	0.46	0.13
Sodium	Dissolved	mg/l	NA	NA	NA	NA
Sodium	Total	mg/l	15	2.7	7.7	4.31
Strontium	Dissolved	µg/l	NA	NA	NA	NA
Strontium	Total	µg/l	11	41.8	269	96.7
Thallium	Dissolved	µg/l	4	< 0.02	< 0.2	NA
Thallium	Total	µg/l	11	< 0.017	0.53	0.15
Titanium	Dissolved	µg/l	NA	NA	NA	NA
Titanium	Total	µg/l	11	< 10	2100	563
Zinc	Dissolved	µg/l	15	< 6	13.8	4.34
Zinc	Total	µg/l	11	< 6	366	53.4

NA No data available.
Averages calculated with non-detects at half the detection limit. Averages not calculated if 100% non-detects.
Field duplicates not included in count of samples.

Water Quality Data for GW012 2009 - 2015						
Parameter	**Fraction**	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Average**
General Parameters						
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	14	496	680	606
Alkalinity, carbonate, as CaCO3	NA	mg/l	13	< 20	23.7	11.1
Alkalinity, total, as CaCO3	NA	mg/l	21	496	696	609
Biochemical Oxygen Demand (5-day)	NA	mg/l	13	< 2.4	< 8	NA
Carbon, dissolved organic	NA	mg/l	14	3.9	7.1	5.6
Carbon, total organic	NA	mg/l	21	4	6.8	5.1
Chemical Oxygen Demand	NA	mg/l	14	< 10	59.1	19.1
Chloride	NA	mg/l	21	13.3	23	17.3
Cyanide	NA	mg/l	14	< 0.0035	0.0289	0.009
Dissolved oxygen	NA	mg/l	21	0.03	9.4	1.88
Fluoride	NA	mg/l	21	< 0.13	0.26	0.2
Hardness, as CaCO3	NA	mg/l	20	670	1090	859
Nitrogen, Nitrate, as N	NA	mg/l	1	< 0.1	NA	NA
Nitrogen, Nitrite, as N	NA	mg/l	1	< 0.1	NA	NA
Nitrogen, Nitrate + Nitrite, as N	NA	mg/l	20	< 0.1	0.11	0.053
Nitrogen, ammonia, as N	NA	mg/l	21	< 0.05	< 0.1	0.05
Orthophosphate, as PO4	NA	mg/l	1	NA	NA	0.02
pH	NA	pH units	40	6.59	7.9	7.3
Phosphorus, total, as P	Dissolved	mg/l	NA	NA	NA	NA
Phosphorus, total, as P	NA	mg/l	15	< 0.1	2.9	0.27
Redox (oxidation potential)	NA	mV	21	215	792	411
Silica, as SiO2	NA	mg/l	1	NA	NA	18.9
Silica, Reactive as (SiO2)	NA	mg/l	5	15.5	19	17.4
Solids, total dissolved	NA	mg/l	19	893	1458	1201
Solids, total suspended	NA	mg/l	1	NA	NA	4.90
Specific Conductance @ 25 ºC	NA	umhos/cm	22	573	2376	1703
Sulfate, as SO4	NA	mg/l	21	246	507	392
Sulfide, as S^{2}-	NA	mg/l	1	< 5	NA	NA
Temperature	NA	deg C	21	2.83	13.98	9.24
Turbidity	NA	NTU	21	0	1651	122
Metals						
Aluminum	Dissolved	µg/l	20	< 10	< 80	16.7
Aluminum	Total	µg/l	15	< 20	29000	3556
Antimony	Dissolved	µg/l	6	< 0.5	< 0.5	NA
Antimony	Total	µg/l	14	< 0.5	< 0.5	NA
Arsenic	Dissolved	µg/l	18	< 0.5	< 2	0.36
Arsenic	Total	µg/l	14	< 0.5	3.44	0.80
Barium	Dissolved	µg/l	15	153	277	207
Barium	Total	µg/l	15	156	452	245
Beryllium	Dissolved	µg/l	6	< 0.2	< 0.2	NA
Beryllium	Total	µg/l	14	< 0.2	1.02	0.17
Boron	Dissolved	µg/l	14	168	442	374
Boron	Total	µg/l	15	313	442	386
Cadmium	Dissolved	µg/l	20	< 0.2	1.1	0.16
Cadmium	Total	µg/l	14	< 0.2	2	0.30
Calcium	Dissolved	mg/l	NA	NA	NA	NA
Calcium	Total	mg/l	21	128	211	165
Chromium	Dissolved	µg/l	20	< 1	< 1	NA
Chromium	Total	µg/l	14	< 1	68.2	9.00
Cobalt	Dissolved	µg/l	15	< 0.2	0.88	0.54
Cobalt	Total	µg/l	14	0.42	17.9	2.76
Copper	Dissolved	µg/l	20	1.8	6.2	3.38
Copper	Total	µg/l	14	2.1	205	24.5
Iron	Dissolved	µg/l	18	< 50	551	88.6
Iron	Total	µg/l	15	77.2	30100	3510
Lead	Dissolved	µg/l	15	< 0.5	< 0.5	NA
Lead	Total	µg/l	14	< 0.5	8.26	1.28
Magnesium	Dissolved	mg/l	NA	NA	NA	NA
Magnesium	Total	mg/l	21	81.4	136	110
Manganese	Dissolved	µg/l	18	140	567	267
Manganese	Total	µg/l	15	173	776	392
Mercury	Total	ng/l	19	1.05	153	12.4
Methyl Mercury	Total	ng/l	12	< 0.03	< 0.1	0.04
Molybdenum	Dissolved	µg/l	20	26.5	38.4	34.2
Molybdenum	Total	µg/l	14	19.5	37.2	31.9
Nickel	Dissolved	µg/l	20	8.1	13.3	10.7
Nickel	Total	µg/l	14	8.2	90.6	19.7
Palladium	Total	µg/l	14	< 0.03	1.72	0.41
Platinum	Dissolved	µg/l	NA	NA	NA	NA
Platinum	Total	µg/l	14	< 0.009	< 0.5	NA
Potassium	Dissolved	mg/l	NA	NA	NA	NA
Potassium	Total	mg/l	21	2.59	5.04	3.46
Selenium	Dissolved	µg/l	20	< 1	< 1	NA
Selenium	Total	µg/l	14	< 1	< 1	NA
Silicon, as Si	Dissolved	mg/l	5	8	8.7	8.40
Silicon, as Si	Total	mg/l	5	7.9	9	8.44
Silver	Dissolved	µg/l	14	< 0.2	< 0.2	NA
Silver	Total	µg/l	14	< 0.2	0.23	0.11
Sodium	Dissolved	mg/l	NA	NA	NA	NA
Sodium	Total	mg/l	21	80.3	131	107
Strontium	Dissolved	µg/l	NA	NA	NA	NA
Strontium	Total	µg/l	15	692	1050	873
Thallium	Dissolved	µg/l	6	< 0.02	< 0.2	NA
Thallium	Total	µg/l	14	< 0.017	< 0.4	NA
Titanium	Dissolved	µg/l	NA	NA	NA	NA
Titanium	Total	µg/l	14	< 10	780	134
Zinc	Dissolved	µg/l	20	< 6	43.7	5.30
Zinc	Total	µg/l	14	< 6	94.9	13.4

NA No data available.
Averages calculated with non-detects at half the detection limit. Averages not calculated if 100% non-detects.
Field duplicates not included in count of samples.

Water Quality Data for GW013 2010 - 2015						
Parameter	**Fraction**	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Average**
General Parameters						
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	12	12.7	46.2	18.5
Alkalinity, carbonate, as CaCO3	NA	mg/l	12	< 10	< 20	NA
Alkalinity, total, as CaCO3	NA	mg/l	18	11.4	46.2	16.8
Biochemical Oxygen Demand (5-day)	NA	mg/l	12	< 2.4	< 8	NA
Carbon, dissolved organic	NA	mg/l	12	2.4	5.2	3.64
Carbon, total organic	NA	mg/l	18	2.4	5.8	3.39
Chemical Oxygen Demand	NA	mg/l	12	< 10	23.5	12.2
Chloride	NA	mg/l	18	< 0.5	< 1	0.39
Cyanide	NA	mg/l	12	< 0.01	0.945	0.086
Dissolved oxygen	NA	mg/l	18	5.8	10.79	8.10
Fluoride	NA	mg/l	18	0.06	0.56	0.06
Hardness, as CaCO3	NA	mg/l	18	11.7	19.8	16.3
Nitrate + Nitrite, as N	NA	mg/l	18	< 0.1	0.25	0.13
Nitrogen, ammonia as N	NA	mg/l	18	< 0.05	0.49	0.07
Nitrogen, Nitrate as N	NA	mg/l	NA	NA	NA	NA
Nitrogen, Nitrite as N	NA	mg/l	NA	NA	NA	NA
Orthophosphate, as PO4	NA	mg/l	NA	NA	NA	NA
pH	NA	pH units	35	5.39	7.2	6.16
Phosphorus, total, as P	Dissolved	mg/l	12	< 0.1	< 0.1	NA
Phosphorus, total, as P	NA	mg/l	12	< 0.1	< 0.1	NA
Redox (oxidation potential)	NA	mV	18	364	635	484
Silica, as SiO2	NA	mg/l	NA	NA	NA	NA
Silica, Reactive as (SiO2)	NA	mg/l	NA	NA	NA	NA
Solids, total dissolved	NA	mg/l	18	12	104	61.9
Solids, total suspended	NA	mg/l	NA	NA	NA	NA
Specific Conductance @ 25 ºC	NA	µmhos/cm	18	0	43	28.5
Sulfate, as SO4	NA	mg/l	18	2.2	4.1	2.93
Sulfide, as S^{2}-	NA	mg/l	NA	NA	NA	NA
Temperature, ºC	NA	deg C	18	4.69	10.56	7.67
Turbidity	NA	NTU	18	0	71.4	12.0
Metals						
Aluminum	Dissolved	µg/l	18	27.7	154	56.9
Aluminum	Total	µg/l	12	51.6	2450	654
Antimony	Dissolved	µg/l	6	< 0.5	< 0.5	NA
Antimony	Total	µg/l	12	< 0.5	< 0.5	NA
Arsenic	Dissolved	µg/l	18	< 0.31	< 1	NA
Arsenic	Total	µg/l	12	< 0.5	< 1	0.37
Barium	Dissolved	µg/l	15	13.8	20.2	17.4
Barium	Total	µg/l	12	15.8	50.5	25.6
Beryllium	Dissolved	µg/l	6	< 0.2	< 0.2	NA
Beryllium	Total	µg/l	12	< 0.2	< 0.2	NA
Boron	Dissolved	µg/l	14	< 50	< 100	NA
Boron	Total	µg/l	12	< 50	< 50	NA
Cadmium	Dissolved	µg/l	18	< 0.03	< 0.2	0.10
Cadmium	Total	µg/l	12	0.04	< 0.2	0.10
Calcium	Dissolved	mg/l	NA	NA	NA	NA
Calcium	Total	mg/l	18	2.8	4.39	3.76
Chromium	Dissolved	µg/l	18	< 1	1.46	0.77
Chromium	Total	µg/l	12	< 1	6.42	1.90
Cobalt	Dissolved	µg/l	15	< 0.2	3.3	0.29
Cobalt	Total	µg/l	12	< 0.2	1.36	0.43
Copper	Dissolved	µg/l	18	1.1	7.18	2.10
Copper	Total	µg/l	12	1.5	7.68	3.17
Iron	Dissolved	µg/l	18	< 50	103	34.9
Iron	Total	µg/l	12	55.6	2320	630
Lead	Dissolved	µg/l	15	< 0.5	< 0.5	NA
Lead	Total	µg/l	12	< 0.5	3.55	0.53
Magnesium	Dissolved	mg/l	NA	NA	NA	NA
Magnesium	Total	mg/l	18	1.2	2.14	1.67
Manganese	Dissolved	µg/l	18	< 0.5	29	3.78
Manganese	Total	µg/l	12	1	39.7	10.4
Mercury	Total	ng/l	18	1.8	6	3.40
Methyl Mercury	Total	ng/l	11	< 0.03	0.25	0.05
Molybdenum	Dissolved	µg/l	18	< 0.2	0.44	0.16
Molybdenum	Total	µg/l	12	< 0.2	0.48	0.19
Nickel	Dissolved	µg/l	18	0.51	1.69	0.80
Nickel	Total	µg/l	12	0.71	6.93	2.12
Palladium	Total	µg/l	12	< 0.5	< 0.5	NA
Platinum	Dissolved	µg/l	NA	NA	NA	NA
Platinum	Total	µg/l	12	< 0.5	< 0.5	NA
Potassium	Dissolved	mg/l	NA	NA	NA	NA
Potassium	Total	mg/l	18	0.246	0.64	0.35
Selenium	Dissolved	µg/l	18	< 0.2	< 1	NA
Selenium	Total	µg/l	12	< 0.2	< 1	0.47
Silicon, as Si	Dissolved	µg/l	NA	NA	NA	NA
Silicon, as Si	Total	µg/l	NA	NA	NA	NA
Silver	Dissolved	µg/l	12	< 0.2	< 0.2	NA
Silver	Total	µg/l	12	< 0.2	< 0.2	NA
Sodium	Dissolved	mg/l	NA	NA	NA	NA
Sodium	Total	mg/l	18	1.3	< 2	1.34
Strontium	Dissolved	µg/l	NA	NA	NA	NA
Strontium	Total	µg/l	12	15.9	27.3	22.2
Thallium	Dissolved	µg/l	6	< 0.02	< 0.2	NA
Thallium	Total	µg/l	12	< 0.017	0.81	0.15
Titanium	Dissolved	µg/l	NA	NA	NA	NA
Titanium	Total	µg/l	12	< 10	88	24.4
Zinc	Dissolved	µg/l	18	< 6	12.3	4.12
Zinc	Total	µg/l	12	< 6	11.9	3.68

NA No data available.
Averages calculated with non-detects at half the detection limit. Averages not calculated if 100% non-detects.
Field duplicates not included in count of samples.

Water Quality Data for GW014 2010 - 2015						
Parameter	**Fraction**	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Average**
General Parameters						
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	12	317	507	398
Alkalinity, carbonate, as CaCO3	NA	mg/l	12	< 10	< 20	NA
Alkalinity, total, as CaCO3	NA	mg/l	15	317	507	389
Biochemical Oxygen Demand (5-day)	NA	mg/l	12	< 3	9.7	4.36
Carbon, dissolved organic	NA	mg/l	12	9.1	19.3	12.1
Carbon, total organic	NA	mg/l	15	9.1	16.3	11.8
Chemical Oxygen Demand	NA	mg/l	12	23.7	126	49.4
Chloride	NA	mg/l	15	9.1	25	17.3
Cyanide	NA	mg/l	12	< 0.01	0.0234	0.010
Dissolved oxygen	NA	mg/l	15	0.16	9.81	4.24
Fluoride	NA	mg/l	15	< 0.1	0.86	0.46
Hardness, as CaCO3	NA	mg/l	15	274	1220	492
Nitrate + Nitrite, as N	NA	mg/l	15	< 0.1	0.51	0.10
Nitrogen, ammonia as N	NA	mg/l	15	0.07	0.3	0.09
Nitrogen, Nitrate as N	NA	mg/l	NA	NA	NA	NA
Nitrogen, Nitrite as N	NA	mg/l	NA	NA	NA	NA
Orthophosphate, as PO4	NA	mg/l	NA	NA	NA	NA
pH	NA	pH units	29	6.1	7.8	7.09
Phosphorus, total, as P	Dissolved	mg/l	NA	NA	NA	NA
Phosphorus, total, as P	NA	mg/l	12	< 0.1	10.6	1.63
Redox (oxidation potential)	NA	mV	15	3.7	535	307
Silica, as SiO2	NA	mg/l	NA	NA	NA	NA
Silica, Reactive as (SiO2)	NA	mg/l	NA	NA	NA	NA
Solids, total dissolved	NA	mg/l	15	421	653	566
Solids, total suspended	NA	mg/l	NA	NA	NA	NA
Specific Conductance @ 25 ºC	NA	µmhos/cm	15	505	1022	898
Sulfate, as SO4	NA	mg/l	15	37.4	211	94.8
Sulfide, as S^{2}-	NA	mg/l	NA	NA	NA	NA
Temperature, ºC	NA	deg C	15	3.61	25.98	12.0
Turbidity	NA	NTU	15	12.6	2458	361
Metals						
Aluminum	Dissolved	µg/l	15	< 20	232	39.7
Aluminum	Total	µg/l	12	582	134000	25097
Antimony	Dissolved	µg/l	3	< 0.5	< 0.5	NA
Antimony	Total	µg/l	12	< 0.5	< 5	0.68
Arsenic	Dissolved	µg/l	15	0.34	4.99	0.86
Arsenic	Total	µg/l	12	< 0.5	26.6	4.35
Barium	Dissolved	µg/l	12	36.6	200	124
Barium	Total	µg/l	12	77.3	1520	357
Beryllium	Dissolved	µg/l	3	< 0.2	< 0.2	NA
Beryllium	Total	µg/l	12	< 0.2	5.43	0.92
Boron	Dissolved	µg/l	11	136	267	191
Boron	Total	µg/l	12	169	< 500	203
Cadmium	Dissolved	µg/l	15	0.04	1.1	0.16
Cadmium	Total	µg/l	12	< 0.2	4.57	0.78
Calcium	Dissolved	mg/l	NA	NA	NA	NA
Calcium	Total	mg/l	15	47.4	252	97.8
Chromium	Dissolved	µg/l	15	< 1	2.86	0.79
Chromium	Total	µg/l	12	1.5	1000	139
Cobalt	Dissolved	µg/l	12	0.26	5	1.30
Cobalt	Total	µg/l	12	1.3	215	28.0
Copper	Dissolved	µg/l	15	< 0.5	5.81	2.05
Copper	Total	µg/l	12	4.1	545	80.4
Iron	Dissolved	µg/l	15	< 50	10800	4389
Iron	Total	µg/l	12	2410	228000	43592
Lead	Dissolved	µg/l	12	< 0.5	< 0.5	NA
Lead	Total	µg/l	12	< 0.5	78.4	11.7
Magnesium	Dissolved	mg/l	NA	NA	NA	NA
Magnesium	Total	mg/l	15	37.7	144	60.1
Manganese	Dissolved	µg/l	15	547	1940	1472
Manganese	Total	µg/l	12	864	6720	2285
Mercury	Total	ng/l	15	0.81	102	12.4
Methyl Mercury	Total	ng/l	11	< 0.03	0.44	0.15
Molybdenum	Dissolved	µg/l	15	3.7	59	21.1
Molybdenum	Total	µg/l	12	9.8	130	35.6
Nickel	Dissolved	µg/l	15	0.8	11.2	3.04
Nickel	Total	µg/l	12	2.6	620	85.4
Palladium	Total	µg/l	12	< 0.5	5.72	1.08
Platinum	Dissolved	µg/l	NA	NA	NA	NA
Platinum	Total	µg/l	12	< 0.5	< 5	NA
Potassium	Dissolved	mg/l	NA	NA	NA	NA
Potassium	Total	mg/l	15	2.1	17.2	5.41
Selenium	Dissolved	µg/l	15	0.47	< 1	0.50
Selenium	Total	µg/l	12	< 1	< 10	1.50
Silicon, as Si	Dissolved	mg/l	NA	NA	NA	NA
Silicon, as Si	Total	mg/l	NA	NA	NA	NA
Silver	Dissolved	µg/l	12	< 0.2	< 0.2	NA
Silver	Total	µg/l	12	< 0.2	< 2	0.28
Sodium	Dissolved	mg/l	NA	NA	NA	NA
Sodium	Total	mg/l	15	48.8	80.1	64.0
Strontium	Dissolved	µg/l	NA	NA	NA	NA
Strontium	Total	µg/l	12	230	1230	459
Thallium	Dissolved	µg/l	3	< 0.2	< 0.2	NA
Thallium	Total	µg/l	12	< 0.017	< 2	0.29
Titanium	Dissolved	µg/l	NA	NA	NA	NA
Titanium	Total	µg/l	12	37.2	5560	1434
Zinc	Dissolved	µg/l	15	< 6	37.2	7.15
Zinc	Total	µg/l	12	< 6	610	92.2

NA No data available.
Averages calculated with non-detects at half the detection limit. Averages not calculated if 100% non-detects.
Field duplicates not included in count of samples.

Water Quality Data for GW015 2010 - 2015						
Parameter	**Fraction**	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Average**
General Parameters						
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	12	98	135	109
Alkalinity, carbonate, as CaCO3	NA	mg/l	12	< 10	< 20	NA
Alkalinity, total, as CaCO3	NA	mg/l	18	98	135	108
Biochemical Oxygen Demand (5-day)	NA	mg/l	12	< 2.4	< 8	NA
Carbon, dissolved organic	NA	mg/l	12	2	3.6	2.95
Carbon, total organic	NA	mg/l	18	1.9	3.7	2.43
Chemical Oxygen Demand	NA	mg/l	12	< 10	40.6	14.0
Chloride	NA	mg/l	18	< 0.5	4.8	0.81
Cyanide	NA	mg/l	12	< 0.01	< 0.02	NA
Dissolved oxygen	NA	mg/l	18	< 0.1	3.6	0.85
Fluoride	NA	mg/l	18	0.16	0.23	0.19
Hardness, as CaCO3	NA	mg/l	18	104	162	116
Nitrate + Nitrite, as N	NA	mg/l	18	< 0.1	0.28	0.063
Nitrogen, ammonia as N	NA	mg/l	18	0.08	0.19	0.077
Nitrogen, Nitrate as N	NA	mg/l	NA	NA	NA	NA
Nitrogen, Nitrite as N	NA	mg/l	NA	NA	NA	NA
Orthophosphate, as PO4	NA	mg/l	NA	NA	NA	NA
pH	NA	pH units	35	7.04	8	7.55
Phosphorus, total, as P	Dissolved	mg/l	NA	NA	NA	NA
Phosphorus, total, as P	NA	mg/l	12	< 0.1	0.43	0.11
Redox (oxidation potential)	NA	mV	18	35	472	263
Silica, as SiO2	NA	mg/l	NA	NA	NA	NA
Silica, Reactive as (SiO2)	NA	mg/l	NA	NA	NA	NA
Solids, total dissolved	NA	mg/l	18	124	236	165
Solids, total suspended	NA	mg/l	NA	NA	NA	NA
Specific Conductance @ 25 °C	NA	µmhos/cm	18	175	312	215
Sulfate, as SO4	NA	mg/l	18	5.2	38.6	9.54
Sulfide, as S^{2}-	NA	mg/l	NA	NA	NA	NA
Temperature, °C	NA	deg C	18	6.1	8.92	7.38
Turbidity	NA	NTU	18	0	303	43.2
Metals						
Aluminum	Dissolved	µg/l	18	< 10	89.9	17.9
Aluminum	Total	µg/l	12	< 20	4870	1277
Antimony	Dissolved	µg/l	6	< 0.5	< 0.5	NA
Antimony	Total	µg/l	12	< 0.5	< 5	NA
Arsenic	Dissolved	µg/l	18	0.58	1.3	0.79
Arsenic	Total	µg/l	12	< 0.5	< 5	0.94
Barium	Dissolved	µg/l	15	146	273	215
Barium	Total	µg/l	12	160	258	209
Beryllium	Dissolved	µg/l	6	< 0.2	< 0.2	NA
Beryllium	Total	µg/l	12	< 0.2	< 2	NA
Boron	Dissolved	µg/l	14	< 50	< 100	NA
Boron	Total	µg/l	12	< 50	< 100	NA
Cadmium	Dissolved	µg/l	18	< 0.2	0.26	0.11
Cadmium	Total	µg/l	12	< 0.2	< 2	NA
Calcium	Dissolved	mg/l	NA	NA	NA	NA
Calcium	Total	mg/l	18	24.2	38.7	27.2
Chromium	Dissolved	µg/l	18	< 1	1.04	0.53
Chromium	Total	µg/l	12	< 1	< 10	3.39
Cobalt	Dissolved	µg/l	15	< 0.2	< 0.2	NA
Cobalt	Total	µg/l	12	< 0.2	3.52	1.17
Copper	Dissolved	µg/l	18	< 0.5	6.49	1.34
Copper	Total	µg/l	12	< 0.5	21.7	6.69
Iron	Dissolved	µg/l	18	< 50	159	93.7
Iron	Total	µg/l	12	112	5800	1638
Lead	Dissolved	µg/l	15	< 0.5	< 0.5	NA
Lead	Total	µg/l	12	< 0.5	< 5	0.92
Magnesium	Dissolved	mg/l	NA	NA	NA	NA
Magnesium	Total	mg/l	18	10.5	16	11.6
Manganese	Dissolved	µg/l	18	294	744	597
Manganese	Total	µg/l	12	541	730	619
Mercury	Total	ng/l	18	< 0.5	2.6	0.78
Methyl Mercury	Total	ng/l	11	< 0.03	< 0.1	0.04
Molybdenum	Dissolved	µg/l	18	2	16.6	4.03
Molybdenum	Total	µg/l	12	2.1	17.1	5.47
Nickel	Dissolved	µg/l	18	< 0.5	1.6	0.56
Nickel	Total	µg/l	12	< 0.5	11.4	3.81
Palladium	Total	µg/l	12	< 0.5	< 5	NA
Platinum	Dissolved	µg/l	NA	NA	NA	NA
Platinum	Total	µg/l	12	< 0.5	< 5	NA
Potassium	Dissolved	mg/l	NA	NA	NA	NA
Potassium	Total	mg/l	18	1.2	2.43	1.57
Selenium	Dissolved	µg/l	18	< 1	< 1	NA
Selenium	Total	µg/l	12	< 1	< 10	NA
Silicon, as Si	Dissolved	mg/l	NA	NA	NA	NA
Silicon, as Si	Total	mg/l	NA	NA	NA	NA
Silver	Dissolved	µg/l	12	< 0.2	< 0.2	NA
Silver	Total	µg/l	12	< 0.2	< 2	NA
Sodium	Dissolved	mg/l	NA	NA	NA	NA
Sodium	Total	mg/l	18	3.3	9.76	4.36
Strontium	Dissolved	µg/l	NA	NA	NA	NA
Strontium	Total	µg/l	12	208	275	245
Thallium	Dissolved	µg/l	6	< 0.02	< 0.2	NA
Thallium	Total	µg/l	12	< 0.017	< 2	NA
Titanium	Dissolved	µg/l	NA	NA	NA	NA
Titanium	Total	µg/l	12	< 10	281	86.8
Zinc	Dissolved	µg/l	18	< 6	17.8	4.89
Zinc	Total	µg/l	12	< 6	< 60	8.04

NA No data available.
Averages calculated with non-detects at half the detection limit. Averages not calculated if 100% non-detects.
Field duplicates not included in count of samples.

Water Quality Data for GW016 2013 - 2015						
Parameter	**Fraction**	**Units**	**# of Samples**	**Minimum**	**Maximum**	**Average**
General Parameters						
Alkalinity, bicarbonate, as CaCO3	NA	mg/l	2	32.9	63.8	48.4
Alkalinity, carbonate, as CaCO3	NA	mg/l	2	< 10	< 10	NA
Alkalinity, total, as CaCO3	NA	mg/l	8	32.9	63.8	45.9
Biochemical Oxygen Demand (5-day)	NA	mg/l	2	4.3	13	8.65
Carbon, dissolved organic	NA	mg/l	2	8.9	20.7	14.8
Carbon, total organic	NA	mg/l	8	2.5	20.4	6.68
Chemical Oxygen Demand	NA	mg/l	2	31.6	89.7	60.7
Chloride	NA	mg/l	8	< 1	2.4	0.85
Cyanide	NA	mg/l	2	0.0134	0.0211	0.017
Dissolved oxygen	NA	mg/l	8	< 0.1	6.12	3.58
Fluoride	NA	mg/l	8	< 0.1	0.26	0.13
Hardness, as CaCO3	NA	mg/l	8	32.3	64.7	42.7
Nitrate + Nitrite, as N	NA	mg/l	8	< 0.1	0.16	0.080
Nitrogen, ammonia as N	NA	mg/l	8	< 0.1	< 0.1	NA
Nitrogen, Nitrate as N	NA	mg/l	NA	NA	NA	NA
Nitrogen, Nitrite as N	NA	mg/l	NA	NA	NA	NA
Orthophosphate, as PO4	NA	mg/l	NA	NA	NA	NA
pH	NA	pH units	16	6.37	8	6.95
Phosphorus, total, as P	Dissolved	mg/l	NA	NA	NA	NA
Phosphorus, total, as P	NA	mg/l	2	< 0.1	< 0.1	NA
Redox (oxidation potential)	NA	mV	8	228	469	309
Silica, as SiO2	NA	mg/l	NA	NA	NA	NA
Silica, Reactive as (SiO2)	NA	mg/l	NA	NA	NA	NA
Solids, total dissolved	NA	mg/l	8	83	129	107
Solids, total suspended	NA	mg/l	NA	NA	NA	NA
Specific Conductance @ 25 ºC	NA	µmhos/cm	8	86.6	157	103
Sulfate, as SO4	NA	mg/l	8	3.4	6.8	4.38
Sulfide, as S^{2}-	NA	mg/l	NA	NA	NA	NA
Temperature, ºC	NA	deg C	8	3.58	13.22	9.05
Turbidity	NA	NTU	8	1.9	59.1	16.5
Metals						
Aluminum	Dissolved	µg/l	8	10.2	47	16.5
Aluminum	Total	µg/l	2	651	3060	1856
Antimony	Dissolved	µg/l	6	< 0.5	< 0.5	NA
Antimony	Total	µg/l	2	< 0.5	< 0.5	NA
Arsenic	Dissolved	µg/l	8	< 0.5	1.1	0.67
Arsenic	Total	µg/l	2	< 0.5	1.1	0.68
Barium	Dissolved	µg/l	8	9.1	19.7	14.4
Barium	Total	µg/l	2	15.1	49.9	32.5
Beryllium	Dissolved	µg/l	6	< 0.2	< 0.2	NA
Beryllium	Total	µg/l	2	< 0.2	< 0.2	NA
Boron	Dissolved	µg/l	8	< 50	< 100	NA
Boron	Total	µg/l	2	< 50	< 50	NA
Cadmium	Dissolved	µg/l	8	< 0.2	< 0.2	NA
Cadmium	Total	µg/l	2	< 0.2	< 0.2	NA
Calcium	Dissolved	mg/l	NA	NA	NA	NA
Calcium	Total	mg/l	8	6.9	13.2	9.43
Chromium	Dissolved	µg/l	8	< 1	1.6	0.64
Chromium	Total	µg/l	2	2.4	8.6	5.50
Cobalt	Dissolved	µg/l	8	1.4	5.4	2.48
Cobalt	Total	µg/l	2	2	7.5	4.75
Copper	Dissolved	µg/l	8	0.56	2	1.19
Copper	Total	µg/l	2	3.2	11.9	7.55
Iron	Dissolved	µg/l	8	67.6	766	440
Iron	Total	µg/l	2	729	3980	2355
Lead	Dissolved	µg/l	8	< 0.5	< 0.5	NA
Lead	Total	µg/l	2	< 0.5	1.3	0.78
Magnesium	Dissolved	mg/l	NA	NA	NA	NA
Magnesium	Total	mg/l	8	3.7	7.8	5.19
Manganese	Dissolved	µg/l	8	184	1420	966
Manganese	Total	µg/l	2	217	903	560
Mercury	Total	ng/l	8	< 0.5	5.5	1.42
Methyl Mercury	Total	ng/l	2	< 0.03	0.12	0.07
Molybdenum	Dissolved	µg/l	8	1.2	1.6	1.45
Molybdenum	Total	µg/l	2	1.1	1.3	1.20
Nickel	Dissolved	µg/l	8	1.8	7.7	3.16
Nickel	Total	µg/l	2	4.3	16.3	10.3
Palladium	Total	µg/l	2	< 0.5	< 0.5	NA
Platinum	Dissolved	µg/l	NA	NA	NA	NA
Platinum	Total	µg/l	2	< 0.5	< 0.5	NA
Potassium	Dissolved	mg/l	NA	NA	NA	NA
Potassium	Total	mg/l	8	0.828	1.6	1.11
Selenium	Dissolved	µg/l	8	< 1	< 1	NA
Selenium	Total	µg/l	2	< 1	< 1	NA
Silicon, as Si	Dissolved	mg/l	NA	NA	NA	NA
Silicon, as Si	Total	mg/l	NA	NA	NA	NA
Silver	Dissolved	µg/l	2	< 0.2	< 0.2	NA
Silver	Total	µg/l	2	< 0.2	< 0.2	NA
Sodium	Dissolved	mg/l	NA	NA	NA	NA
Sodium	Total	mg/l	8	3.7	8	4.85
Strontium	Dissolved	µg/l	NA	NA	NA	NA
Strontium	Total	µg/l	2	32.6	69	50.8
Thallium	Dissolved	µg/l	6	< 0.02	< 0.2	NA
Thallium	Total	µg/l	2	< 0.017	< 0.2	NA
Titanium	Dissolved	µg/l	NA	NA	NA	NA
Titanium	Total	µg/l	2	28.1	127	77.6
Zinc	Dissolved	µg/l	8	< 6	< 6	NA
Zinc	Total	µg/l	2	< 6	9.6	6.30

NA No data available.
Averages calculated with non-detects at half the detection limit. Averages not calculated if 100% non-detects.
Field duplicates not included in count of samples.

Water quality data is not available for GW003 or GW004 because these wells have been dry during the period of monitoring (2007-2015)

Large Figures

TAILINGS BASIN

CELL 2E

CELL 2W

CELL 1E

EMERGENCY BASIN

PROCESS PLANT AREA

AREA 2 SHOPS

AREA 1 LOCOMOTIVE FUELING FACILITY

AREA 1 SHOPS

ADMINISTRATION BUILDING AND GUARD SHACK

RAILROAD CORRIDOR

DUNKA ROAD AND UTILITY CORRIDOR

RAILROAD CONNECTION TRACK

Unnamed Creek

Second Creek

Wyman Creek

Longnose Creek

Spring Mine Lake

SITE LOCATION

Lake Superior

MINNESOTA

[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.

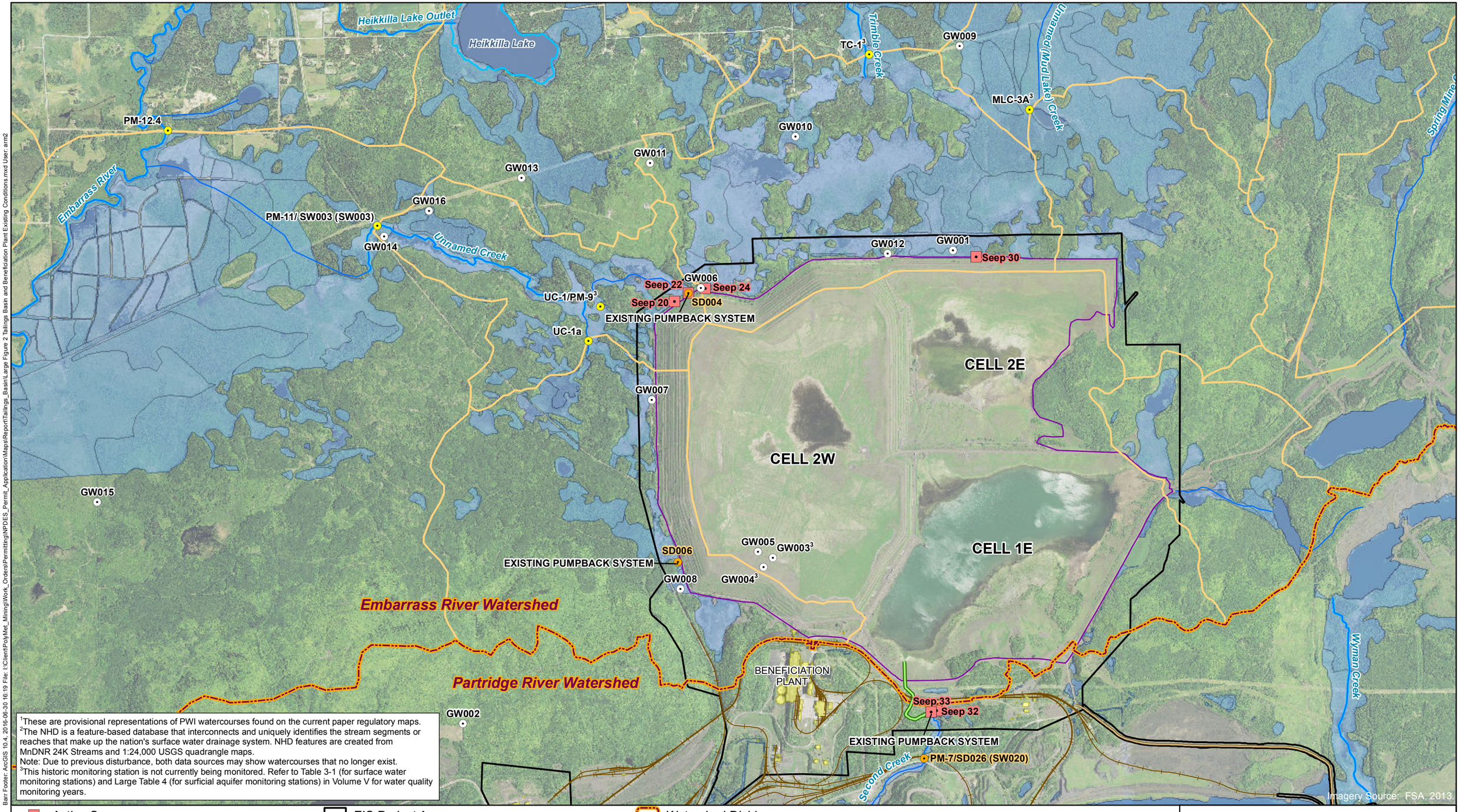
- EIS Project Areas
- Existing Tailings Basin
- Proposed Railroad
- Existing Private Railroad
- Public Waters Inventory (PWI) Watercourses[1]
- National Hydrography Dataset (NHD) Rivers & Streams[2]

0 1,500 3,000 6,000
Feet

BARR

SITE LOCATION
NorthMet Project
Poly Met Mining Inc.

Large Figure 1
NPDES/SDS Permit Application
Volume V: Tailings Basin and Benefication Plant



[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 4 (for surficial aquifer monitoring stations) in Volume V for water quality monitoring years.

- Active Seeps
- Cliffs Erie NPDES Surface Discharge Locations
- Existing Surficial Aquifer Monitoring Stations
- Existing Surface Water Monitoring Stations

PM-7/SD026 (SW020) Current Monitoring Station ID (Proposed NPDES/SDS Monitoring Station ID)

- EIS Project Areas
- Existing Tailings Basin (DNR Mine Feature, 2013)
- Existing Buildings
- Existing Private Railroad
- Watershed Divide
- Embarrass River Subwatersheds
- Wetlands
- Public Waters Inventory (PWI) Watercourses[1]
- National Hydrography Dataset (NHD) Rivers & Streams[2]

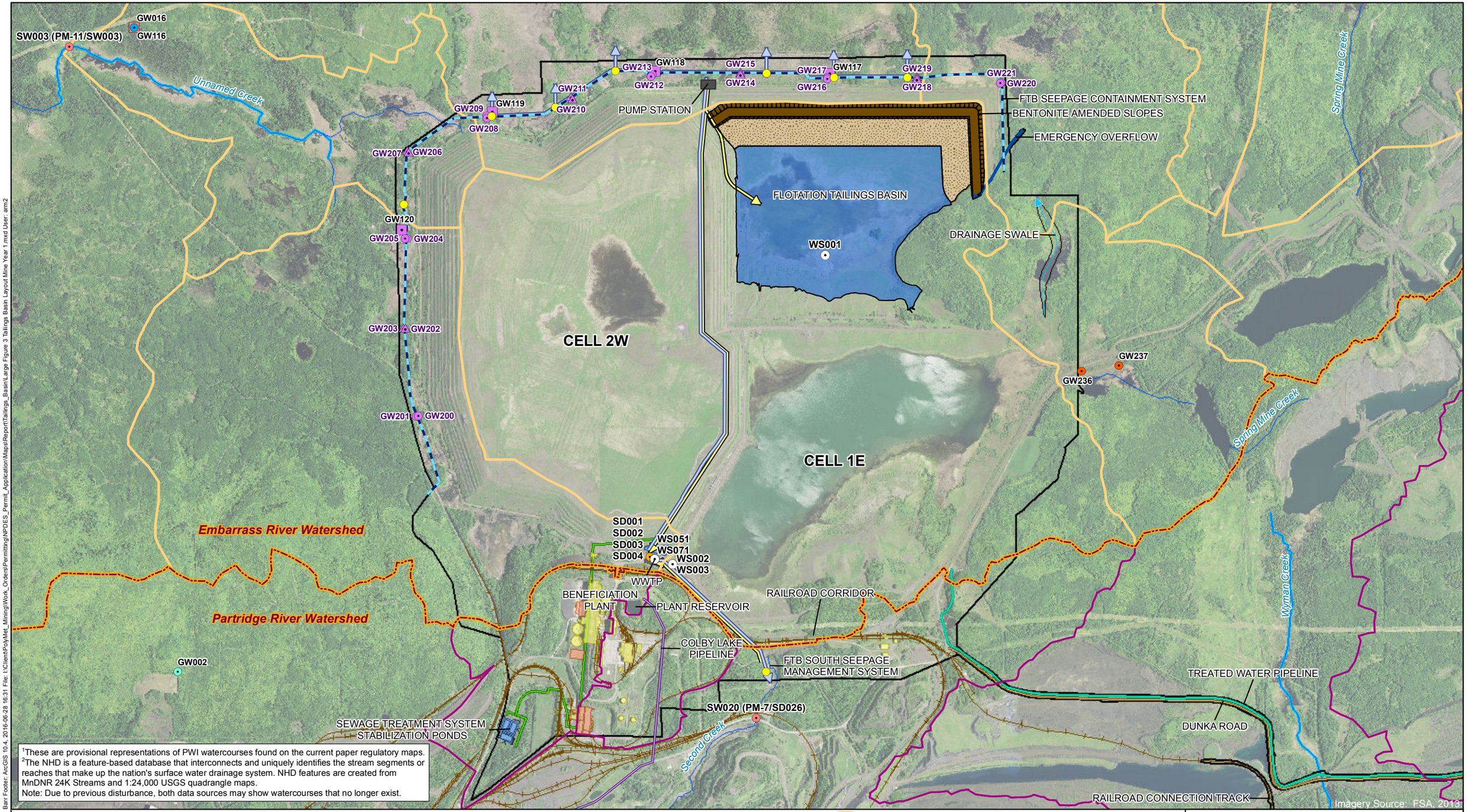
This figure only shows existing monitoring stations associated with the Tailings Basin. Additional existing monitoring stations are shown in Large Figure 3 of Volume II, Large Figure 2 of Volume IV, Large Figure 2 of Volume VI, and Large Figure 2 of Volume VII.

0 1,250 2,500 5,000
Feet

BARR

TAILINGS BASIN AND BENEFICIATION PLANT EXISTING CONDITIONS
NorthMet Project
Poly Met Mining Inc.

Large Figure 2
NPDES/SDS Permit Application
Volume V: Tailings Basin and Beneficiation Plant



[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.

Proposed Monitoring Stations
- Internal Waste Stream Monitor Only
- Surface Water Monitor Only
- Surface Water Discharge

SW003 (PM-11) Proposed NPDES/SDS Monitoring Station ID (Current Monitoring Station ID)

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

- Groundwater Background - Surficial
- Groundwater Compliance - Surficial
- Groundwater Indicator - Surficial
- Groundwater Performance - Surficial
- Performance Piezometer - Surficial
- Groundwater Monitor Only - Bedrock
- Groundwater Performance - Bedrock

- EIS Project Areas
- Existing Buildings
- Proposed Buildings

Flotation Tailings Basin
- Dam
- Beach
- Pond

- Surface Water Discharge Outfall

Conceptual Pipe Alignment
- Seepage Water Pipe
- Surface Water Discharge Pipe
- Sewer Pipe (Final pipe alignment to be determined)

Flotation tailings transport piping and Tailings Basin water return piping not shown. Refer to Permit Application Support Drawings.

- Watershed Divide
- Embarrass River Subwatersheds
- Partridge River Subwatersheds
- Public Waters Inventory (PWI) Watercourses[1]
- National Hydrography Dataset (NHD) Rivers & Streams[2]

0 750 1,500 Feet

BARR

TAILINGS BASIN LAYOUT - MINE YEAR 1
NorthMet Project
Poly Met Mining Inc.

Large Figure 3
NPDES/SDS Permit Application
Volume V: Tailings Basin and Beneficiation Plant

SW003 (PM-11/SW003)
GW016
GW116
Unnamed Creek
GW209
GW119
GW208
GW211
GW210
GW213
GW118
GW212
GW215
GW214
GW217
GW117
GW216
GW219
GW218
GW220
GW221
PUMP STATION
FTB SEEPAGE CONTAINMENT SYSTEM
BENTONITE AMENDED SLOPES
EMERGENCY OVERFLOW
Spring Mine Creek
GW207
GW206
GW120
GW205
GW204
WS001
DRAINAGE SWALE
FLOTATION TAILINGS BASIN
GW203
GW202
CELL 2W
GW222
GW223
GW237
GW236
GW201
GW200
CELL 1E
Spring Mine Creek
HYDROMETALLURGICAL RESIDUE FACILITY
Embarrass River Watershed
SD001
SD002
SD003
SD004
WS051
WS071
WS002
WS003
WWTP
BENEFICIATION PLANT
PLANT RESERVOIR
Partridge River Watershed
COLBY LAKE PIPELINE
GW002
RAILROAD CORRIDOR
TREATED WATER PIPELINE
FTB SOUTH SEEPAGE MANAGEMENT SYSTEM
SW020 (PM-7/SD026)
DUNKA ROAD
SEWAGE TREATMENT SYSTEM STABILIZATION PONDS
Second Creek
Wyman Creek
RAILROAD CONNECTION TRACK
Imagery Source: FSA, 2013

[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.

Proposed Monitoring Stations
- Internal Waste Stream Monitor Only
- Surface Water Monitor Only
- Surface Water Discharge

SW003 (PM-11) Proposed NPDES/SDS Monitoring Station ID (Current Monitoring Station ID)

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

- Groundwater Background - Surficial
- Groundwater Compliance - Surficial
- Groundwater Indicator - Surficial
- Groundwater Performance - Surficial
- Performance Piezometer - Surficial
- Groundwater Monitor Only - Bedrock
- Groundwater Performance - Bedrock

- EIS Project Areas
- Existing Buildings
- Proposed Buildings

Flotation Tailings Basin
- Dam
- Beach
- Pond

- Surface Water Discharge Outfall

Conceptual Pipe Alignment
- Seepage Water Pipe
- Surface Water Discharge Pipe
- Sewer Pipe (Final pipe alignment to be determined)

Flotation tailings transport piping and Tailings Basin water return piping not shown. Refer to Permit Application Support Drawings.

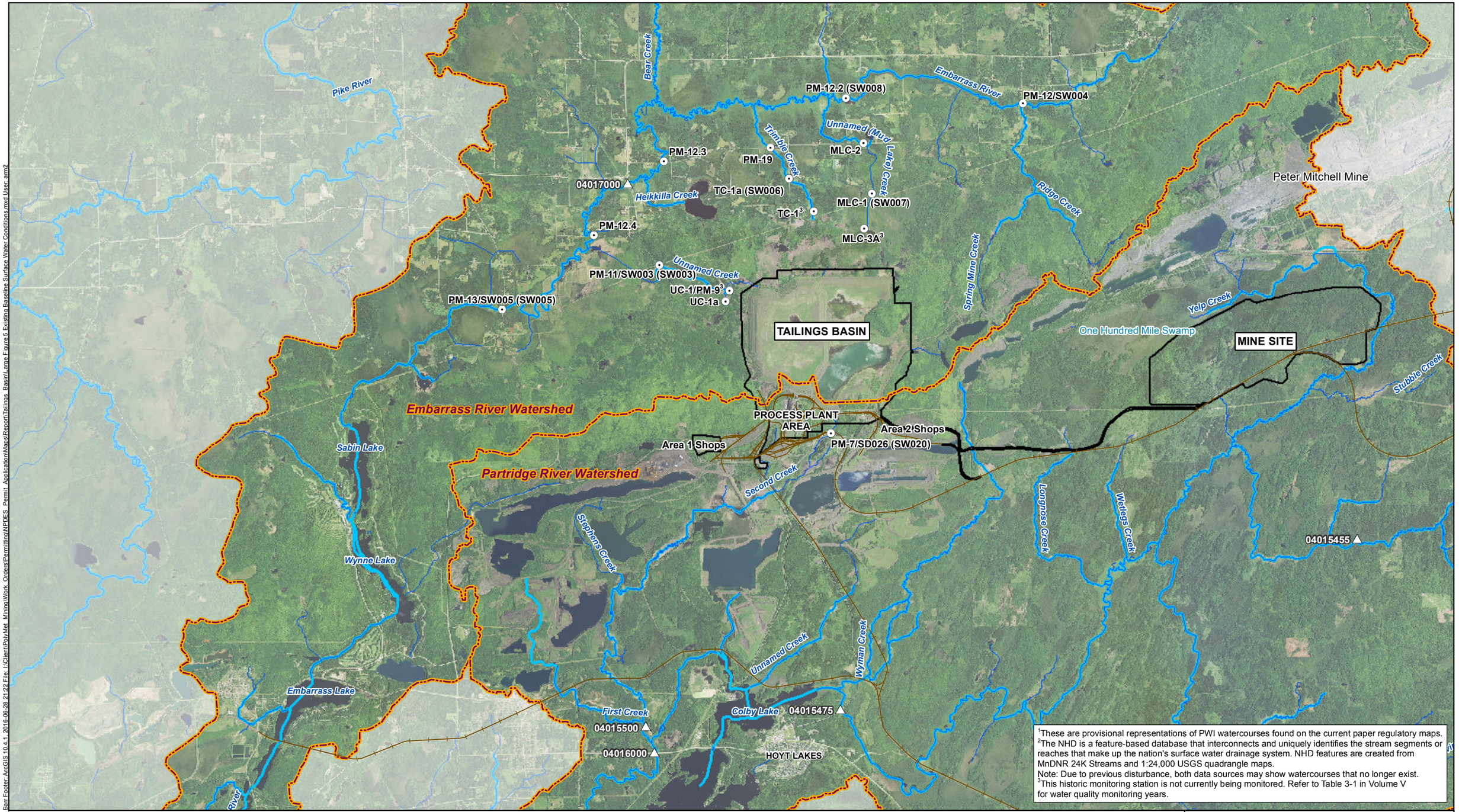
- Watershed Divide
- Embarrass River Subwatersheds
- Partridge River Subwatersheds
- Public Waters Inventory (PWI) Watercourses[1]
- National Hydrography Dataset (NHD) Rivers & Streams[2]

N
0 750 1,500
Feet

BARR

TAILINGS BASIN LAYOUT - MINE YEAR 20
NorthMet Project
Poly Met Mining Inc.

Large Figure 4
NPDES/SDS Permit Application
Volume V: Tailings Basin and Beneficiation Plant



[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 in Volume V for water quality monitoring years.

PolyMet Mining's Past and Existing Monitoring Stations

- Surface Water Monitoring Stations in the Embarrass River and Second Creek Watersheds
- USGS Gage Stations

PM-7/SD026 (SW020) Current Monitoring Station ID (Proposed NPDES/SDS Monitoring Station ID)

Other existing and past surface water monitoring stations in the Partridge River watershed are shown on Large Figure 7 in Volume II.

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

N

0 0.75 1.5 3
Miles

BARR

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

Large Figure 5
NPDES/SDS Permit Application
Volume V: Tailings Basin and Beneficiation Plant

Appendices

Appendix A

Permit Application Support Drawings

FTB Seepage Containment and Stream Augmentation Systems Permit Application Support Drawings
Flotation Tailings Basin Permit Application Support Drawings

FTB Seepage Containment and Stream Augmentation Systems Permit Application Support Drawings

Errata Sheet

Poly Met Mining Inc. NorthMet Project

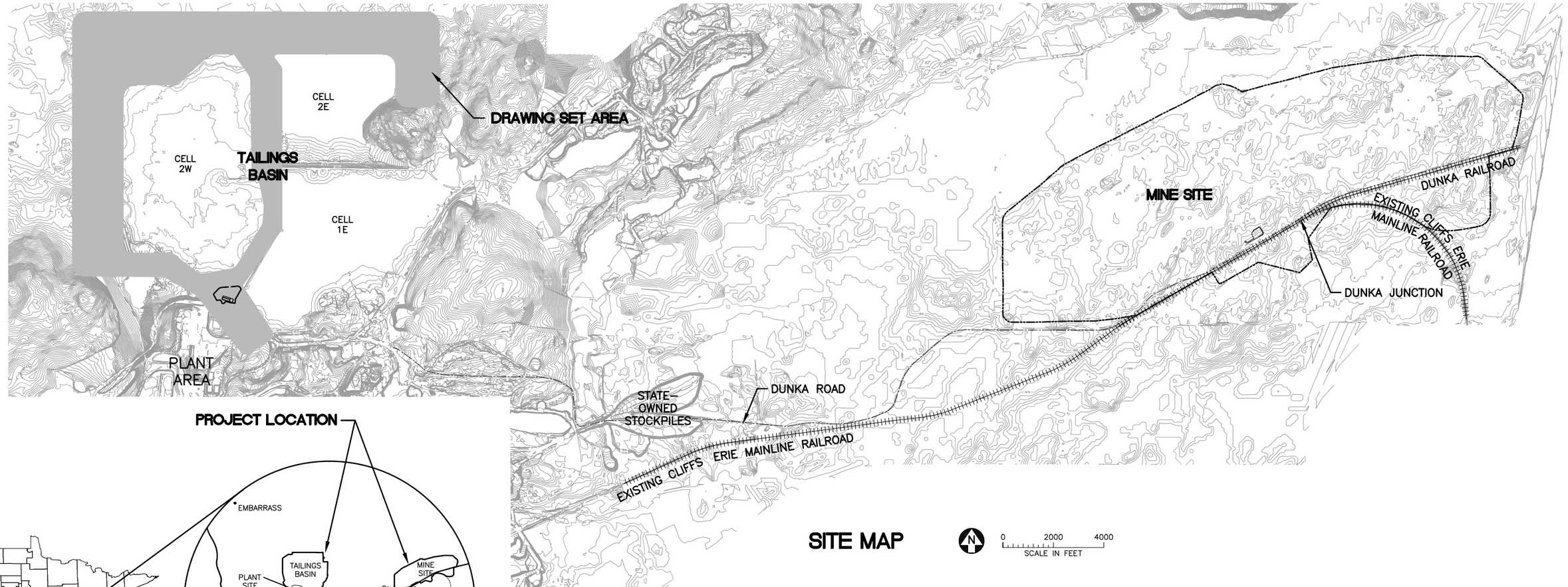
Permit Application Support Drawings: FTBCA

May 2016

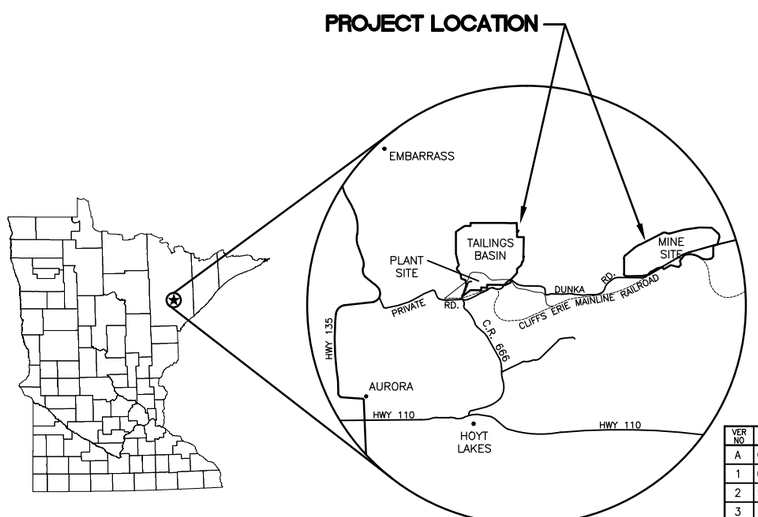
The table below lists changes that were identified during completion of the Construction Stormwater Pollution Prevention Plans (SWPPPs) and have not yet been incorporated in the attached permit application support drawings within this set. These changes and additional details developed during final design will be incorporated into the final design drawing set.

Drawing Sheet(s)	Change
Global change to all sheets, as needed	The terminology "stream augmentation" system as noted in these drawings has been changed to "surface water discharge" system.
FTBCA-013, FTBCA-015	The cross slope on the perimeter access road surface was revised so that it slopes entirely towards the FTB, instead of being crowned in the center.
FTBCA-013, FTBCA-015	To eliminate additional fill in wetlands, the monitoring wells located outside of the perimeter access road were moved to within the road embankment.
FTBCA-003, FTBCA-004	The alignment of the stream augmentation pipe was revised to a more optimal layout.

POLY MET MINING, INC. NORTHMET PROJECT
FTB SEEPAGE CONTAINMENT
AND STREAM AUGMENTATION SYSTEMS
HOYT LAKES, MINNESOTA



SITE MAP



LOCATION MAP
NOT TO SCALE

VICINITY MAP
NOT TO SCALE

VER NO	DATE	DESCRIPTION
A	09/28/12	WATER MANAGEMENT PLAN – PLANT– VERSION 2 – ATTACHEMENT B
1	09/09/14	WATER MANAGEMENT PLAN – PLANT– VERSION 3 – ATTACHEMENT B
2	12/31/14	WATER MANAGEMENT PLAN – PLANT– VERSION 3,4 – ATTACHEMENT B
3	5/28/15	ISSUED FOR PERMIT TO MINE APPLICATION

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	3	5/28/15
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 5/28/15 LICENSE# 20951

DRAWN: BDP
CHECKED: DVS/AMP
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

FTB SEEPAGE CONTAINMENT AND STREAM AUGMENTATION SYSTEMS LOCATION MAP AND SITE MAP

POLYMET MINING

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

BARR ENGINEERING COMPANY
4700 WEST 77TH STREET
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. FTBCA-001
REV

INCHES 1 2

GENERAL LEGEND

- EXISTING CONTOUR – MAJOR (1000)
- EXISTING CONTOUR – MINOR
- PROPOSED CONTOUR – MAJOR (1000)
- PROPOSED CONTOUR – MINOR
- EXISTING POWER POLE
- EXISTING RAILROAD
- EXISTING ROAD
- EXISTING TRAIL
- EXISTING UNIMPROVED TRAIL
- EXISTING STRUCTURES
- TREE LINE
- WETLAND BOUNDARY
- EXISTING CULVERT
- EXISTING PIPELINE (P)
- CUTOFF WALL ALIGNMENT
- OVERHEAD ELECTRIC
- SURFACE DRAINAGE
- PROPOSED DEWATERING PIPE
- PROPOSED DISCHARGE PIPELINE
- PROPOSED RETURN PIPELINE
- PROPOSED CULVERT (NON–MINE DRAINAGE)
- PROPOSED SEEPAGE COLLECTION DRAIN
- PROPOSED STORMWATER DRAIN
- PROPOSED MANHOLE
- PROPOSED RIP RAP
- ROTASONIC BORING
- ROTASONIC BORING WITH PIEZOMETER
- SPT BORING
- SPT BORING WITH PACKER
- FLOW METER (M)

ABBREVIATIONS

APPROX.	–	APPROXIMATE
CDSM	–	CEMENT DEEP SOIL MIX
CMP	–	CORRUGATED METAL PIPE
CPEP	–	CORRUGATED POLYETHYLENE PIPE
CY	–	CUBIC YARD
DR	–	DIMENSION RATIO
DWG	–	DRAWING
EL.	–	ELEVATION
ø	–	DIAMETER
FTB	–	FLOTATION TAILINGS BASIN
GCL	–	GEOSYNTHETIC CLAY LINER
HDPE	–	HIGH DENSITY POLYETHYLENE
HRF	–	HYDROMETALLURGICAL RESIDUE FACILITY
LDPE	–	LOW DENSITY POLYETHYLENE
LF	–	LINER FEET
LTVSMC	–	LTV STEEL MINING COMPANY
MCY	–	MILLION CUBIC YARDS
mil	–	one thousandth of an inch
MIN	–	MINIMUM
MSL	–	MEAN SEA LEVEL
NTS	–	NOT TO SCALE
SCH.	–	SCHEDULE
DR	–	DIMENSION RATIO
TYP	–	TYPICAL
N–MH–XX	–	NORTH SECTION MANHOLE
NW–MH–XX	–	NORTHWEST SECTION MANHOLE
W–MH–XX	–	WEST SECTION MANHOLE
N–MH/PS–XX	–	NORTH SECTION MANHOLE/PUMP STATION
NW–MH/PS–XX	–	NORTHWEST SECTION MANHOLE
W–MH/PS–XX	–	WEST SECTION MANHOLE/PUMP STATION

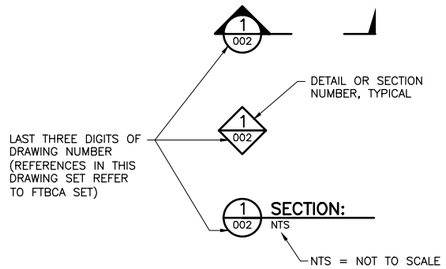
NOTES

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.
4. EXISTING TOPOGRAPHIC INFORMATION WAS UPDATED FOR AREAS SOUTH EAST OF COAL ASH LANDFILL AND EAST OF OUTCROP BETWEEN CELLS 1E AND 2E USING CONTOURS FROM DATA COLLECTED IN 1999.

SHEET INDEX

SHEET NO. TITLE

DRAWING NUMBERING



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3	5/28/15	ISSUED FOR PERMIT TO MINE APPLICATION

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	3	5/28/15
FOR CONSTRUCTION	–	–

NOT APPROVED FOR CONSTRUCTION.

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PRINTED NAME THOMAS J. RADUE
SIGNATURE Thomas J. Radue
DATE 5/28/15 LICENSE# 20951

DRAWN: BDP
CHECKED: DVS/AMP
BARR PROJECT NO.: 23/69–0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

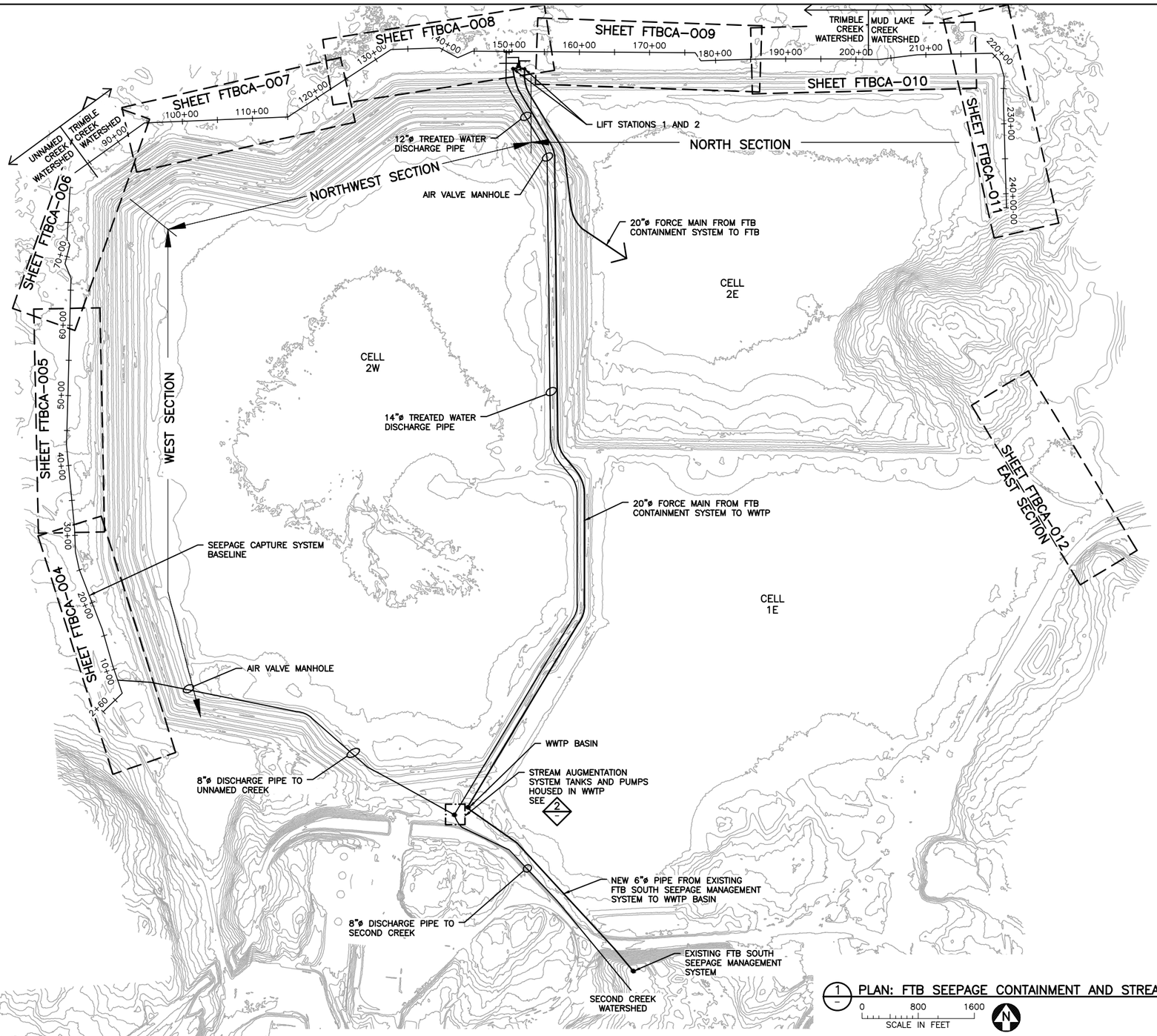
FTB SEEPAGE CONTAINMENT AND STREAM AUGMENTATION SYSTEMS
LEGEND AND SHEET INDEX

POLYMET MINING

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

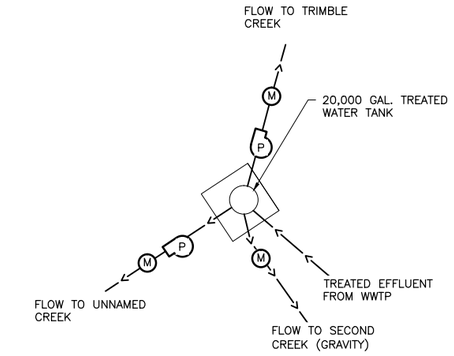
BARR ENGINEERING COMPANY
4700 WEST 77TH STREET
MINNEAPOLIS, MN.
Ph: 1–800–632–2277

DWG. NO. FTBCA–002
REV



1/– PLAN: FTB SEEPAGE CONTAINMENT AND STREAM AUGMENTATION LAYOUT

0 800 1600
SCALE IN FEET



2/– DETAIL: CONCEPTUAL STREAM AUGMENTATION SYSTEM SUPPLY
NOT TO SCALE

NOTES

1. SEEPAGE CAPTURE SYSTEMS INCLUDE THE FTB CONTAINMENT SYSTEM ALONG THE WEST, NORTH AND EAST SIDES OF THE FTB, THE SOUTH SEEPAGE MANAGEMENT SYSTEM ON THE SOUTH SIDE OF THE FTB AND CONVEYANCE TO THE WWTP EQUALIZATION BASIN.
2. STREAM AUGMENTATION SYSTEM INCLUDES TREATED WATER CONVEYANCE AND DISCHARGE TO UNNAMED CREEK, TRIMBLE CREEK, AND SECOND CREEK WATERSHEDS.
3. FTB SEEPAGE CONTAINMENT AND STREAM AUGMENTATION SYSTEMS DESIGN REFERENCE BASELINE SHOWN ON THIS SHEET. SEE SUBSEQUENT SHEETS FOR PROPOSED LAYOUT OF SYSTEMS ALONG BASELINE.

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CHECKED: DVS
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

FTB SEEPAGE CONTAINMENT AND STREAM AUGMENTATION SYSTEMS PLAN SHEET LAYOUT

POLYMET MINING

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

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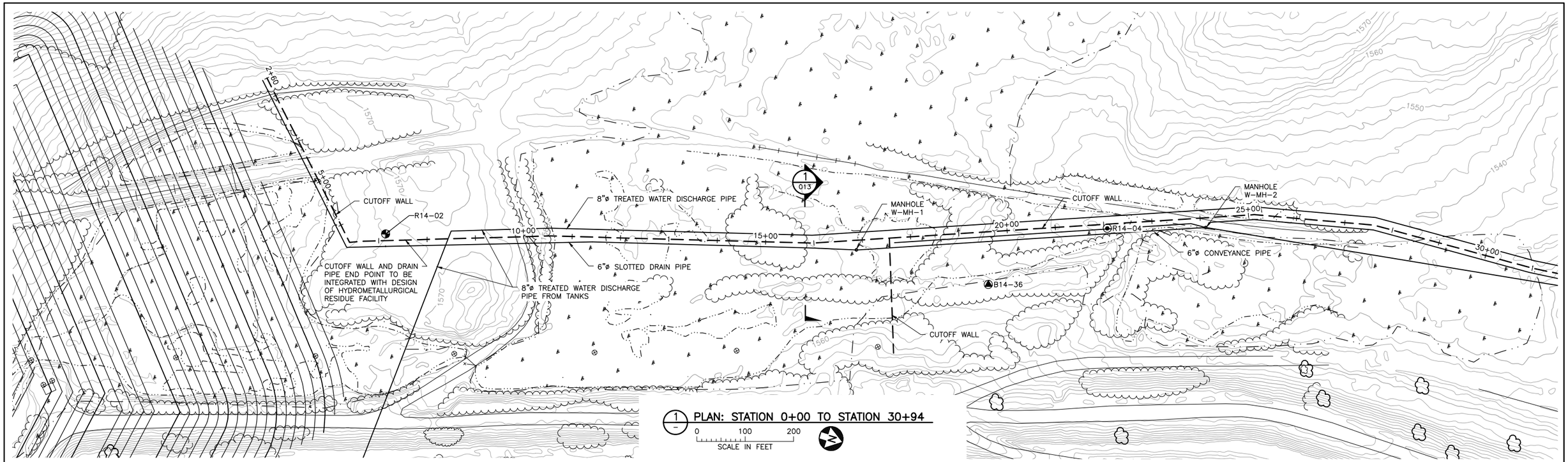
4700 WEST 77TH STREET
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

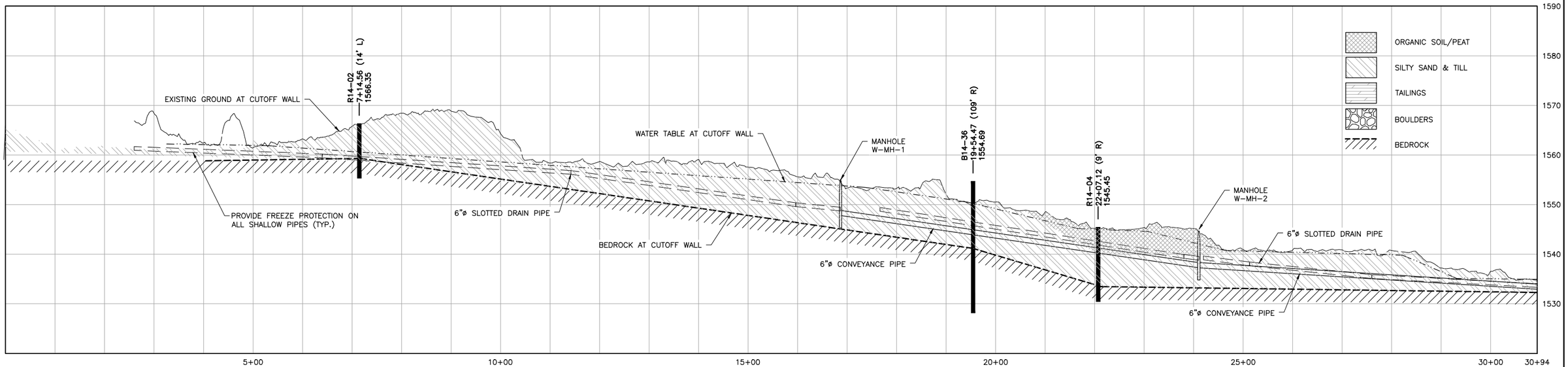
DWG. NO. FTBCA-003
REV



1 / – PLAN: STATION 0+00 TO STATION 30+94

0 100 200

SCALE IN FEET



2 / – PROFILE: STATION 0+00 TO STATION 30+94

0 100 200 0 10 20

SCALE IN FEET HORIZONTAL

SCALE IN FEET VERTICAL

NOTES:

1. HORIZONTAL LOCATION OF FORCE MAIN, SEEPAGE CONVEYANCE PIPES AND STREAM AUGMENTATION PIPES/DISCHARGE POINTS ON THIS SHEET AND SUBSEQUENT SHEETS SHOWN FOR CLARITY. ACTUAL LOCATION TO BE DETERMINED DURING FINAL DESIGN.
2. MANHOLE LOCATIONS ON THIS SHEET AND SUBSEQUENT SHEETS ARE PRELIMINARY.
3. ACCESS ROAD NOT SHOWN ON THIS SHEET AND SUBSEQUENT SHEETS.
4. TREATED WATER DISCHARGE PIPES NOT SHOWN IN PROFILE ON THIS SHEET AND SUBSEQUENT SHEETS.
5. WATER TABLE ELEVATIONS ARE ESTIMATED BASED ON PIEZOMETERS, BORING LOGS, SOIL TYPES AND AERIAL PHOTOGRAPHY.
6. GROUND SURFACE ELEVATIONS ARE BASED ON 2010 LIDAR DATA (NAVD88). BORING ELEVATIONS SHOWN ARE BASED ON 2010 LIDAR DATA (NAVC88) ADJUSTED AFTER GEOTECHNICAL EXPLORATION (03-11-2014 THRU 05-20-2014). STRATIGRAPHY AND WATER TABLES ARE BASED ON THE 2014 FIELD INVESTIGATION LOGS.
7. BORING LOCATION OFFSETS FROM PROPOSED CUTOFF WALL ALIGNMENT ARE SHOWN. SUBSURFACE CONDITIONS ON WALL ALIGNMENT WILL DIFFER FROM THOSE SHOWN.
8. AREAS OF COBBLES AND BOULDERS BETWEEN BORING LOCATIONS AND ADJACENT BORING LOCATIONS SHOULD BE ASSUMED TO EXIST.

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DRAWN: BJH

CHECKED: DVS/AMP

BARR PROJECT NO.: 23/69-0C29

SCALE: AS SHOWN

PLANT DRAWING NUMBER:

FTB SEEPAGE CONTAINMENT AND STREAM AUGMENTATION SYSTEMS PLAN & PROFILE STATION 0+00 TO 30+94

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

BARR ENGINEERING COMPANY
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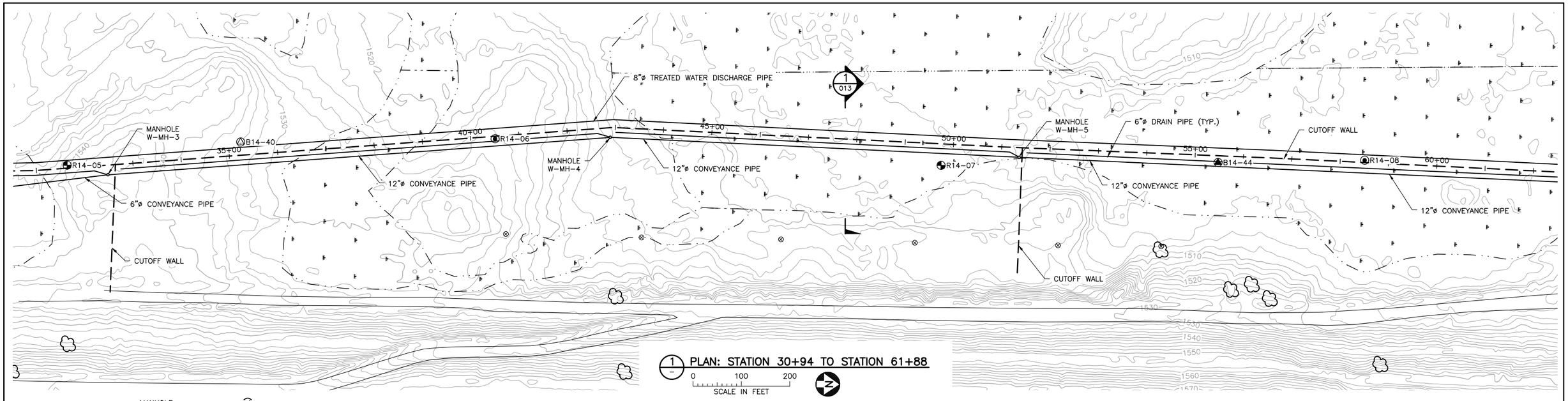
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. FTBCA-004

REV

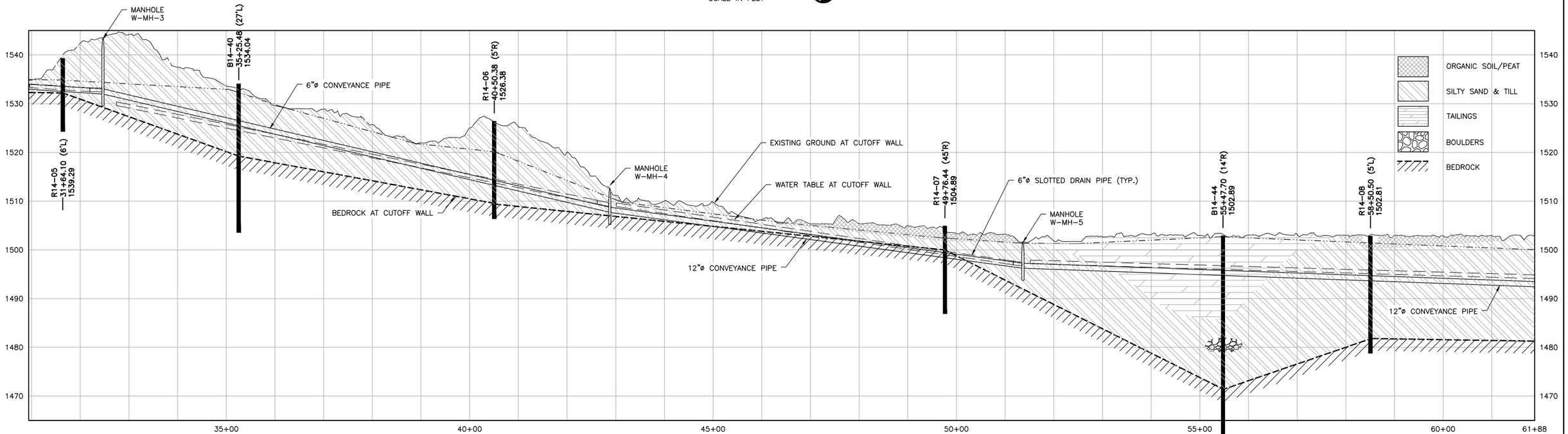
INCHES 1 2



1 PLAN: STATION 30+94 TO STATION 61+88

0 100 200

SCALE IN FEET



2 PROFILE: STATION 30+94 TO STATION 61+88

0 100 200 SCALE IN FEET HORIZONTAL

0 10 20 SCALE IN FEET VERTICAL

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CHECKED: DVS/AMP

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PLANT DRAWING NUMBER:

FTB SEEPAGE CONTAINMENT AND STREAM AUGMENTATION SYSTEMS PLAN & PROFILE STATION 30+94 TO 61+88

POLYMET MINING

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

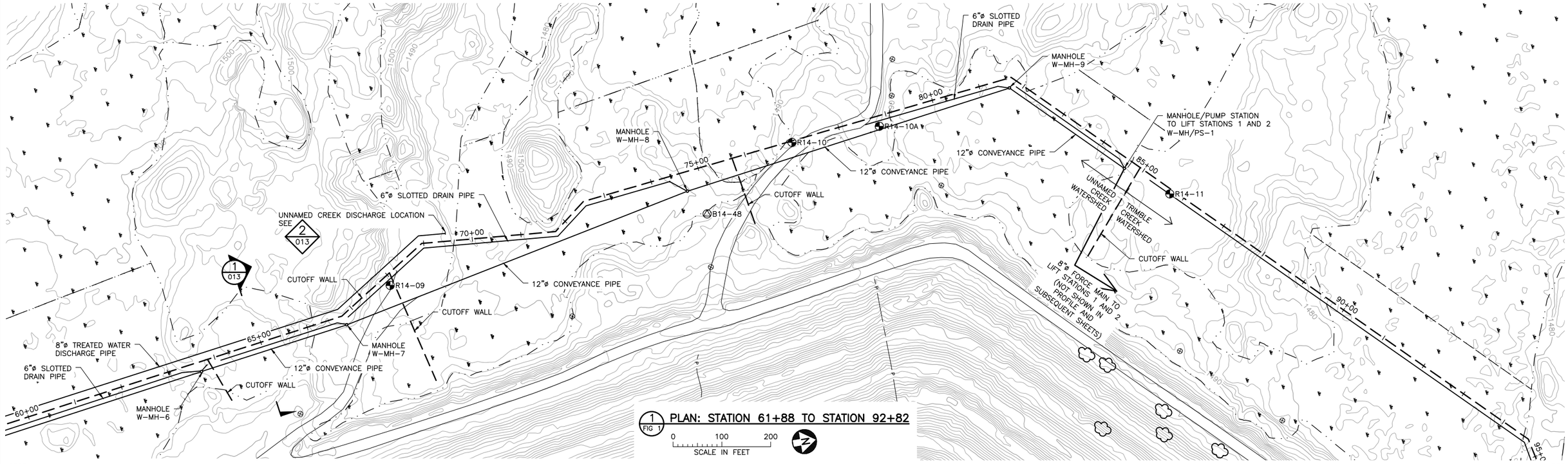
BARR

BARR ENGINEERING COMPANY
4700 WEST 77TH STREET
MINNEAPOLIS, MN.
Ph: 1–800–632–2277

DWG. NO. FTBCA–005

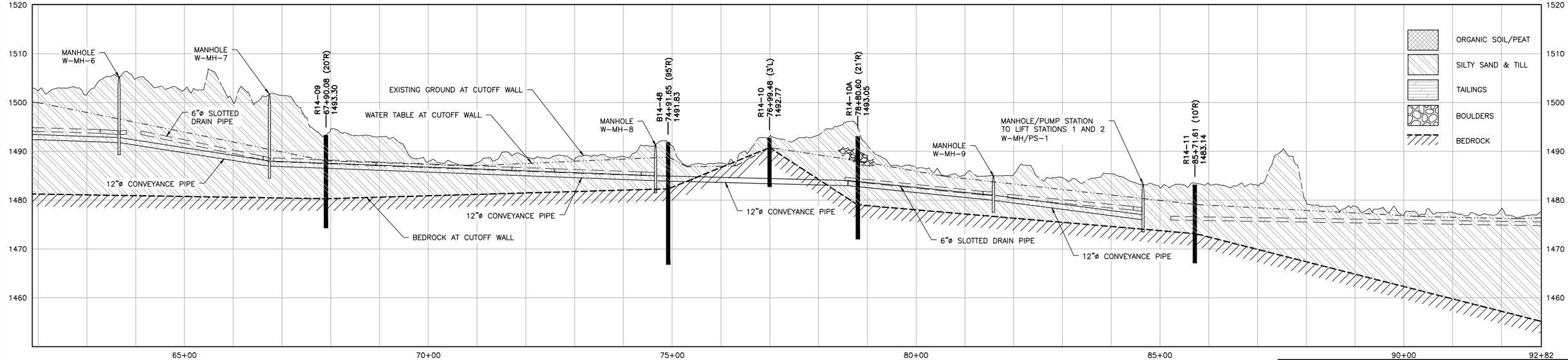
REV

INCHES 1 2



1 FIG 1 **PLAN: STATION 61+88 TO STATION 92+82**

0 100 200 SCALE IN FEET



2 – **PROFILE: STATION 61+88 TO STATION 92+82**

0 100 200 SCALE IN FEET HORIZONTAL

0 10 20 SCALE IN FEET VERTICAL

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FTB SEEPAGE CONTAINMENT AND STREAM AUGMENTATION SYSTEMS PLAN & PROFILE STATION 61+88 TO 92+82

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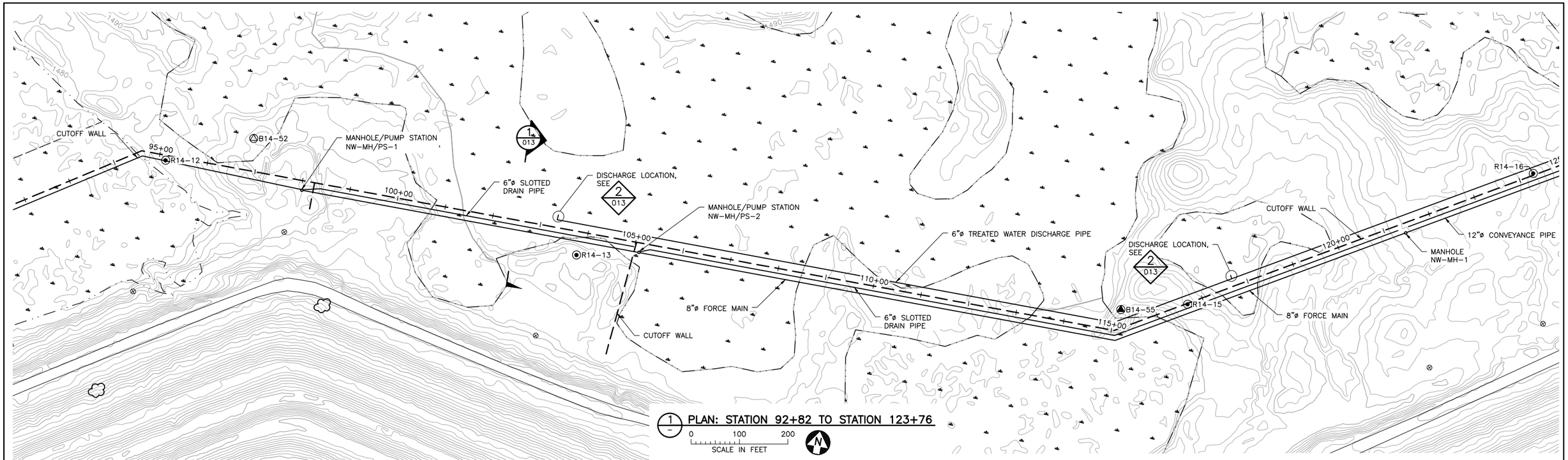
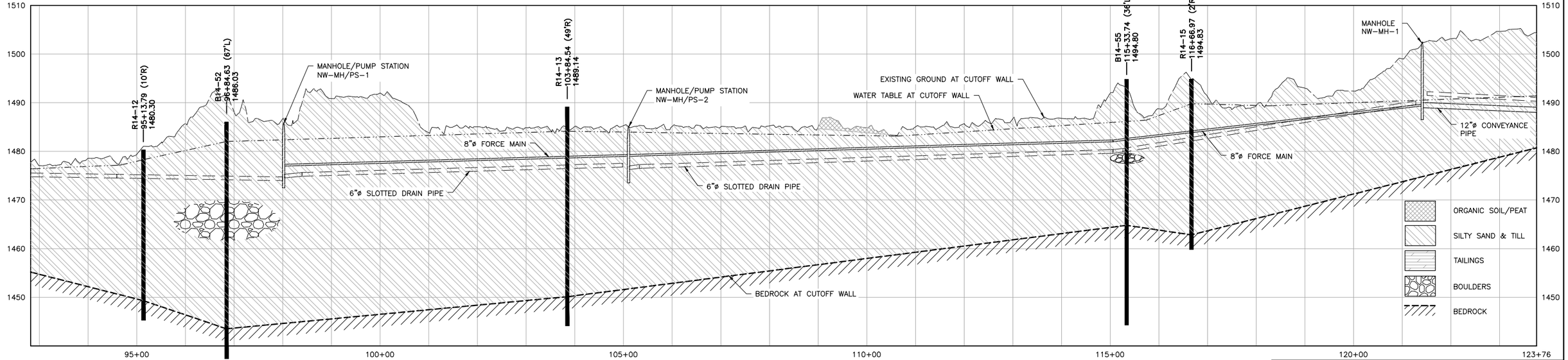
Ph: 1-800-632-2277

DWG. NO. FTBCA-006 REV



1 – PLAN: STATION 92+82 TO STATION 123+76

0 100 200 SCALE IN FEET



2 – PROFILE: STATION 92+82 TO STATION 123+76

0 100 200 SCALE IN FEET HORIZONTAL

0 10 20 SCALE IN FEET VERTICAL

VER NO	DATE	DESCRIPTION
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CHECKED: DVS/AMP

BARR PROJECT NO.: 23/69-0C29

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PLANT DRAWING NUMBER:

FTB SEEPAGE CONTAINMENT AND STREAM AUGMENTATION SYSTEMS PLAN & PROFILE STATION 92+82 TO 123+76

POLYMET MINING

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NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR ENGINEERING COMPANY
4700 WEST 77TH STREET
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. FTBCA-007

REV

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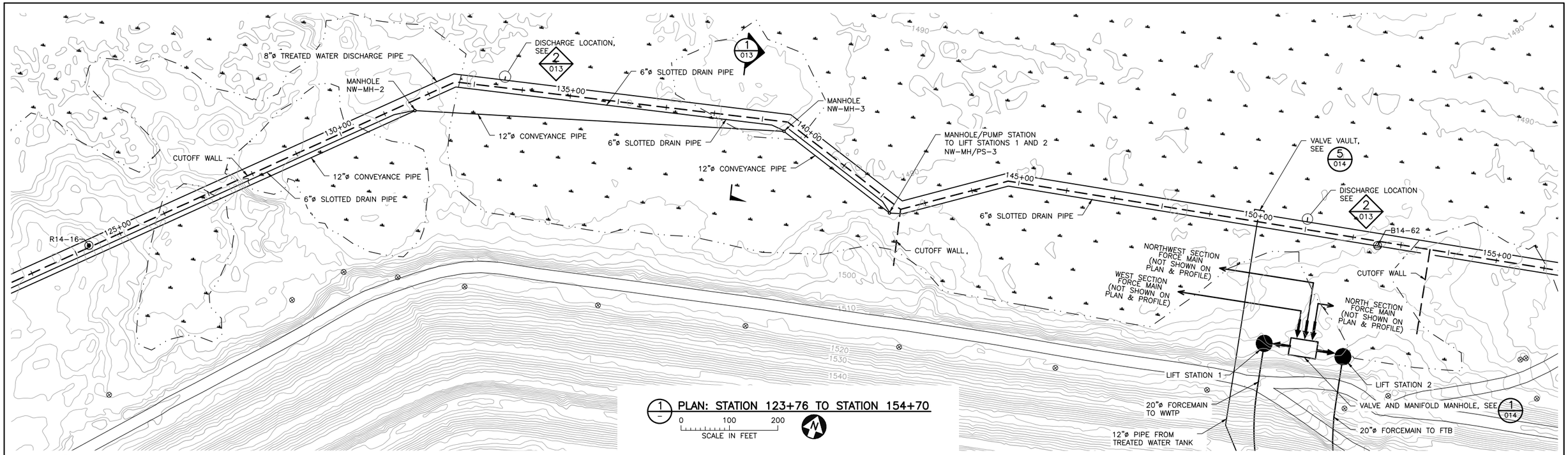
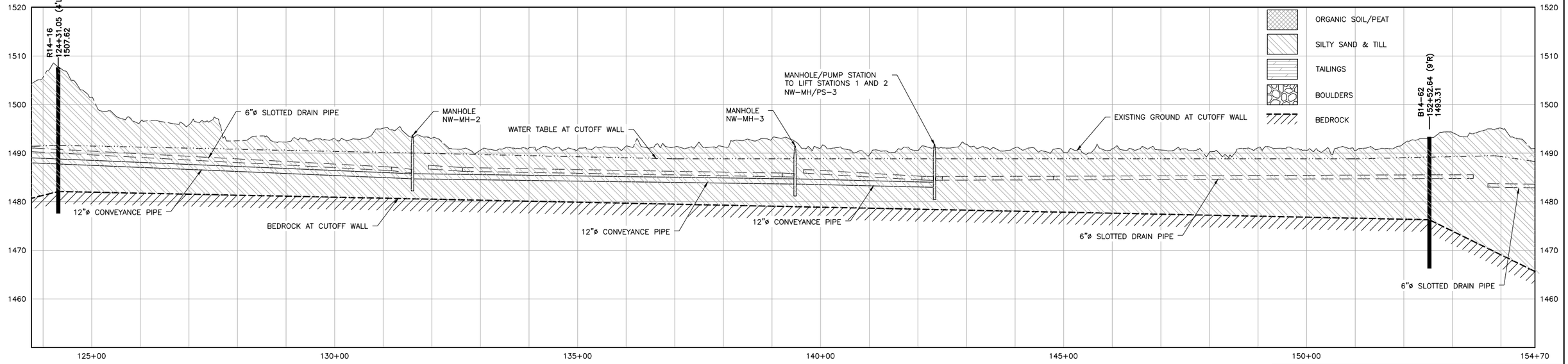


1/– PLAN: STATION 123+76 TO STATION 154+70

0 100 200
SCALE IN FEET



2/– PROFILE: STATION 123+76 TO STATION 154+70

0 100 200 0 10 20
SCALE IN FEET HORIZONTAL
SCALE IN FEET VERTICAL

VER NO.	DATE	DESCRIPTION
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BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

FTB SEEPAGE CONTAINMENT AND STREAM AUGMENTATION SYSTEMS PLAN & PROFILE STATION 123+76 TO 154+70

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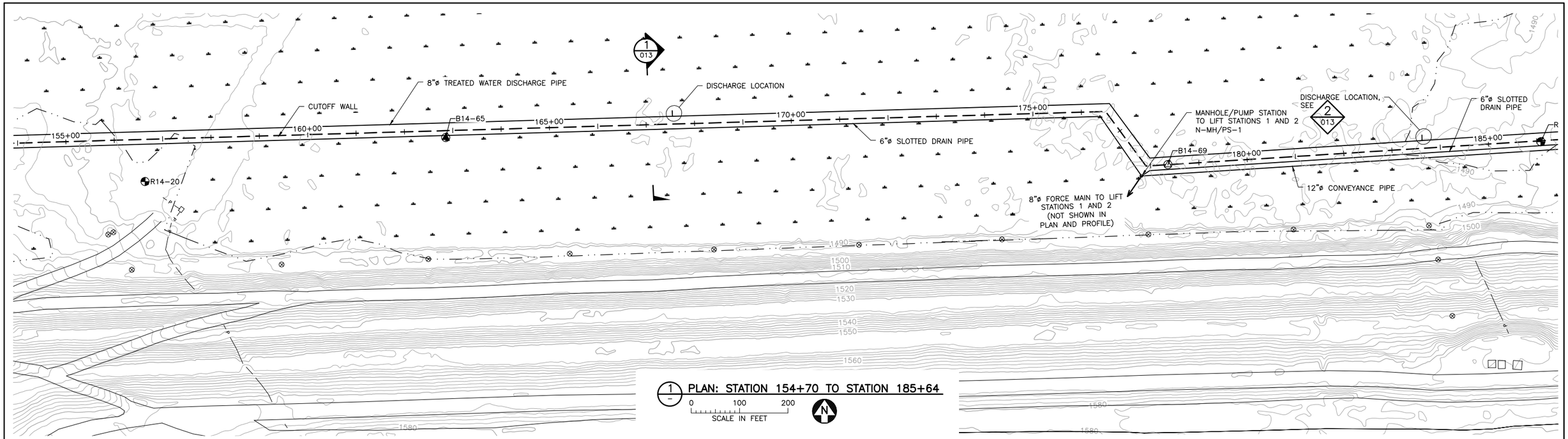
DWG. NO. FTBCA-008
REV

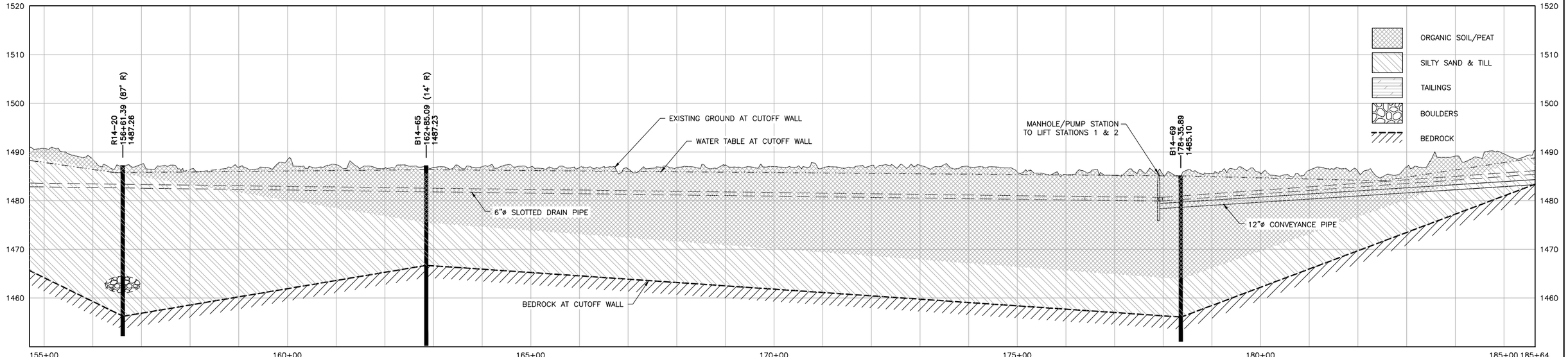
INCHES 1 2



1 – PLAN: STATION 154+70 TO STATION 185+64

0 100 200

SCALE IN FEET



2 – PROFILE: STATION 154+70 TO STATION 185+64

0 100 200 — SCALE IN FEET HORIZONTAL

0 10 20 — SCALE IN FEET VERTICAL

VER NO	DATE	DESCRIPTION
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FTB SEEPAGE CONTAINMENT AND STREAM AUGMENTATION SYSTEMS PLAN & PROFILE STATION 154+70 TO 185+64

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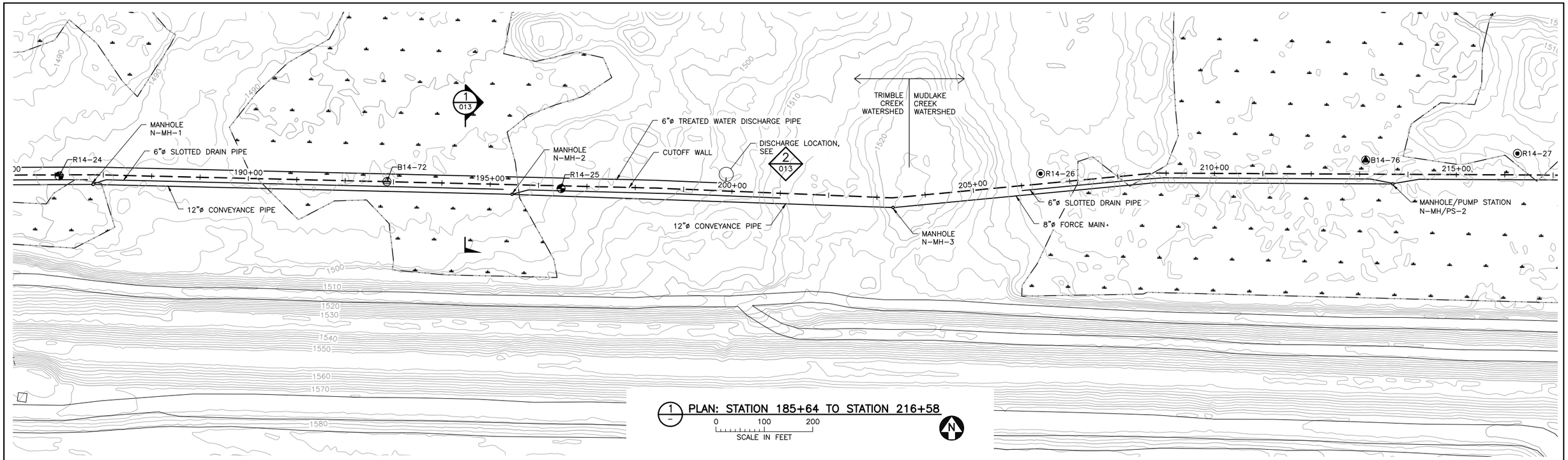
Ph: 1–800–632–2277

DWG. NO. FTBCA–009

REV

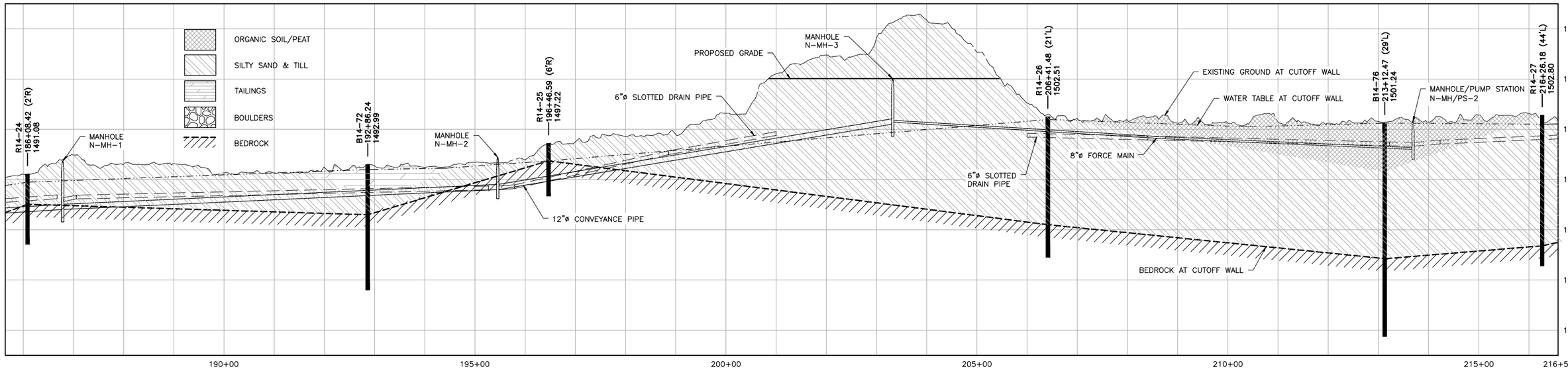
INCHES 1 2



1 PLAN: STATION 185+64 TO STATION 216+58

0 100 200

SCALE IN FEET



2 PROFILE: STATION 185+64 TO STATION 216+58

0 100 200 — SCALE IN FEET HORIZONTAL

0 10 20 — SCALE IN FEET VERTICAL

VER NO.	DATE	DESCRIPTION
A	09/28/12	WATER MANAGEMENT PLAN – PLANT– VERSION 2 – ATTACHEMENT B
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CHECKED: DVS/AMP

BARR PROJECT NO.: 23/69-0C29

SCALE: AS SHOWN

PLANT DRAWING NUMBER:

FTB SEEPAGE CONTAINMENT AND STREAM AUGMENTATION SYSTEMS PLAN & PROFILE STATION 185+64 TO 216+58

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

BARR ENGINEERING COMPANY
4700 WEST 77TH STREET
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. FTBCA-010

REV

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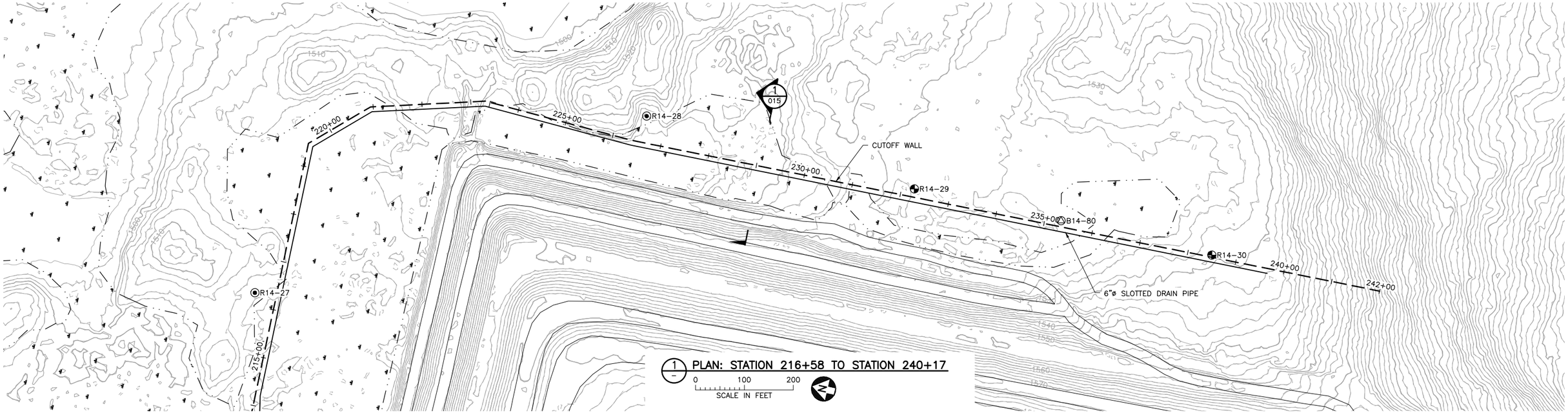
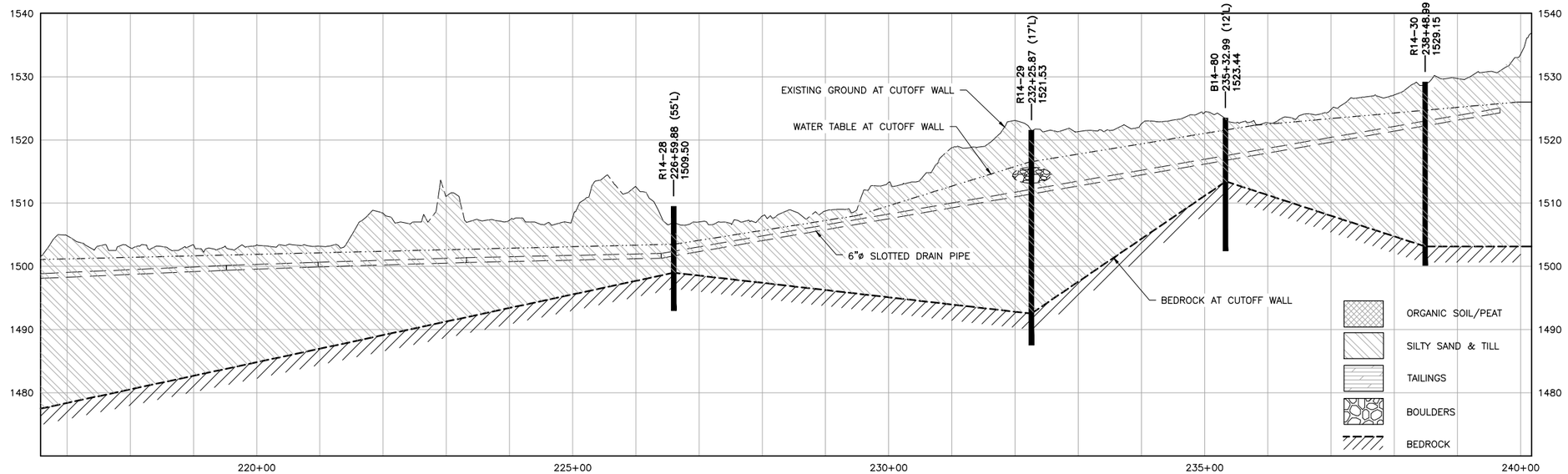


1 — PLAN: STATION 216+58 TO STATION 240+17

0 100 200
SCALE IN FEET



2 — PROFILE: STATION 216+58 TO STATION 240+17

0 100 200
SCALE IN FEET
HORIZONTAL

0 10 20
SCALE IN FEET
VERTICAL

VER NO.	DATE	DESCRIPTION
A	09/28/12	WATER MANAGEMENT PLAN – PLANT– VERSION 2 – ATTACHEMENT B
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PRINTED NAME THOMAS J. RADUE
SIGNATURE Thomas J. Radue
DATE 5/28/15 LICENSE# 20951

DRAWN: BJH
CHECKED: DVS/AMP
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

FTB SEEPAGE CONTAINMENT AND STREAM AUGMENTATION SYSTEMS PLAN & PROFILE STATION 216+58 TO 240+17

POLYMET MINING

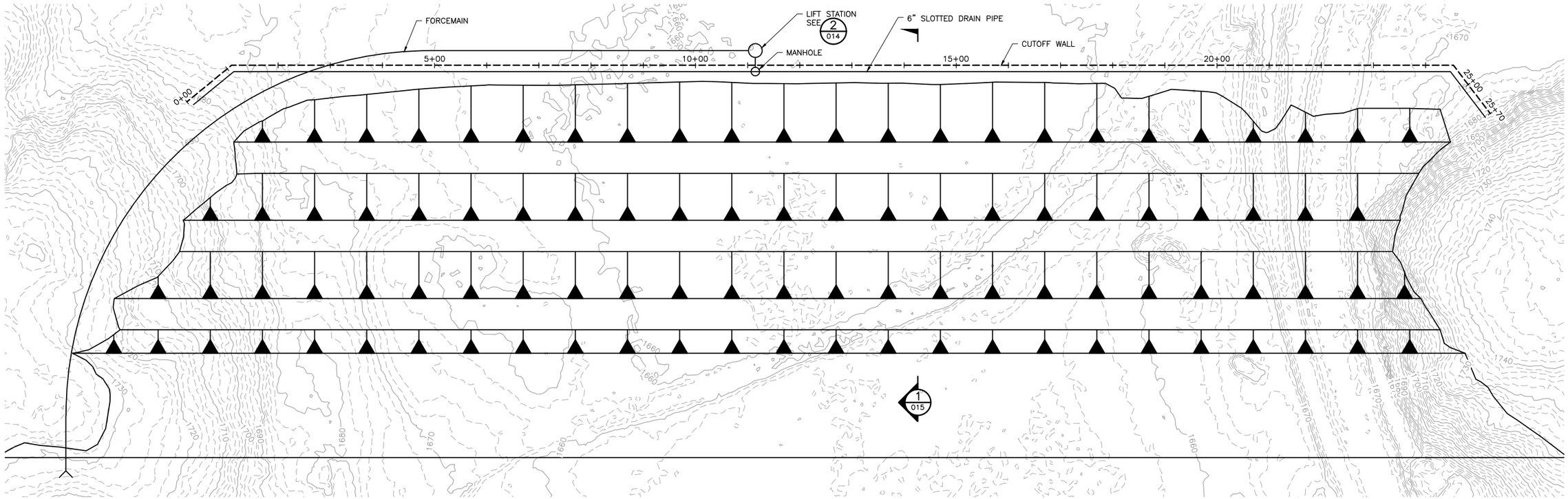
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR ENGINEERING COMPANY
4700 WEST 77TH STREET
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. FTBCA-011

REV

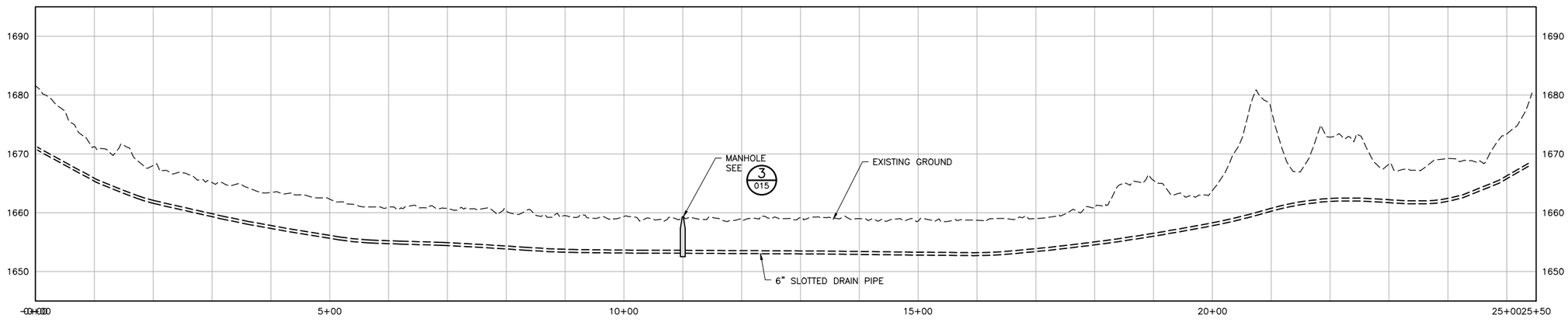
INCHES 1 2



1/– PLAN: STATION 0+00 TO STATION 23+33

0 100 200

SCALE IN FEET



1/– PLAN: STATION 0+00 TO STATION 23+33

0 100 200 — SCALE IN FEET HORIZONTAL

0 10 20 — SCALE IN FEET VERTICAL

VER NO	DATE	DESCRIPTION
A	09/28/12	WATER MANAGEMENT PLAN – PLANT– VERSION 2 – ATTACHEMENT B
1	09/09/14	WATER MANAGEMENT PLAN – PLANT– VERSION 3 – ATTACHEMENT B
2	12/31/14	WATER MANAGEMENT PLAN – PLANT– VERSION 3,4 – ATTACHEMENT B
3	5/28/15	ISSUED FOR PERMIT TO MINE APPLICATION

ISSUE STATUS	VERSION	DATE
FOR PERMITTING	3	5/28/15
FOR CONSTRUCTION		
NOT APPROVED FOR CONSTRUCTION.		

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SIGNATURE Thomas J. Radue

DATE 5/28/15 LICENSE# 20951

DRAWN: BDP

CHECKED: DVS/AMP

BARR PROJECT NO.: 23/69-0C29

SCALE: AS SHOWN

PLANT DRAWING NUMBER:

FTB SEEPAGE CONTAINMENT AND STREAM AUGMENTATION SYSTEMS PLAN & PROFILE STATION 0+00 TO 25+43

POLYMET MINING

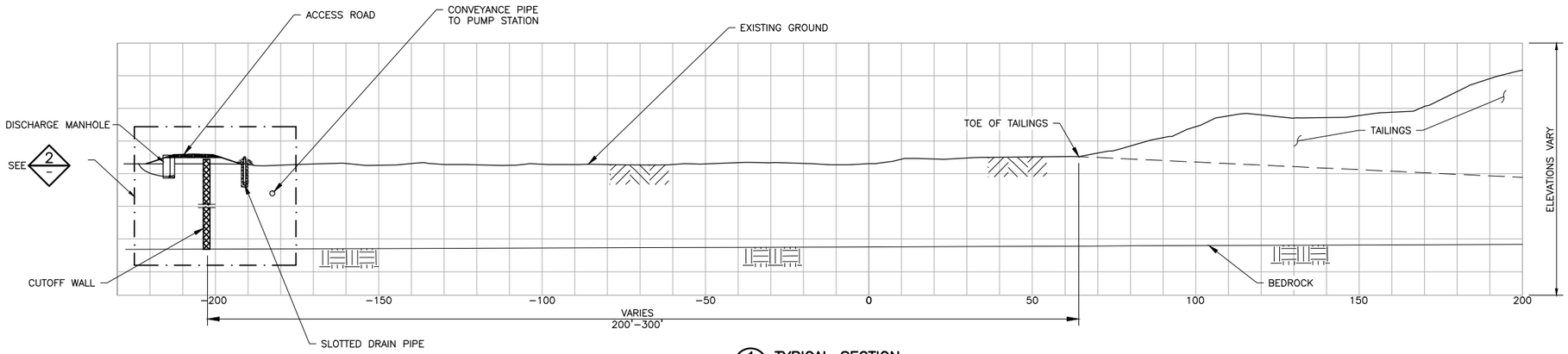
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR ENGINEERING COMPANY
4700 WEST 77TH STREET
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. FTBCA-012

REV

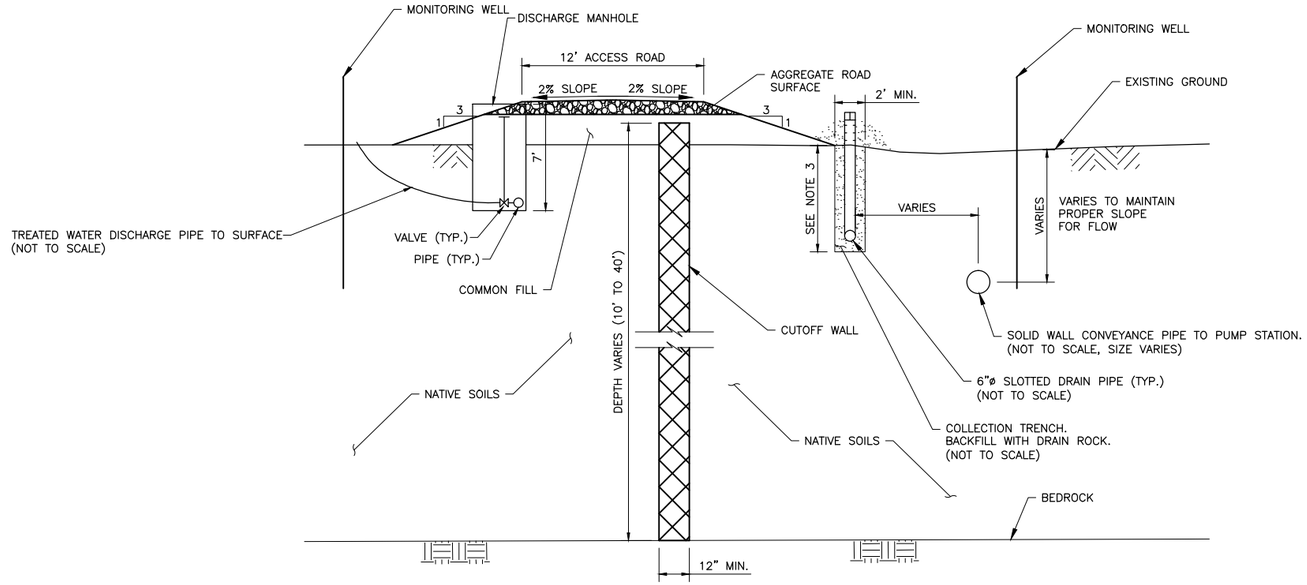
INCHES 1 2



1 TYPICAL SECTION

0 20 40

SCALE IN FEET



2 TYPICAL DETAIL

0 5 10

SCALE IN FEET

NOTES:

1. DIFFUSER TO BE INSTALLED ON DISCHARGE PIPES AS REQUIRED TO PREVENT EROSION.
2. CUTOFF WALL MAXIMUM DESIGN HYDRAULIC CONDUCTIVITY = $1X10^{-6}$CM/SEC
3. 7' TYPICAL BUT MAY BE LESS IN AREAS WITH SHALLOW BEDROCK

VER NO	DATE	DESCRIPTION
A	09/28/12	WATER MANAGEMENT PLAN – PLANT– VERSION 2 – ATTACHEMENT B
1	09/09/14	WATER MANAGEMENT PLAN – PLANT– VERSION 3 – ATTACHEMENT B
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FTB SEEPAGE CONTAINMENT AND STREAM AUGMENTATION SYSTEMS DETAILS

POLYMET MINING

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HOYT LAKES, MINNESOTA

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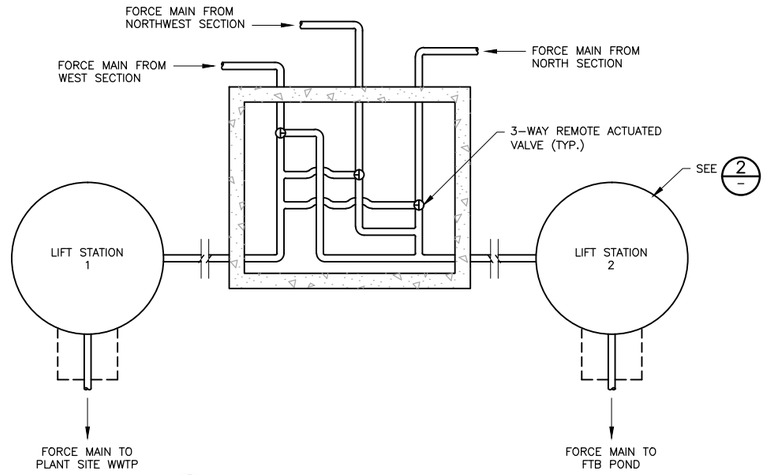
Ph: 1-800-632-2277

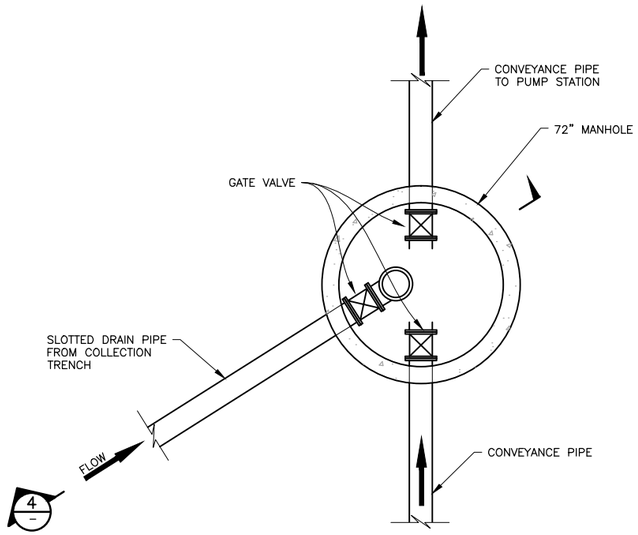
DWG. NO. FTBCA-013

REV

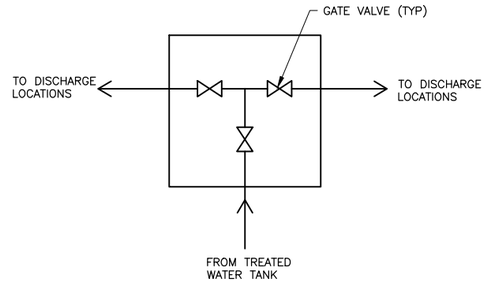
INCHES 1 2



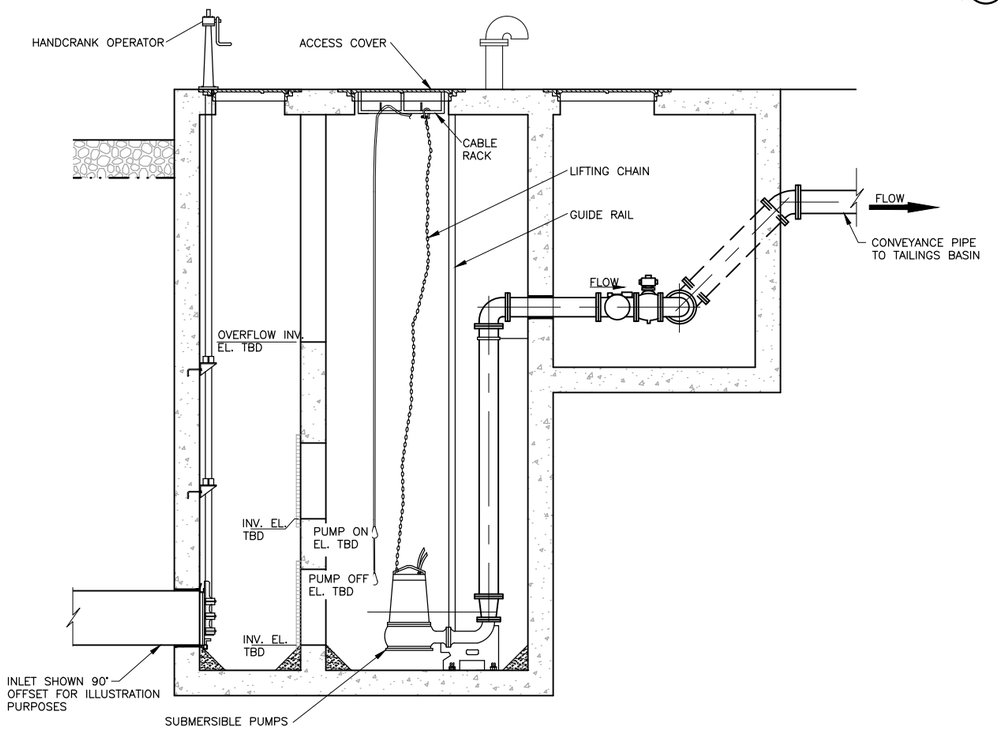
1/008 PLAN: VALVE AND MANIFOLD MANHOLE
NOT TO SCALE



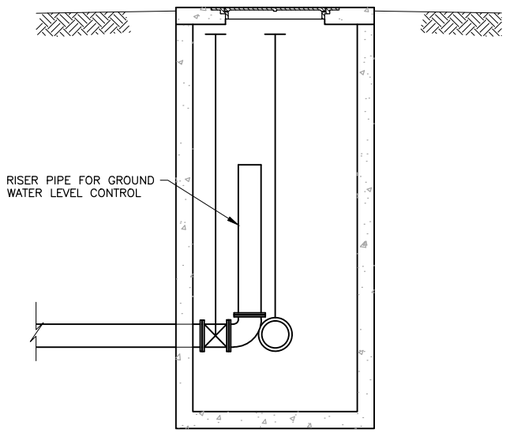
3/- PLAN: MANHOLE (TYP.)
NOT TO SCALE



5/008 PLAN: VALVE VAULT
NOT TO SCALE



2/- SECTION: LIFT STATION (TYP.)
NOT TO SCALE



4/- SECTION: MANHOLE (TYP.)
NOT TO SCALE

NOTES:

1. LIFT STATION, MANHOLE AND VAULT CONFIGURATIONS SHOWN ON THIS SHEET ARE INTENDED TO BE REPRESENTATIVE OF TYPICAL FACILITIES NEEDED FOR OPERATION OF THE SEEPAGE CONTAINMENT AND STREAM AUGMENTATION SYSTEMS. THE ACTUAL DESIGN FOR EACH LIFT STATION, PUMP STATION, MANHOLE, AND VAULT WILL BE DEVELOPED DURING DETAILED DESIGN TO REFLECT THE SPECIFIC EQUIPMENT REQUIREMENTS FOR EACH LOCATION.
2. PUMP STATIONS WILL BE SIMILAR TO MANHOLE SHOWN IN 3/- WITH SMALL SUBMERSIBLE PUMP,
3. FLOW METERS WILL BE PROVIDED FOR DISCHARGE FROM ALL LIFT AND PUMP STATIONS AND AT OTHER LOCATIONS AS REQUIRED FOR OPERATIONS.

VER NO	DATE	DESCRIPTION
A	09/28/12	WATER MANAGEMENT PLAN – PLANT– VERSION 2 – ATTACHEMENT B
1	09/09/14	WATER MANAGEMENT PLAN – PLANT– VERSION 3 – ATTACHEMENT B
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3	5/28/15	ISSUED FOR PERMIT TO MINE APPLICATION

ISSUED	VERSION	DATE
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DRAWN: BDP
CHECKED: DVS/AMP
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SCALE: AS SHOWN

PLANT DRAWING NUMBER:

FTB SEEPAGE CONTAINMENT AND STREAM AUGMENTATION SYSTEMS DETAILS

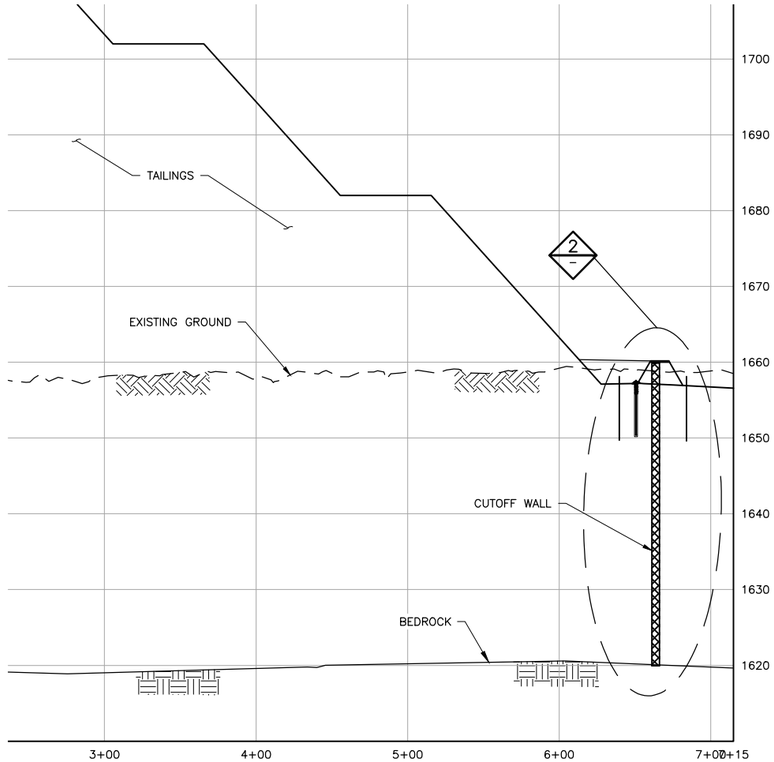
POLYMET MINING

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

BARR ENGINEERING COMPANY
4700 WEST 77TH STREET
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

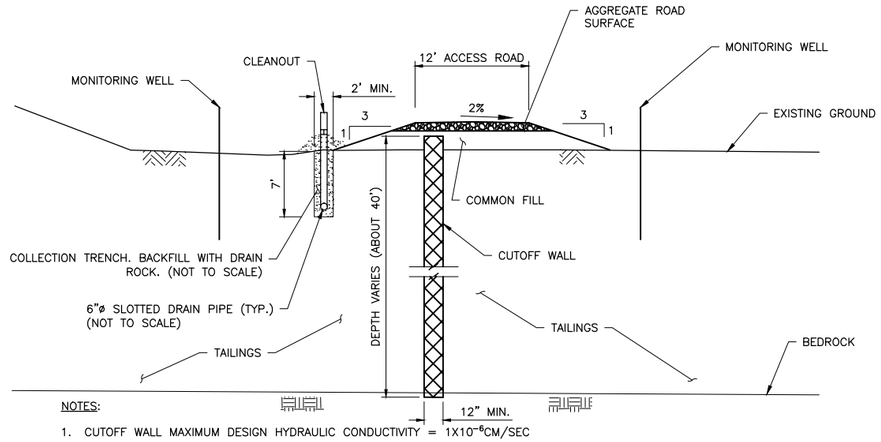
DWG. NO. FTBCA-014
REV

INCHES 1 2



1/11 SECTION: EAST DAM SEEPAGE CONTAINMENT SYSTEM

0 50 100
SCALE IN FEET

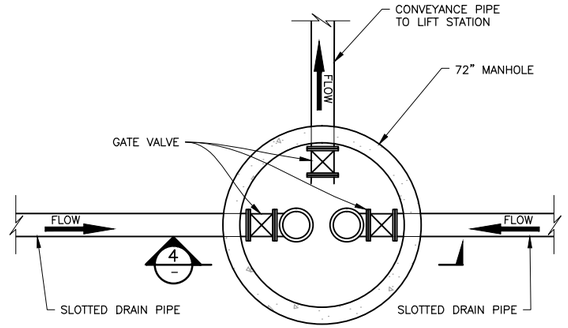


NOTES:

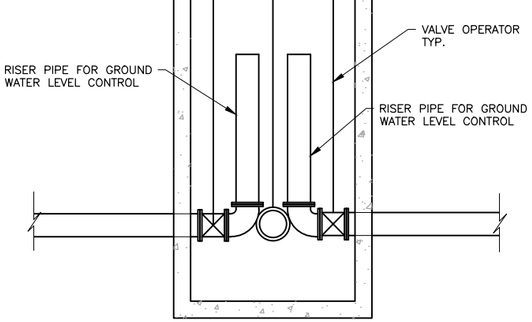
1. CUTOFF WALL MAXIMUM DESIGN HYDRAULIC CONDUCTIVITY = $1X10^{-6}$CM/SEC

2 TYPICAL DETAIL

0 4 8 12 16
SCALE IN FEET



3 PLAN: MANHOLE (TYP.)
NOT TO SCALE



4 SECTION: MANHOLE (TYP.)
NOT TO SCALE

NOTES:

1. LIFT STATION, MANHOLE AND VAULT CONFIGURATIONS SHOWN ON THIS SHEET ARE INTENDED TO BE REPRESENTATIVE OF TYPICAL FACILITIES NEEDED FOR OPERATION OF THE SEEPAGE CONTAINMENT SYSTEM. THE ACTUAL DESIGN FOR EACH LIFT STATION, PUMP STATION, MANHOLE, AND VAULT WILL BE DEVELOPED DURING DETAILED DESIGN TO REFLECT THE SPECIFIC EQUIPMENT REQUIREMENTS FOR EACH LOCATION.
2. FLOW METERS WILL BE PROVIDED FOR DISCHARGE FROM ALL LIFT AND PUMP STATIONS AND AT OTHER LOCATIONS AS REQUIRED FOR OPERATIONS.

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NORTHMET PROJECT
HOYT LAKES, MINNESOTA

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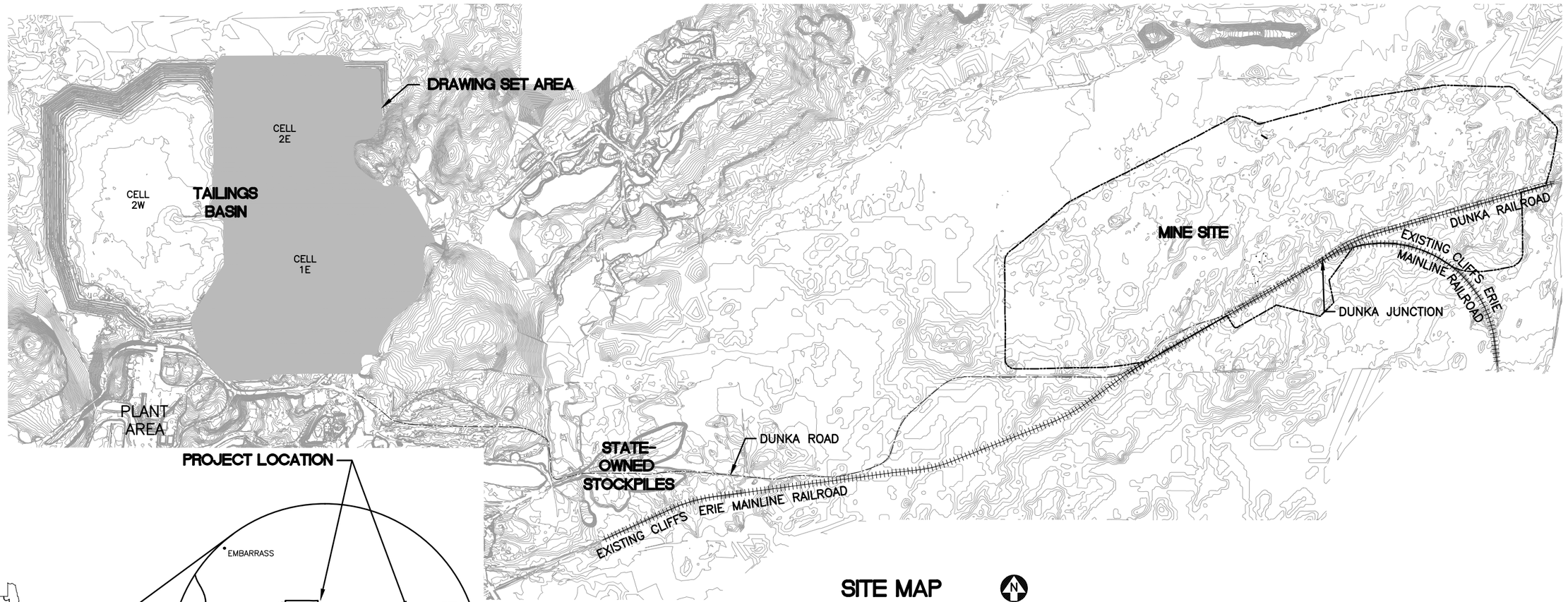
4700 WEST 77TH STREET
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. FTBCA-015
REV

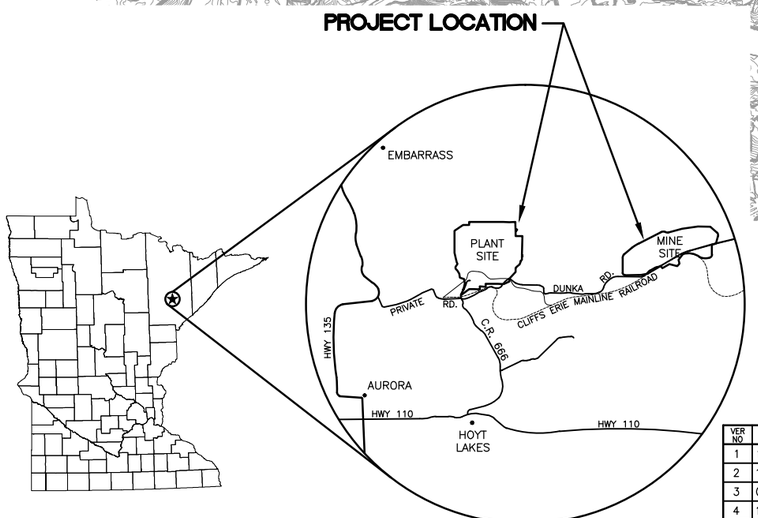
Flotation Tailings Basin Permit Application Support Drawings

POLY MET MINING, INC. NORTHMET PROJECT
PERMIT SUPPORT DRAWINGS
FLOTATION TAILINGS BASIN
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	10/14/11	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 1 – ATTACHMENT A
2	12/07/12	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 2 – ATTACHMENT A
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4	11/25/14	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 4 – ATTACHMENT A
5	03/03/15	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 5 – ATTACHMENT A
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DRAWN: CAD
CHECKED: TJR
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

FLOTATION TAILINGS BASIN
LOCATION MAP AND SITE MAP

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

BARR ENGINEERING COMPANY
4700 WEST 77TH STREET
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. FTB-001 REV

INCHES 1 2

GENERAL LEGEND

- EXISTING CONTOUR – MAJOR
- EXISTING CONTOUR – MINOR
- PROPOSED CONTOUR – MAJOR
- PROPOSED CONTOUR – MINOR
- EXISTING POWER POLE
- EXISTING RAILROAD
- EXISTING ROAD
- EXISTING TRAIL
- EXISTING UNIMPROVED TRAIL
- EXISTING STRUCTURES
- TREE LINE
- WETLAND BOUNDARY
- EXISTING CULVERT
- EXISTING PIPELINE
- OVERHEAD ELECTRIC
- DISCHARGE POINT
- DEWATERING OUTLET POINT
- RETURN PUMP PAD
- DEWATERING PUMP
- SURFACE DRAINAGE
- DRAINAGE COLLECTION STRUCTURE AND PIPE
- DRAINAGE AREA BOUNDARY
- PROPOSED DAMS
- PROPOSED DEWATERING PIPE
- PROPOSED DISCHARGE PIPELINE
- PROPOSED RETURN PIPELINE
- PROPOSED CULVERT (NON–MINE DRAINAGE)
- PROPOSED SEEPAGE COLLECTION DRAIN
- PROPOSED STORMWATER DRAIN
- PROPOSED MANHOLE
- PROPOSED WICK DRAIN LATERAL PIPE
- PROPOSED RIP RAP
- FILL SLOPE
- CUT SLOPE

ABBREVIATIONS

APPROX.	–	APPROXIMATE
CDSM	–	CEMENT DEEP SOIL MIX
CMP	–	CORRUGATED METAL PIPE
CPEP	–	CORRUGATED POLYETHYLENE PIPE
CY	–	CUBIC YARD
DR	–	DIMENSION RATIO
DWG	–	DRAWING
EL.	–	ELEVATION
F	–	DIAMETER
FTB	–	FLOTATION TAILINGS BASIN
GCL	–	GEOSYNTHETIC CLAY LINER
HDPE	–	HIGH DENSITY POLYETHYLENE
HRF	–	HYDROMETALLURGICAL RESIDUE FACILITY
LDPE	–	LOW DENSITY POLYETHYLENE
LF	–	LINER FEET
LTVSMC	–	LTV STEEL MINING COMPANY
MCY	–	MILLION CUBIC YARDS
mil	–	one thousandth of an inch
MIN	–	MINIMUM
MSL	–	MEAN SEA LEVEL
NTS	–	NOT TO SCALE
SCH.	–	SCHEDULE
DR	–	DIMENSION RATIO
TYP.	–	TYPICAL

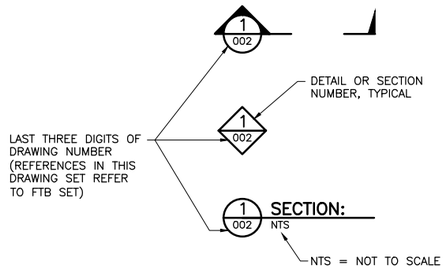
NOTES

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.
4. EXISTING TOPOGRAPHIC INFORMATION WAS UPDATED FOR AREAS SOUTH EAST OF COAL ASH LANDFILL AND EAST OF OUTCROP BETWEEN CELLS 1E AND 2E USING CONTOURS FROM DATA COLLECTED IN 1999.
5. FLOATATION TAILINGS BASIN DESIGN WAS BASED ON CONTOURS FROM DATA COLLECTED IN 1999. PROPOSED DAM LAYOUTS MAY NOT EXACTLY MATCH THE EXISTING TOPOGRAPHY FROM 2010 LIDAR.

SHEET INDEX

SHEET NO. TITLE

DRAWING NUMBERING



VER NO	DATE	DESCRIPTION
1	10/14/11	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 1 – ATTACHMENT A
2	12/07/12	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 2 – ATTACHMENT A
3	04/12/13	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 3 – ATTACHMENT A
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SCALE: AS SHOWN

PLANT DRAWING NUMBER:

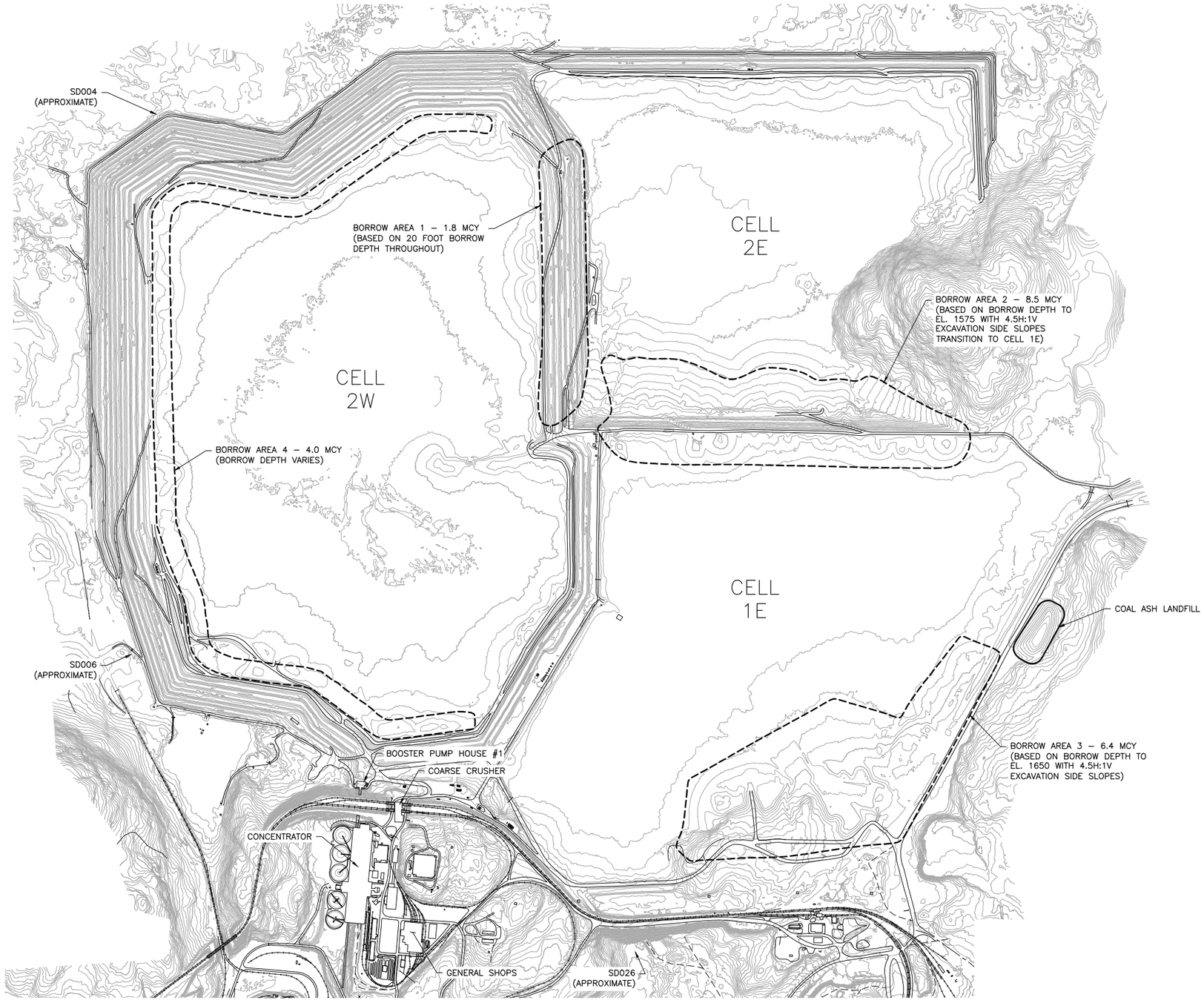
FLOTATION TAILINGS BASIN
LEGEND AND SHEET INDEX

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

BARR ENGINEERING COMPANY
4700 WEST 77TH STREET
MINNEAPOLIS, MN.
Ph: 1–800–632–2277

DWG. NO. FTB–002
REV

INCHES 1 2



NOTES:

1. CONTOURS DO NOT REFLECT BORROW REMOVAL.
2. BORROW LTVSMC COARSE TAILINGS IN THE NUMERICAL SEQUENCE SHOWN.
3. COAL ASH LANDFILL TO BE RELOCATED TO HYDROMET RESIDUE FACILITY OR ALTERNATE PERMITTED FACILITY PRIOR TO TAILINGS DEPOSITION IN CELL 1E.

1 PLAN: EXISTING CONDITIONS

0 800 1600
SCALE IN FEET

N

VER NO	DATE	DESCRIPTION
1	10/14/11	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 1 – ATTACHMENT A
2	12/07/12	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 2 – ATTACHMENT A
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DRAWN: CAD
CHECKED: TJR
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

FLOTATION TAILINGS BASIN EXISTING CONDITIONS

POLYMET MINING

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

BARR ENGINEERING COMPANY
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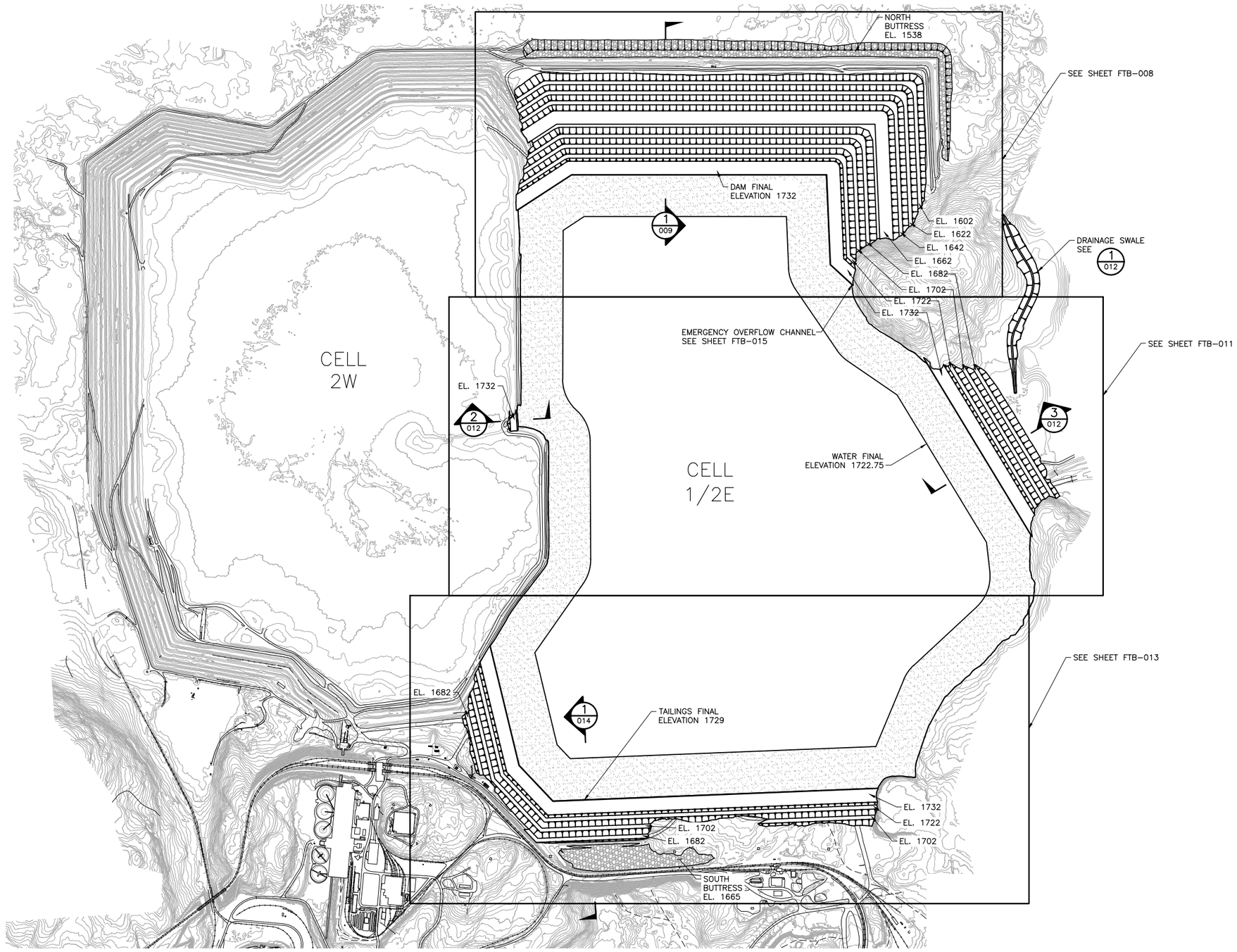
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. FTB-003
REV

INCHES 1 2



1 -- PLAN: TAILINGS BASIN LAYOUT MINE YEAR 20

0 800 1600
SCALE IN FEET

NOTE:

1. CEMENT DEEP SOIL MIX (CDSM) ZONE NOT SHOWN. SEE SHEETS FTB-003 AND FTB-009.
2. LOCATION AND DIMENSIONS OF CDSM SHEAR WALL MAY CHANGE AS DESIGNS ARE FINALIZED.

VER NO	DATE	DESCRIPTION
1	10/14/11	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 1 – ATTACHMENT A
2	12/07/12	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 2 – ATTACHMENT A
3	04/12/13	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 3 – ATTACHMENT A
4	11/25/14	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 4 – ATTACHMENT A
5	03/03/15	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 5 – ATTACHMENT A
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ISSUED	VERSION	DATE
FOR PERMITTING	6	5/20/15
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 5/20/15 LICENSE# 20951

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

PLANT DRAWING NUMBER:

FLOTATION TAILINGS BASIN LAYOUT MINE YEAR 20

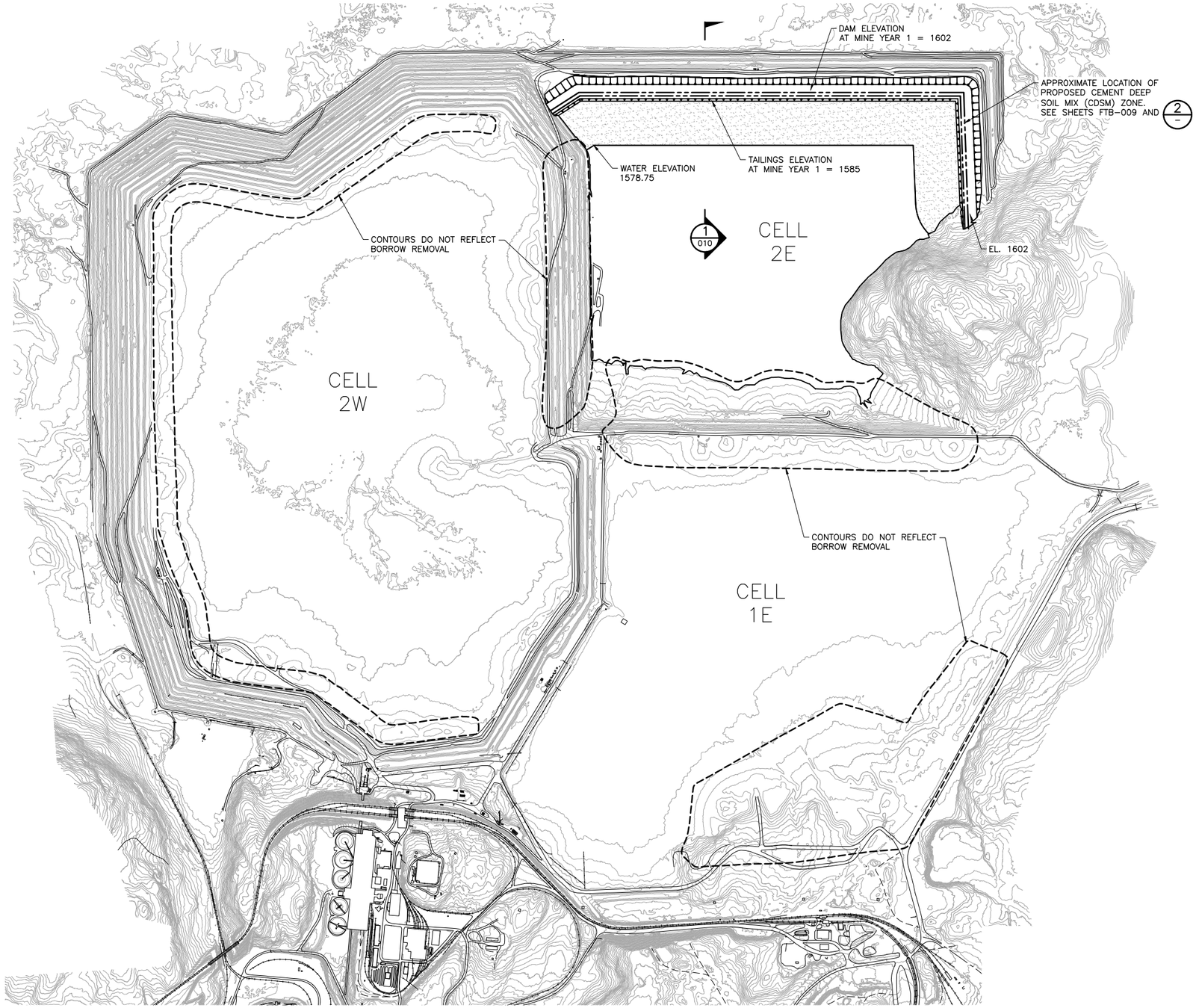
POLYMET MINING

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

BARR

BARR ENGINEERING COMPANY
4700 WEST 77TH STREET
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

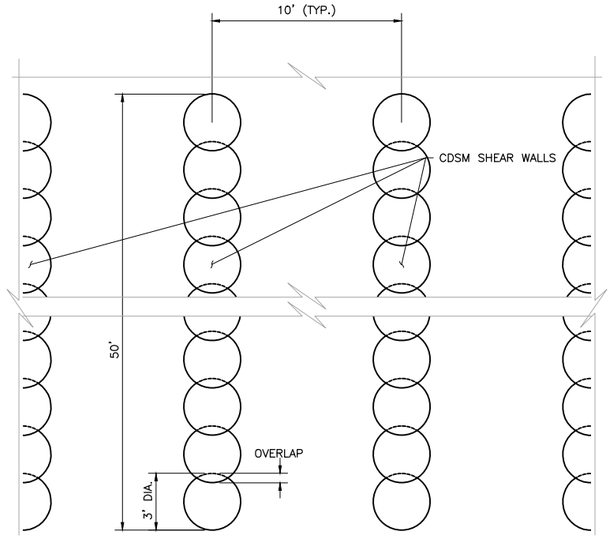
DWG. NO. FTB-004 REV



1/-- PLAN: TAILINGS BASIN LAYOUT MINE YEAR 1

0 800 1600

SCALE IN FEET



2/-- PLAN: CEMENT DEEP SOIL MIX (CDSM) SHEAR WALLS

0 4 8

SCALE IN FEET

NOTES:

1. SEE SHEET FTB-015 FOR OPERATIONS-PHASE EMERGENCY OVERFLOW CHANNEL.
2. CDSM TO BE CONSTRUCTED PRIOR TO TAILINGS PLACEMENT.

VER NO	DATE	DESCRIPTION
1	10/14/11	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 1 – ATTACHMENT A
2	12/07/12	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 2 – ATTACHMENT A
3	04/12/13	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 3 – ATTACHMENT A
4	11/25/14	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 4 – ATTACHMENT A
5	03/03/15	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 5 – ATTACHMENT A
6	5/20/15	ISSUED FOR PERMIT TO MINE APPLICATION

ISSUE STATUS		
ISSUED	VERSION	DATE
FOR PERMITTING	6	5/20/15
FOR CONSTRUCTION	–	–

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DATE 5/20/15 LICENSE# 20951

DRAWN: CAD

CHECKED: TJR

BARR PROJECT NO.: 23/69-0C29

SCALE: AS SHOWN

PLANT DRAWING NUMBER:

FLOTATION TAILINGS BASIN LAYOUT MINE YEAR 1

POLYMET MINING

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

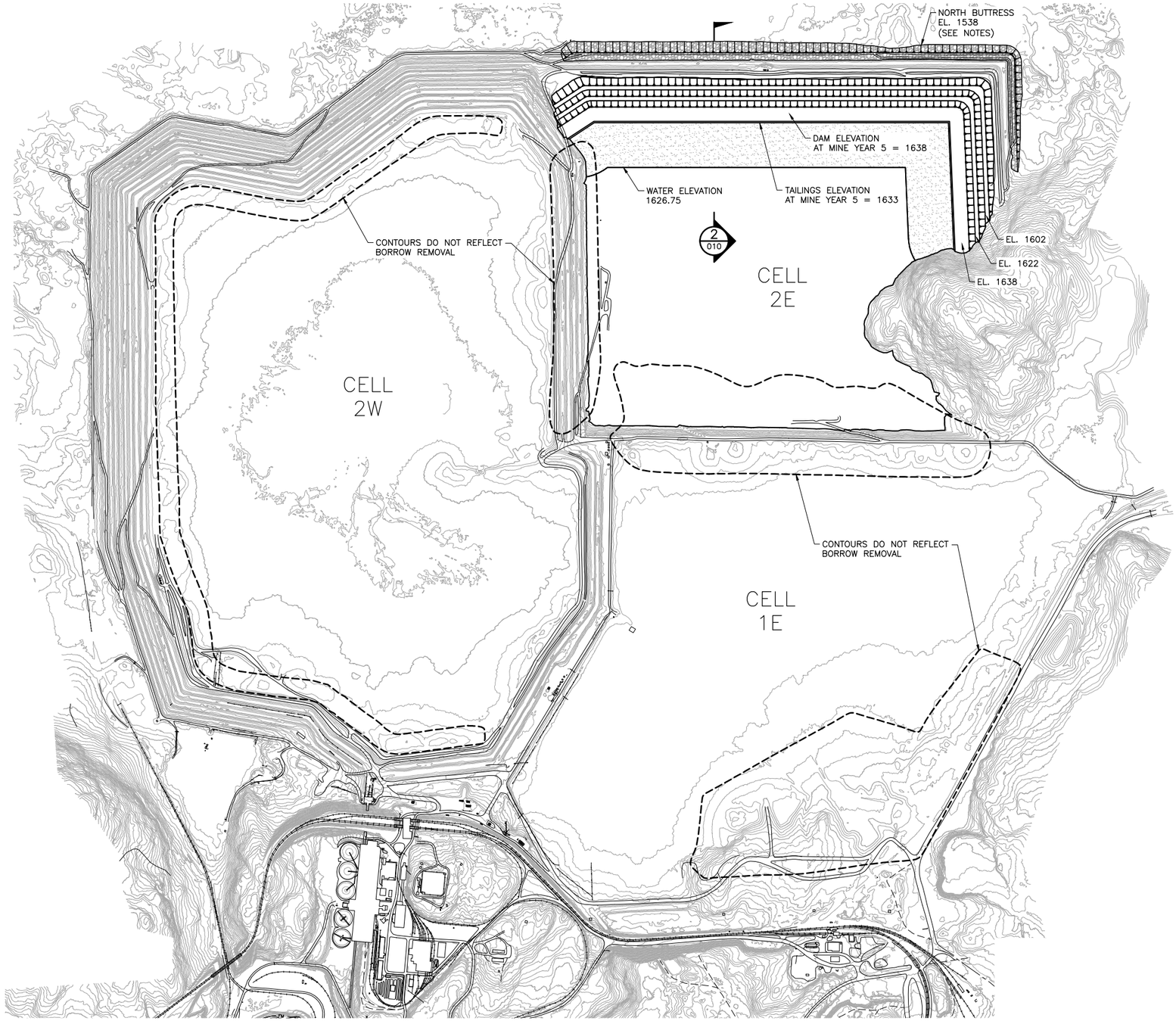
BARR

BARR ENGINEERING COMPANY
4700 WEST 77TH STREET
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. FTB-005

REV

INCHES 1 2



NOTES:

1. SEE SHEET FTB–015 FOR OPERATIONS–PHASE EMERGENCY OVERFLOW CHANNEL.
2. CDSM ZONE NOT SHOWN. SEE SHEETS FTB–003 AND FTB–009.

1 PLAN: TAILINGS BASIN LAYOUT MINE YEAR 5

0 800 1600
SCALE IN FEET

VER NO	DATE	DESCRIPTION
1	10/14/11	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 1 – ATTACHMENT A
2	12/07/12	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 2 – ATTACHMENT A
3	04/12/13	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 3 – ATTACHMENT A
4	11/25/14	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 4 – ATTACHMENT A
5	03/03/15	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 5 – ATTACHMENT A
6	5/20/15	ISSUED FOR PERMIT TO MINE APPLICATION

ISSUE STATUS		
ISSUED	VERSION	DATE
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FOR CONSTRUCTION	–	–

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CHECKED: TJR
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

FLOTATION TAILINGS BASIN LAYOUT MINE YEAR 5

POLYMET MINING

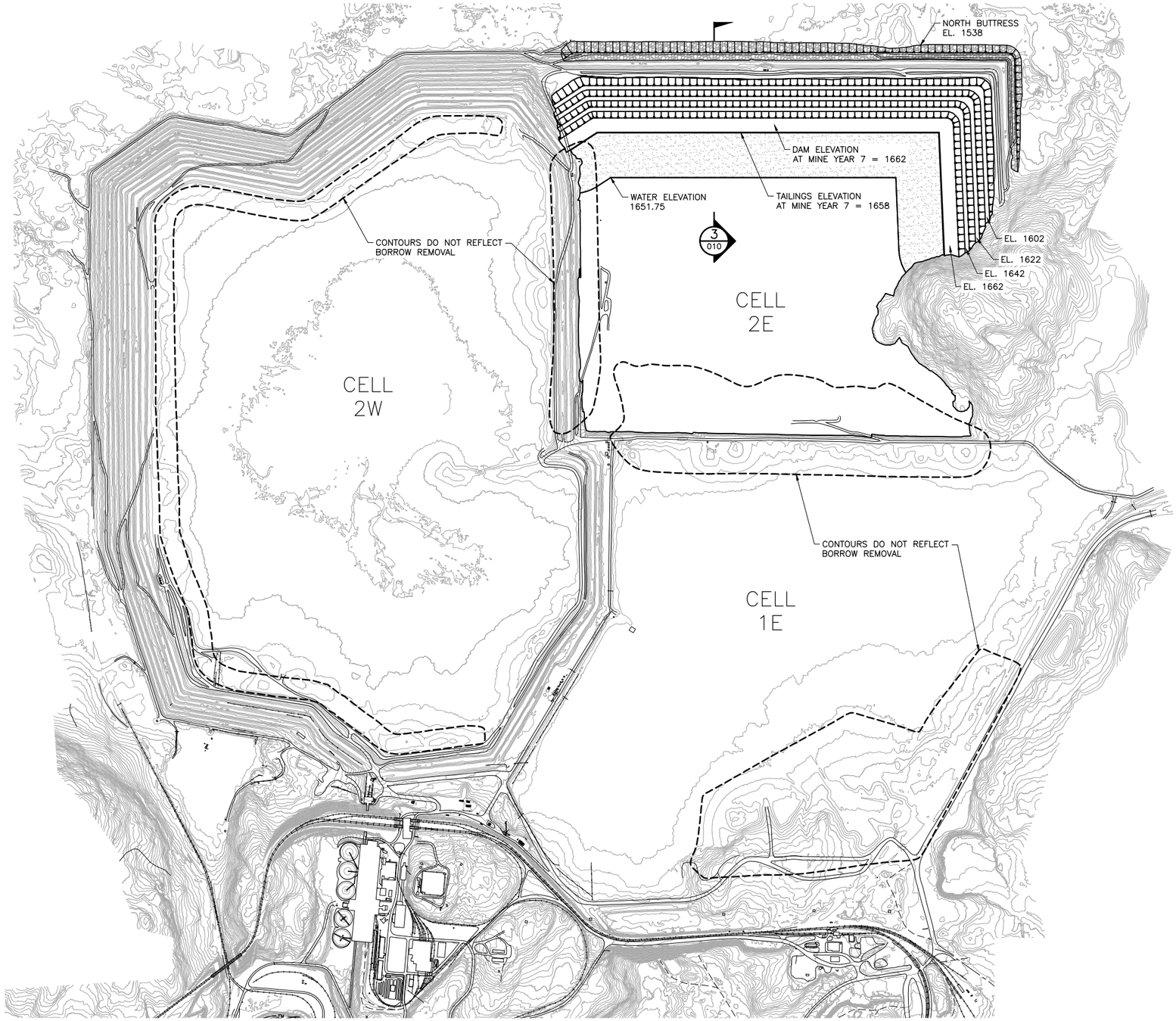
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR

BARR ENGINEERING COMPANY
4700 WEST 77TH STREET
MINNEAPOLIS, MN.
Ph: 1–800–632–2277

DWG. NO. FTB–006
REV

INCHES 1 2



1 PLAN: TAILINGS BASIN LAYOUT MINE YEAR 7

0 800 1600

SCALE IN FEET

NOTES:

1. LAST YEAR BEFORE COMBINING CELLS 2E AND 1E FOR TAILINGS.
2. SEE SHEET FTB-015 FOR OPERATIONS-PHASE EMERGENCY OVERFLOW CHANNEL.
3. CDSM ZONE NOT SHOWN. SEE SHEETS FTB-003 AND FTB-009.

VER NO	DATE	DESCRIPTION
1	10/14/11	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 1 – ATTACHMENT A
2	12/07/12	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 2 – ATTACHMENT A
3	04/12/13	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 3 – ATTACHMENT A
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5	03/03/15	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 5 – ATTACHMENT A
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ISSUE STATUS		
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FOR CONSTRUCTION	–	–

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SIGNATURE Thomas J. Radue

DATE 5/20/15 LICENSE# 20951

DRAWN: CAD

CHECKED: TJR

BARR PROJECT NO.: 23/69-0C29

SCALE: AS SHOWN

PLANT DRAWING NUMBER:

FLOTATION TAILINGS BASIN LAYOUT MINE YEAR 7

POLYMET MINING

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

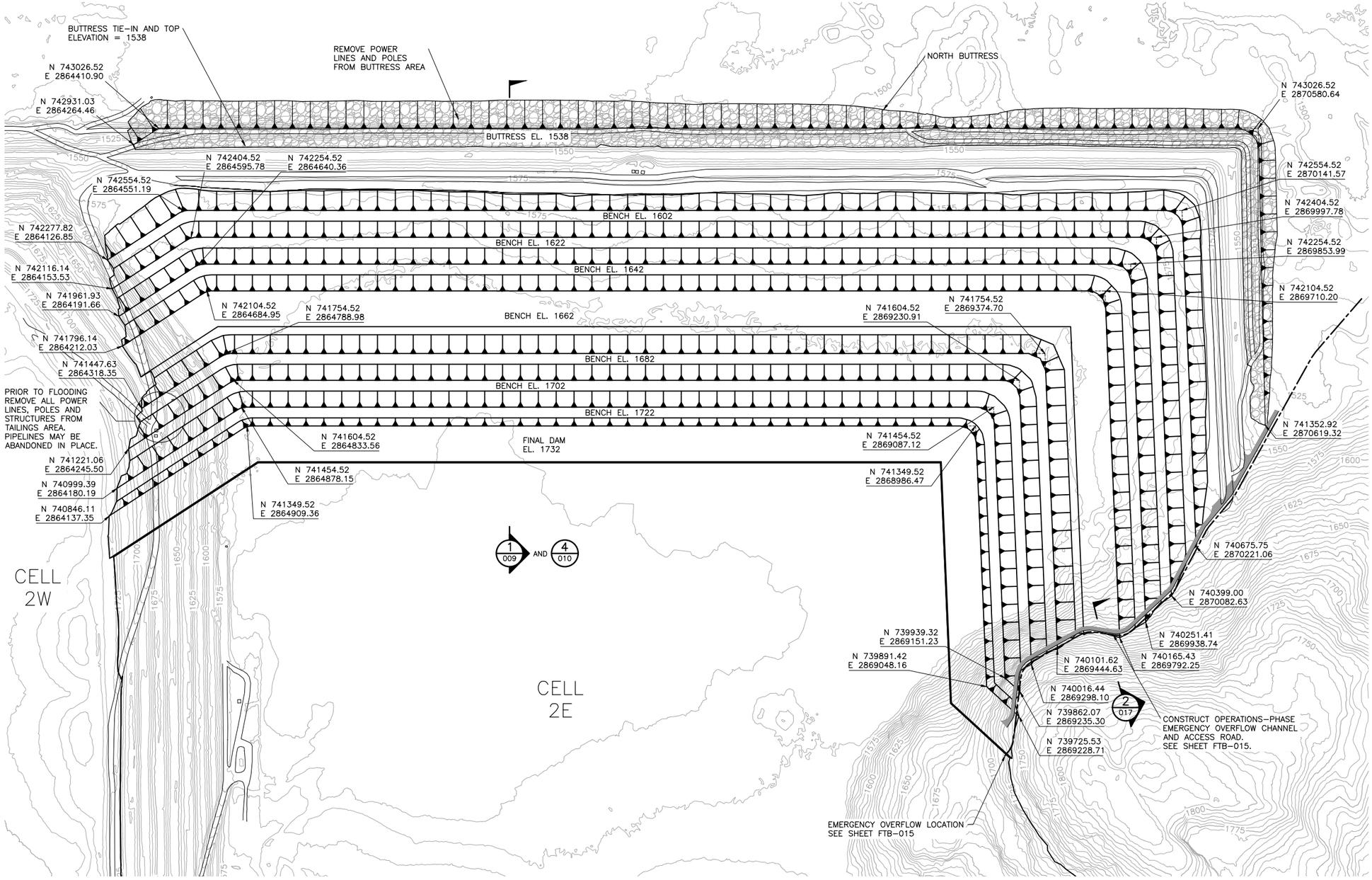
BARR

BARR ENGINEERING COMPANY
4700 WEST 77TH STREET
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. FTB-007

REV

INCHES 1 2



NOTES:

1. DAM ACCESS ROAD LOCATION IS APPROXIMATE. FIELD LOCATE TO PROVIDE PREFERRED SLOPE AND DRAINAGE.
2. EXTEND ACCESS ROAD TO AREA 5 STOCKPILES AND TO PLANT (NOT SHOWN).
3. CDSM ZONE NOT SHOWN. SEE SHEETS FTB–003 AND FTB–009.

1 — PLAN: NORTH DAM LAYOUT

0 300 600
SCALE IN FEET

VER NO	DATE	DESCRIPTION
1	10/14/11	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 1 – ATTACHMENT A
2	12/07/12	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 2 – ATTACHMENT A
3	04/12/13	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 3 – ATTACHMENT A
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6	5/20/15	ISSUED FOR PERMIT TO MINE APPLICATION

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SIGNATURE Thomas J. Radue
DATE 5/20/15 LICENSE# 20951

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

PLANT DRAWING NUMBER:

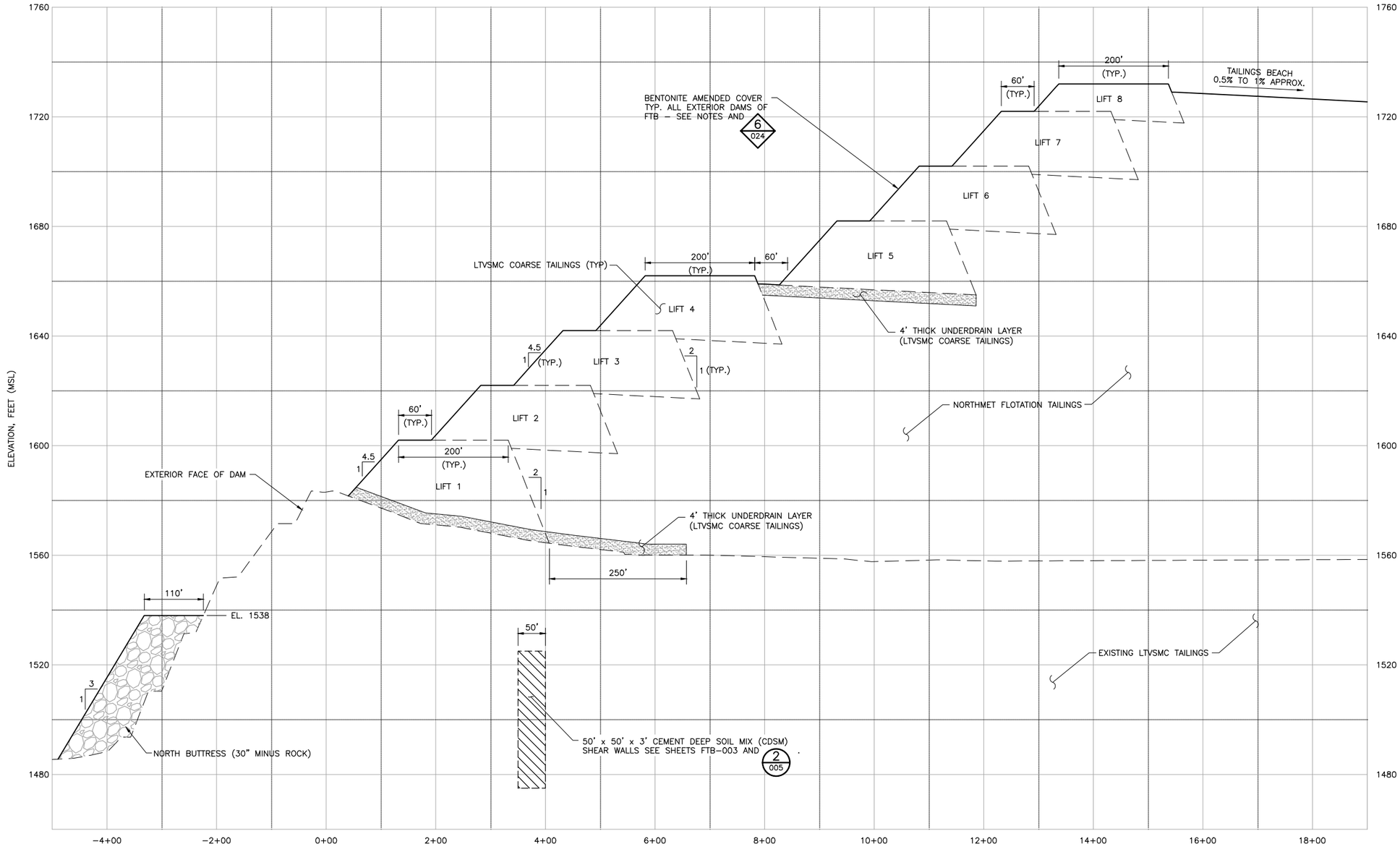
FLOTATION TAILINGS BASIN
NORTH DAM
MINE YEAR 20 LAYOUT

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

BARR ENGINEERING COMPANY
4700 WEST 77TH STREET
MINNEAPOLIS, MN.
Ph: 1–800–632–2277

DWG. NO. FTB–008 REV

INCHES 1 2



1 – ELEVATION: NORTH DAM TYPICAL CROSS SECTION

0 100 200

HORZ. SCALE IN FEET

NOTES:

1. DAMS AND BUTTRESS DIMENSIONS MAY CHANGE WITH EVALUATION OF FUTURE DAM STABILITY PERFORMANCE DATA.

2. LOCATION AND DIMENSIONS OF CDSM SHEAR WALLS MAY CHANGE AS DESIGNS ARE FINALIZED.

VER NO	DATE	DESCRIPTION
1	10/14/11	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 1 – ATTACHMENT A
2	12/07/12	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 2 – ATTACHMENT A
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5	03/03/15	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 5 – ATTACHMENT A
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ISSUE STATUS	VERSION	DATE
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SIGNATURE Thomas J. Radue

DATE 5/20/15 LICENSE# 20951

DRAWN: CAD

CHECKED: TJR

BARR PROJECT NO.: 23/69-0C29

SCALE: AS SHOWN

PLANT DRAWING NUMBER:

FLOTATION TAILINGS BASIN NORTH DAM TYPICAL CROSS SECTION

POLYMET MINING

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

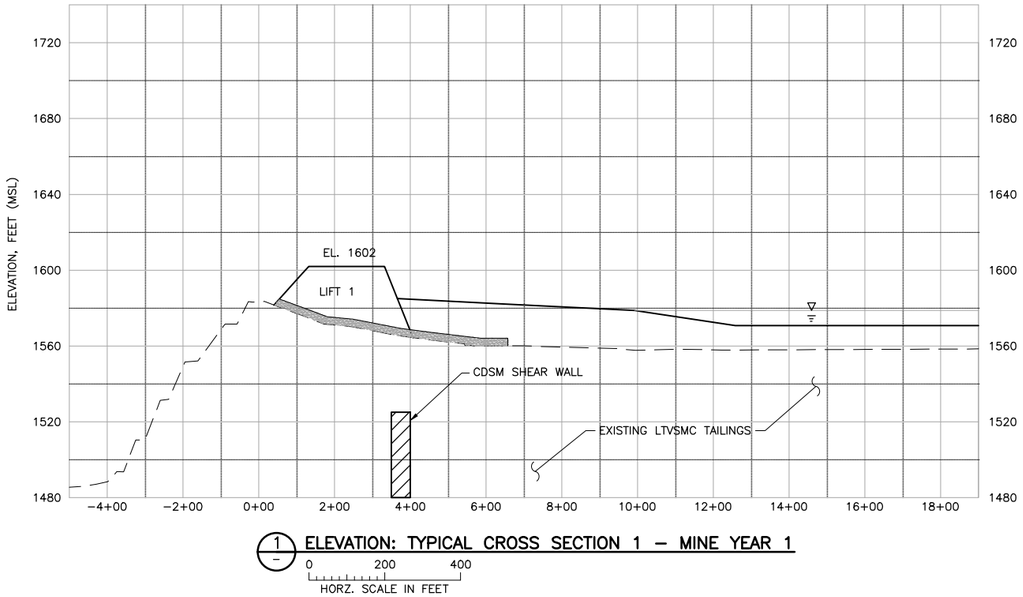
BARR

BARR ENGINEERING COMPANY
4700 WEST 77TH STREET
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. FTB-009

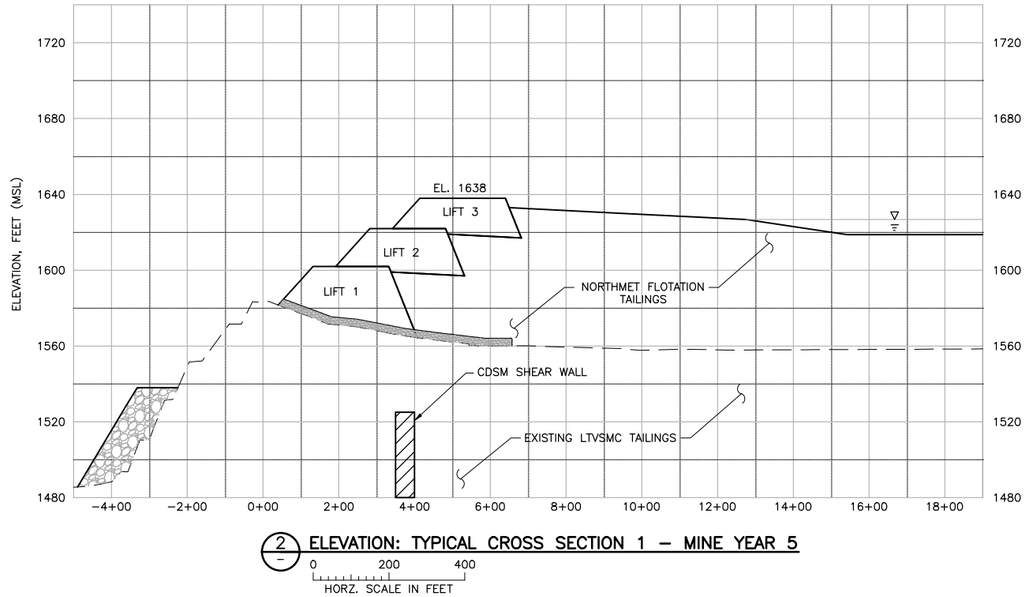
REV

INCHES 1 2



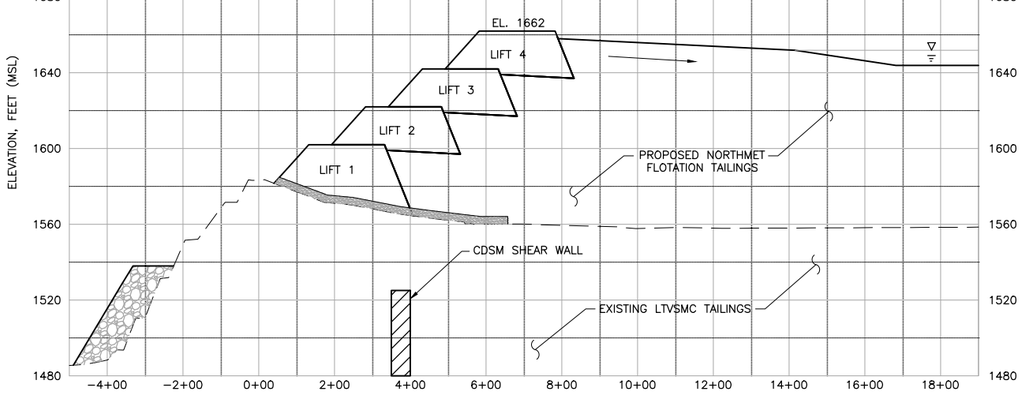
1 — **ELEVATION: TYPICAL CROSS SECTION 1 – MINE YEAR 1**

0 200 400
HORZ. SCALE IN FEET



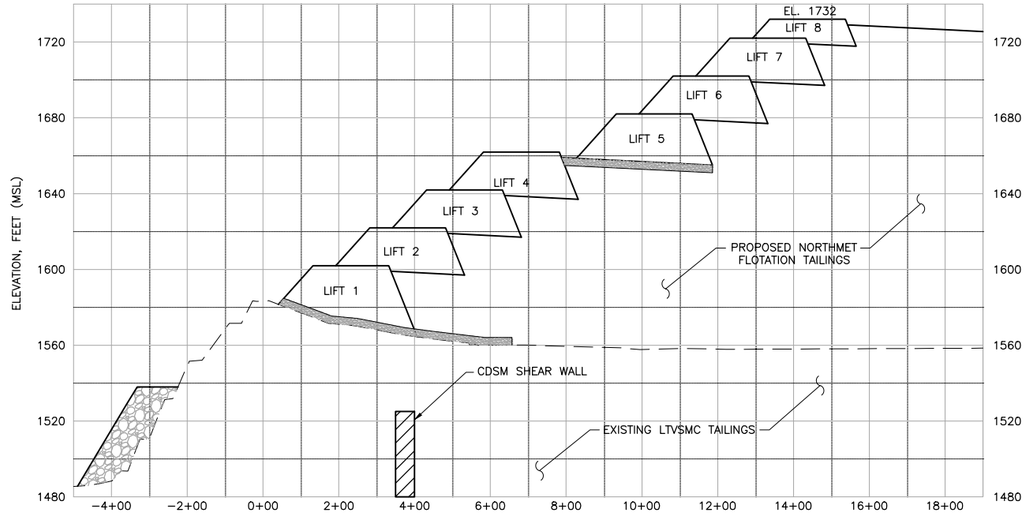
2 — **ELEVATION: TYPICAL CROSS SECTION 1 – MINE YEAR 5**

0 200 400
HORZ. SCALE IN FEET



3 — **ELEVATION: TYPICAL CROSS SECTION 1 – MINE YEAR 7**

0 200 400
HORZ. SCALE IN FEET



4 — **ELEVATION: TYPICAL CROSS SECTION 1 – MINE YEAR 20**

0 200 400
HORZ. SCALE IN FEET

NOTE:

1. DAM AND BUTTRESS DIMENSIONS MAY CHANGE WITH EVALUATION OF FUTURE DAM STABILITY PERFORMANCE DATA.

2. PLACE BENTONITE AMENDED SOIL COVER ON OUTSIDE FACE OF NEW DAMS.

VER NO.	DATE	DESCRIPTION
1	10/14/11	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 1 – ATTACHMENT A
2	12/07/12	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 2 – ATTACHMENT A
3	04/12/13	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 3 – ATTACHMENT A
4	11/25/14	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 4 – ATTACHMENT A
5	03/03/15	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 5 – ATTACHMENT A
6	5/20/15	ISSUED FOR PERMIT TO MINE APPLICATION

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SIGNATURE Thomas J. Radue
DATE 5/20/15 LICENSE# 20951

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

PLANT DRAWING NUMBER:

FLOTATION TAILINGS BASIN NORTH DAM STAGED CONSTRUCTION

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

BARR ENGINEERING COMPANY
4700 WEST 77TH STREET
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. FTB-010 REV

INCHES 1 2

CELL 2E

CELL 1E

N 737605.18
E 2864034.46

2/012

N 737299.05
E 2864055.46

FINAL DAM ELEVATION = 1732

PRIOR TO FLOODING REMOVE ALL POWER LINES, POLES AND STRUCTURES FROM TAILINGS AREA. PIPELINES MAY BE ABANDONED IN PLACE.

PUMP TO REMAIN IN OPERATION

CLOSURE OVERFLOW SEE 3/021

DRAINAGE SWALE SEE 1/012

N 738313.79
E 2870660.40

N 738300.82
E 2870545.47

N 738278.76
E 2870857.04

N 738297.00
E 2871021.39

BENCH EL. 1682

BENCH EL. 1702

BENCH EL. 1722

FINAL DAM EL. 1732

3/012

N 736294.00
E 2872235.58

N 736283.39
E 2872066.60

N 736176.83
E 2871955.79

N 736044.81
E 2871913.03

CONSTRUCT DAM ACCESS ROAD, SEE 2/021

1/--- PLAN: EAST AND WEST DAM LAYOUTS

0 300 600

SCALE IN FEET

INCHES 1 2

VER NO.	DATE	DESCRIPTION
1	10/14/11	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 1 – ATTACHMENT A
2	12/07/12	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 2 – ATTACHMENT A
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DRAWN: CAD
CHECKED: TJR
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

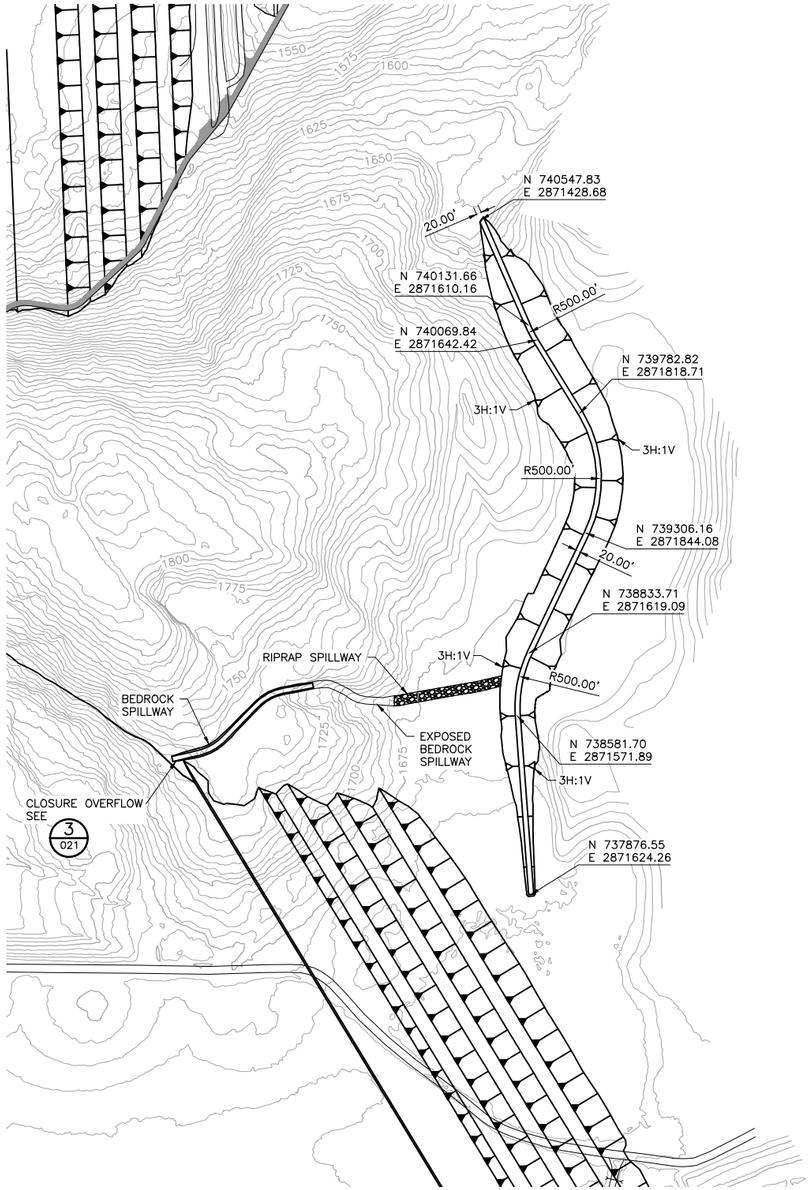
FLOTATION TAILINGS BASIN EAST AND WEST DAMS MINE YEAR 20 LAYOUT

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

BARR ENGINEERING COMPANY
4700 WEST 77TH STREET
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. FTB-011

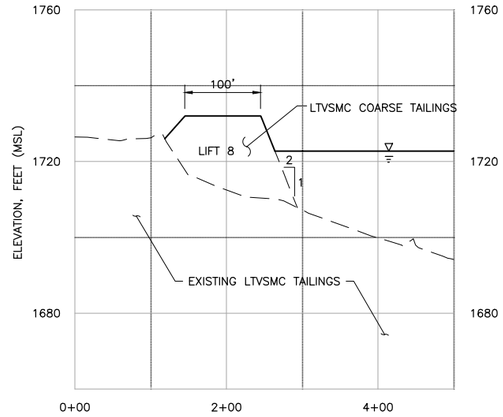
REV



1 / -- PLAN: DRAINAGE SWALE LAYOUT

0 300 600

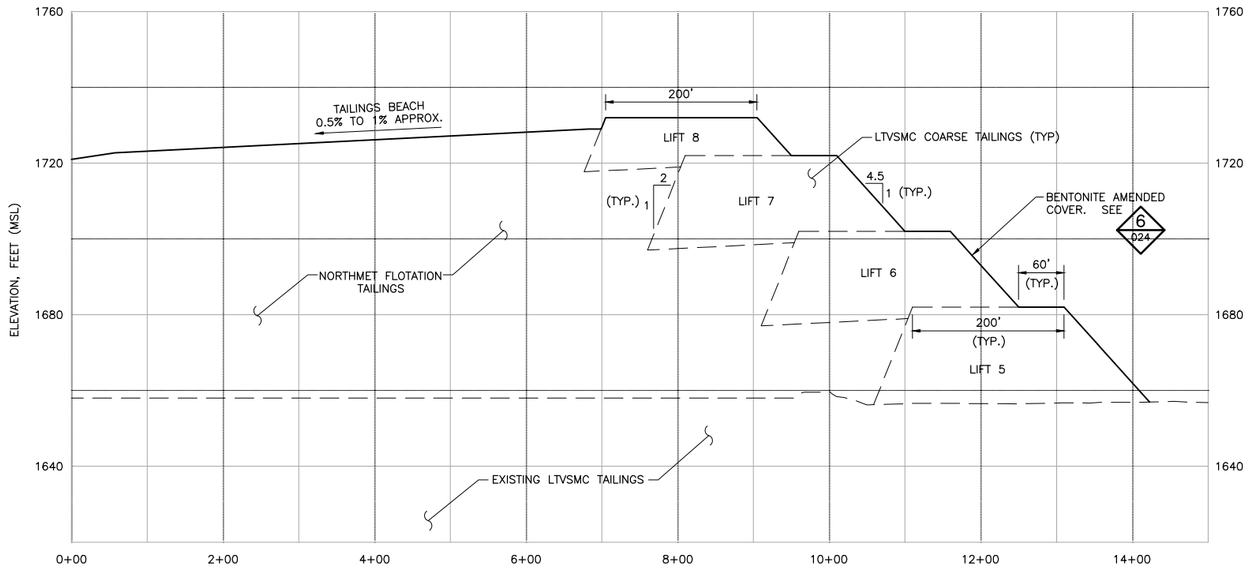
SCALE IN FEET



2 / 011 ELEVATION: WEST DAM TYPICAL CROSS SECTION

0 100 200

HORZ. SCALE IN FEET



3 / 011 ELEVATION: EAST DAM TYPICAL CROSS SECTION

0 100 200

HORZ. SCALE IN FEET

NOTES:

1.CLOSURE OVERFLOW IS FOR EMERGENCY OVERFLOW ONLY UNTIL POND WATER QUALITY MEETS DISCHARGE WATER QUALITY REQUIREMENTS.

2. DAM DIMENSIONS MAY CHANGE WITH EVALUATION OF FUTURE DAM STABILITY PERFORMANCE DATA.

VER NO.	DATE	DESCRIPTION
1	10/14/11	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 1 – ATTACHMENT A
2	12/07/12	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 2 – ATTACHMENT A
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ISSUE STATUS		
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SIGNATURE Thomas J. Radue

DATE 5/20/15 LICENSE# 20951

DRAWN: CAD

CHECKED: TJR

BARR PROJECT NO.: 23/69-0C29

SCALE: AS SHOWN

PLANT DRAWING NUMBER:

FLOTATION TAILINGS BASIN EAST AND WEST DAMS TYPICAL CROSS SECTIONS AND DRAINAGE SWALE

POLYMET MINING

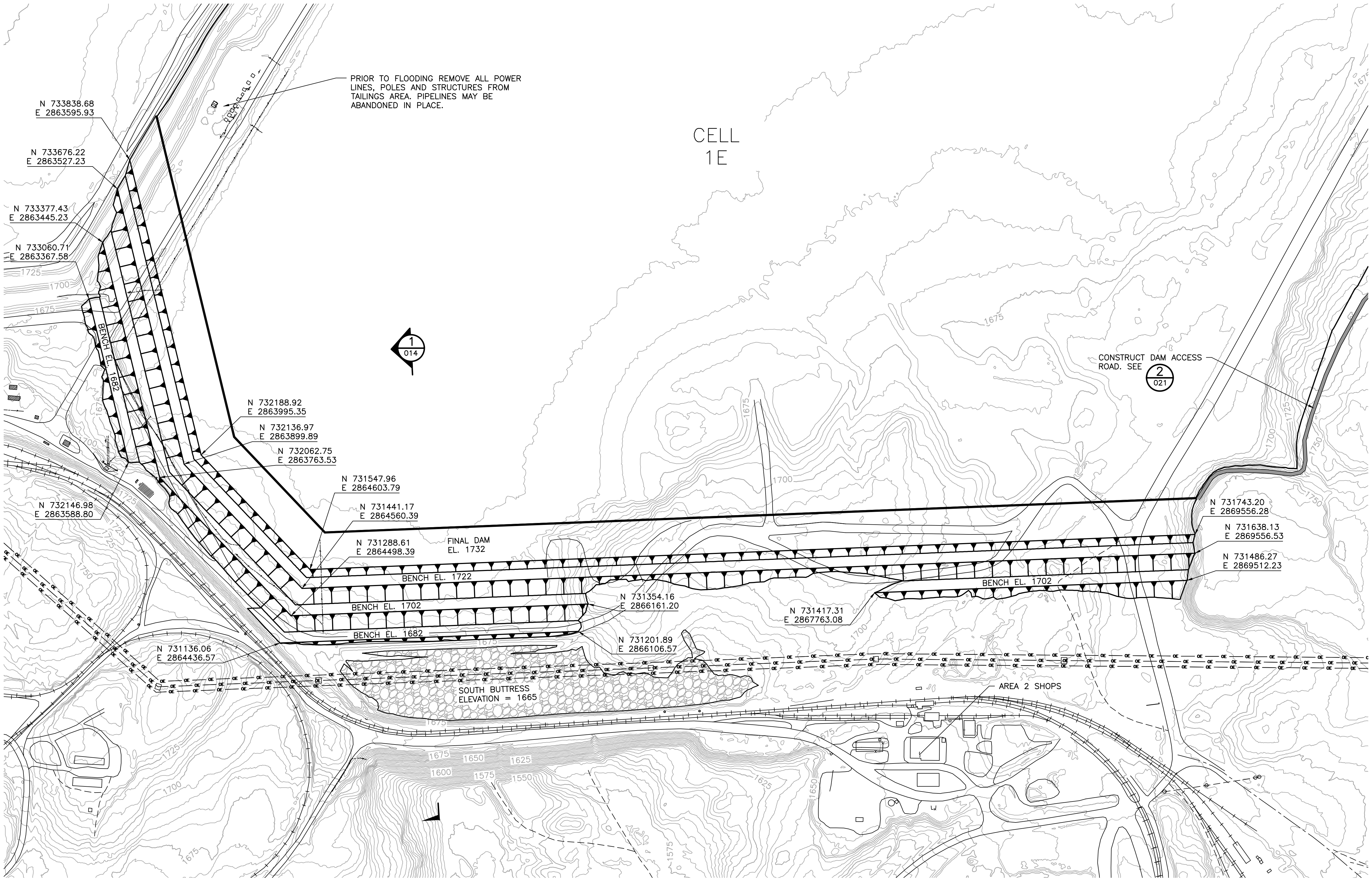
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR ENGINEERING COMPANY
4700 WEST 77TH STREET
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. FTB-012

REV

INCHES 1 2



1 PLAN: SOUTH DAM LAYOUT

0 300 600 SCALE IN FEET

CADD USER: Adeptuser FILE: \\PWEDINA\EDINA PW\EDINA PW IN\23187B86-8BC2-44EA-9171-5237B51A3893\32D01CBE-ECD1-42BD-A128-CAEE1A102165\PERMIT_NMT-02-CS-013.DWG PLOT SCALE: 1:2 PLOT DATE: 5/26/2015 2:27 PM

INCHES 1 2

VER NO	DATE	DESCRIPTION
1	10/14/11	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 1 – ATTACHMENT A
2	12/07/12	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 2 – ATTACHMENT A
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SIGNATURE Thomas J. Radue
DATE 5/20/15 LICENSE# 20951

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

PLANT DRAWING NUMBER:

FLOTATION TAILINGS BASIN
SOUTH DAM
YEAR 20 LAYOUT

POLYMET MINING

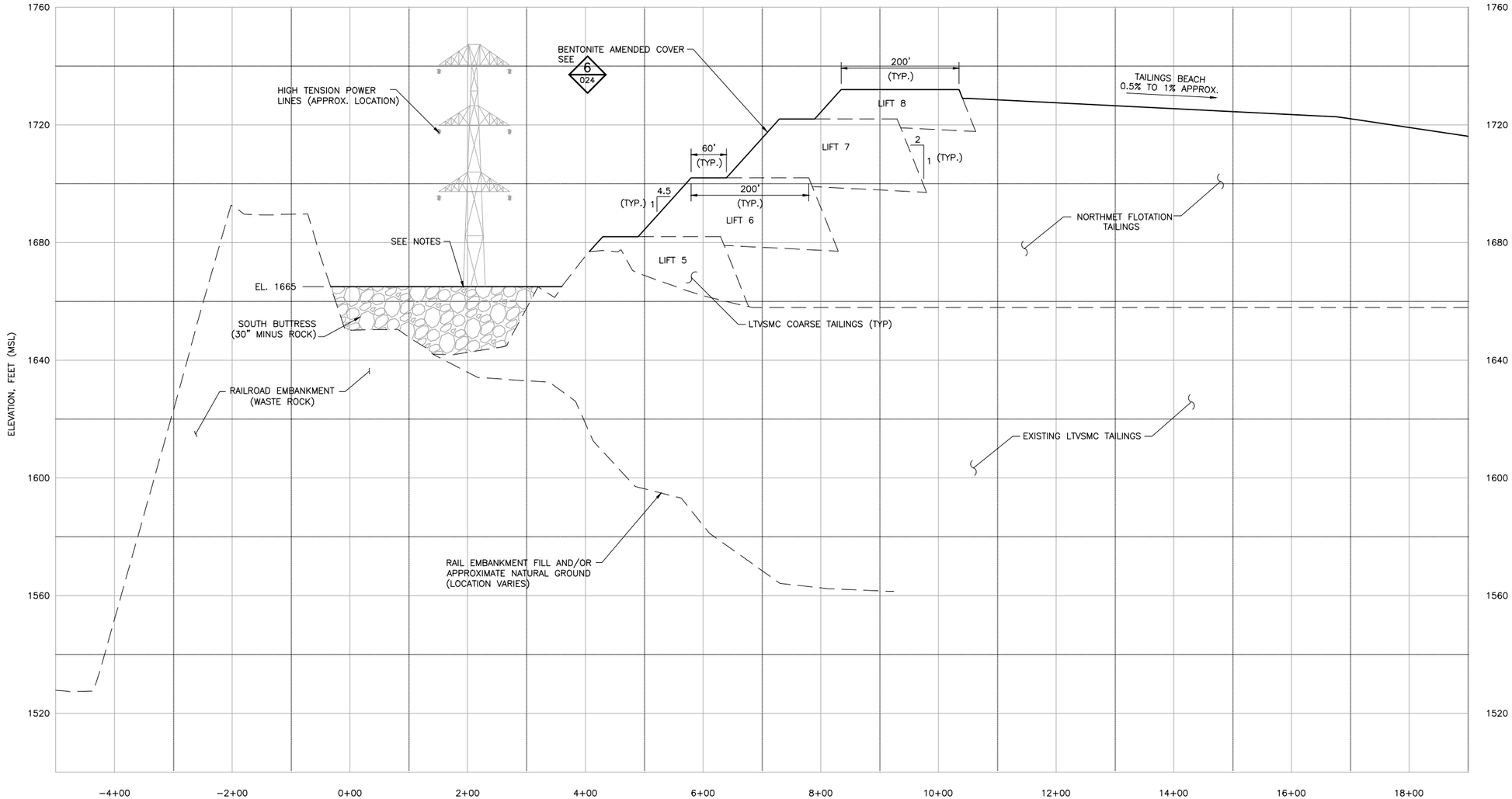
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR

BARR ENGINEERING COMPANY
4700 WEST 77TH STREET
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. FTB-013

REV



1 ELEVATION: SOUTH DAM TYPICAL CROSS SECTION

0 100 200
HORZ. SCALE IN FEET

NOTES:

1. DAM DIMENSIONS MAY CHANGE WITH EVALUATION OF FUTURE PERFORMANCE DATA.

2. HIGH TENSION POWER LINES SHOWN FOR REFERENCE. TOWER FOUNDATIONS ARE LOCATED OUTSIDE OF THE AREA COVERED BY THE BUTTRESS.

VER NO	DATE	DESCRIPTION
1	10/14/11	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 1 – ATTACHMENT A
2	12/07/12	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 2 – ATTACHMENT A
3	04/12/13	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 3 – ATTACHMENT A
4	11/25/14	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 4 – ATTACHMENT A
5	03/03/15	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 5 – ATTACHMENT A
6	5/20/15	ISSUED FOR PERMIT TO MINE APPLICATION

ISSUE STATUS	VERSION	DATE
FOR PERMITTING	6	5/20/15
FOR CONSTRUCTION	–	–

NOT APPROVED FOR CONSTRUCTION

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PRINTED NAME THOMAS J. RADUE
SIGNATURE Thomas J. Radue
DATE 5/20/15 LICENSE# 20951

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

PLANT DRAWING NUMBER:

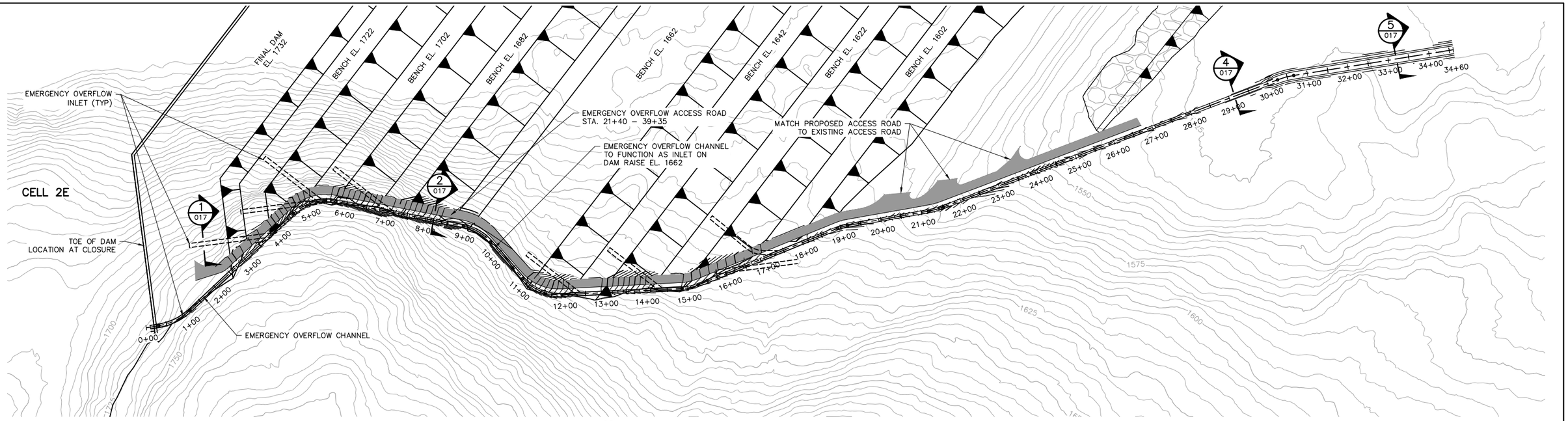
FLOTATION TAILINGS BASIN SOUTH DAM TYPICAL CROSS SECTIONS

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

BARR ENGINEERING COMPANY
4700 WEST 77TH STREET
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. FTB-014
REV

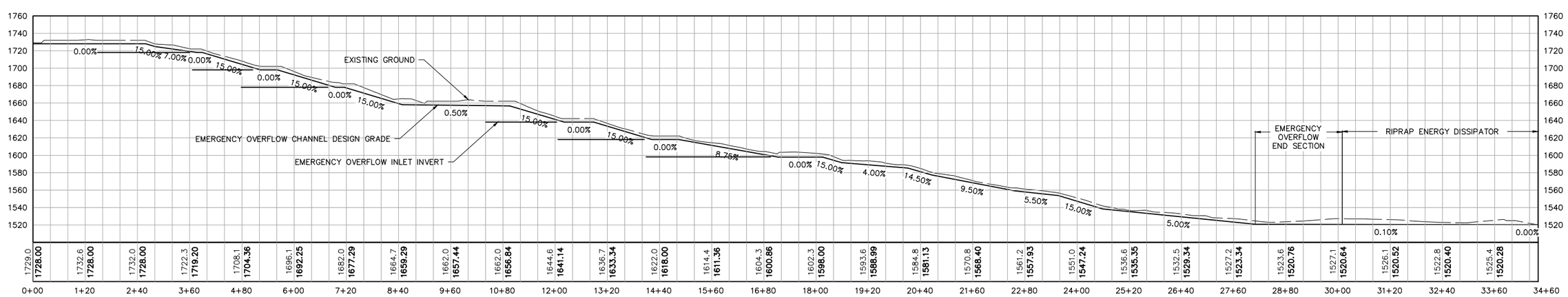
INCHES 1 2



1 – PLAN: EMERGENCY OVERFLOW CHANNEL (OPERATIONS–PHASE)

0 120 240

SCALE IN FEET



2 – PROFILE: EMERGENCY OVERFLOW CHANNEL (OPERATIONS–PHASE)

0 120 240

HORIZONTAL SCALE IN FEET

0 60 120

VERTICAL SCALE IN FEET

VER NO	DATE	DESCRIPTION
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CHECKED: TJR

BARR PROJECT NO.: 23/69-0C29

SCALE: AS SHOWN

PLANT DRAWING NUMBER:

FLOTATION TAILINGS BASIN EMERGENCY OVERFLOW CHANNEL LAYOUT

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

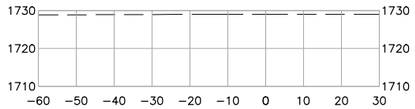
BARR ENGINEERING COMPANY
4700 WEST 77TH STREET
MINNEAPOLIS, MN.
Ph: 1–800–632–2277

DWG. NO. FTB–015

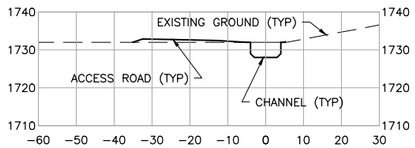
REV

INCHES 1 2

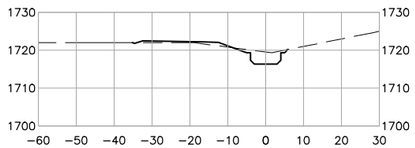
EMERGENCY OVERFLOW STA 0+00



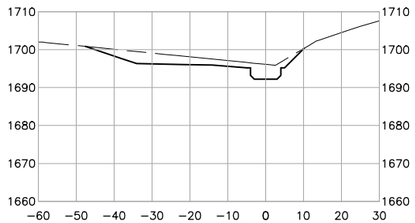
EMERGENCY OVERFLOW STA 2+00



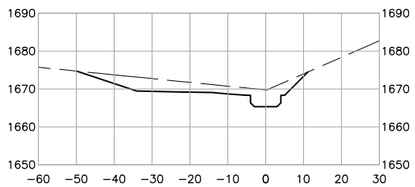
EMERGENCY OVERFLOW STA 4+00



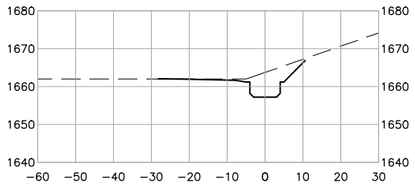
EMERGENCY OVERFLOW STA 6+00



EMERGENCY OVERFLOW STA 8+00



EMERGENCY OVERFLOW STA 10+00



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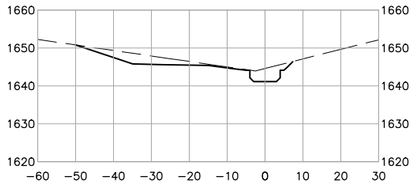

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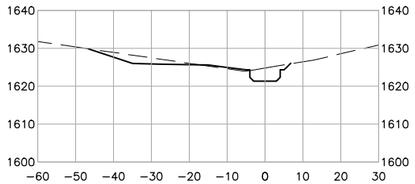

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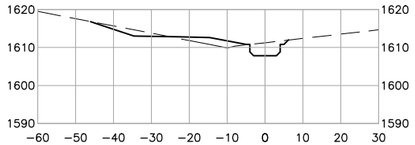

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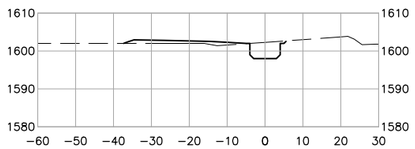

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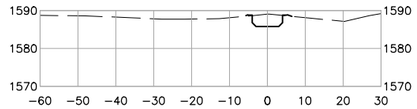
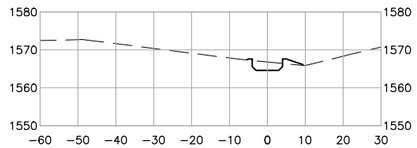


EMERGENCY OVERFLOW STA 22+00



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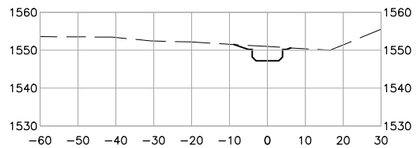
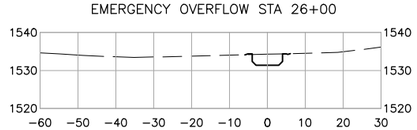
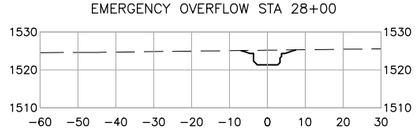


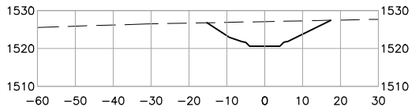
EMERGENCY OVERFLOW STA 26+00



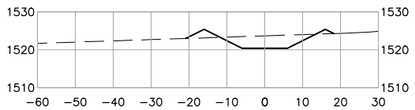
EMERGENCY OVERFLOW STA 28+00



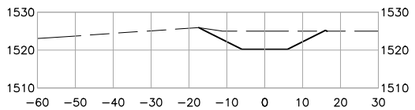
EMERGENCY OVERFLOW STA 30+00



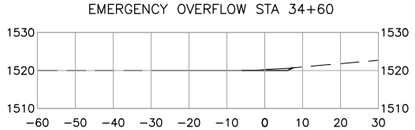
EMERGENCY OVERFLOW STA 32+00



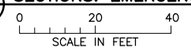
EMERGENCY OVERFLOW STA 34+00



EMERGENCY OVERFLOW STA 34+60



1 SECTIONS: EMERGENCY OVERFLOW CHANNEL



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PRINTED NAME THOMAS J. RADUE

SIGNATURE Thomas J. Radue

DATE 5/20/15 LICENSE# 20951

DRAWN: CAD

CHECKED: TJR

BARR PROJECT NO.: 23/69-0C29

SCALE: AS SHOWN

PLANT DRAWING NUMBER:

FLOTATION TAILINGS BASIN EMERGENCY OVERFLOW CHANNEL SECTIONS

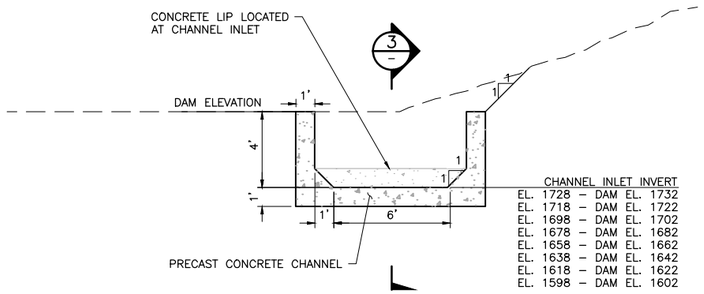
POLY MET MINING, INC.
NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR ENGINEERING COMPANY
4700 WEST 77TH STREET
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

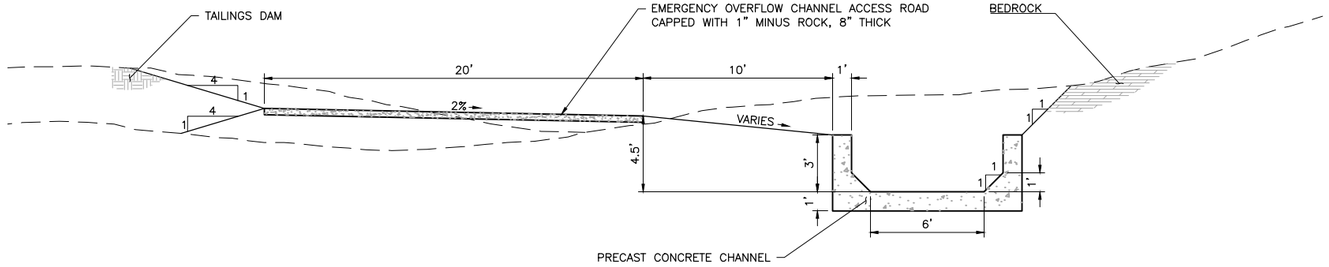
DWG. NO. FTB-016

REV

INCHES 1 2

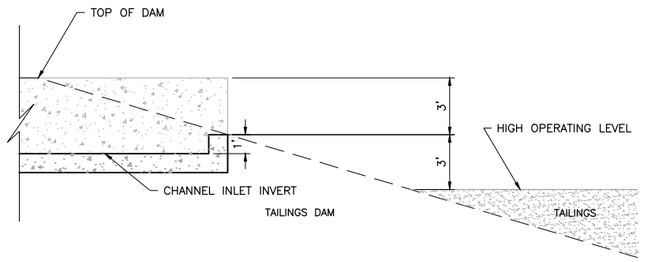


1/015 **SECTION: TYPICAL EMERGENCY OVERFLOW CHANNEL INLET**
NTS

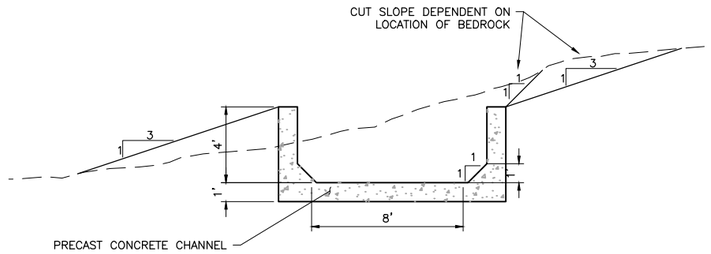


2/015 **SECTION: EMERGENCY OVERFLOW CHANNEL**
NTS

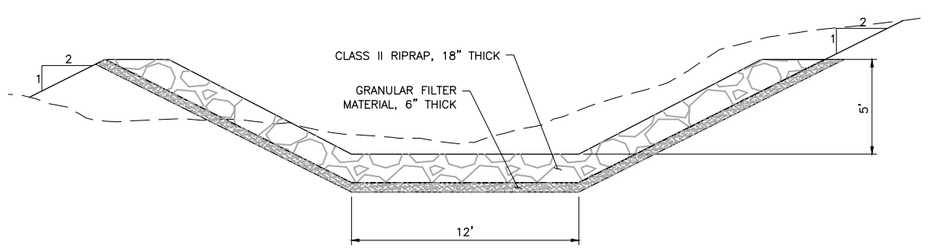
NOTE:
INCREASE EMERGENCY OVERFLOW CHANNEL DEPTH TO 4' WHEN CHANNEL SLOPE IS 0%



3/– **DETAIL: EMERGENCY OVERFLOW CHANNEL INLET**
NTS



4/015 **SECTION: EMERGENCY OVERFLOW CHANNEL END SECTION – STA. 28+10 – 30+10**
NTS



5/015 **SECTION: RIPRAP OVERFLOW CHANNEL ENERGY DISSIPATOR – STA. 30+10 – 34+60**
NTS

VER NO.	DATE	DESCRIPTION
1	10/14/11	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 1 – ATTACHMENT A
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DRAWN: CAD
CHECKED: TJR
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

FLOTATION TAILINGS BASIN EMERGENCY OVERFLOW CHANNEL DETAILS

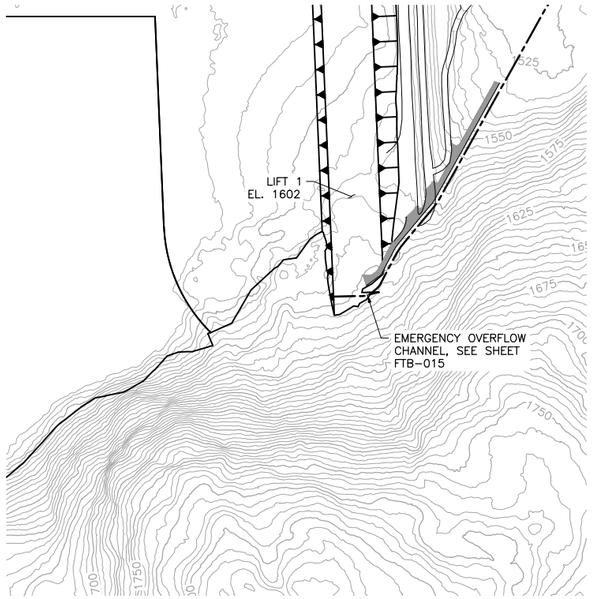
POLYMET MINING

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

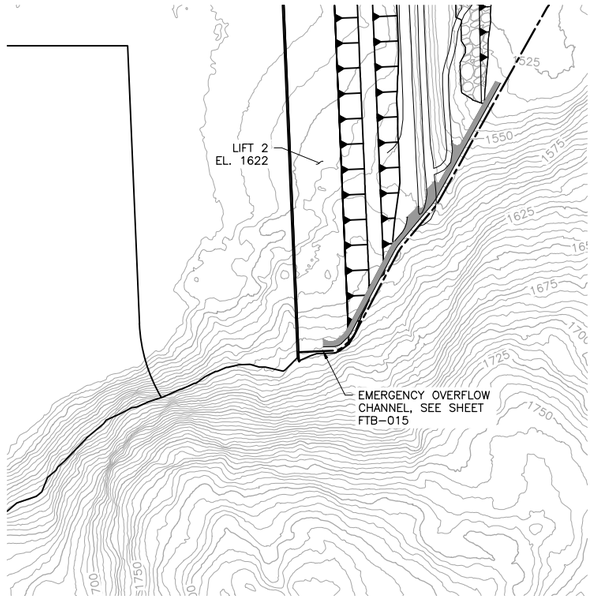
BARR ENGINEERING COMPANY
4700 WEST 77TH STREET
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. FTB-017
REV

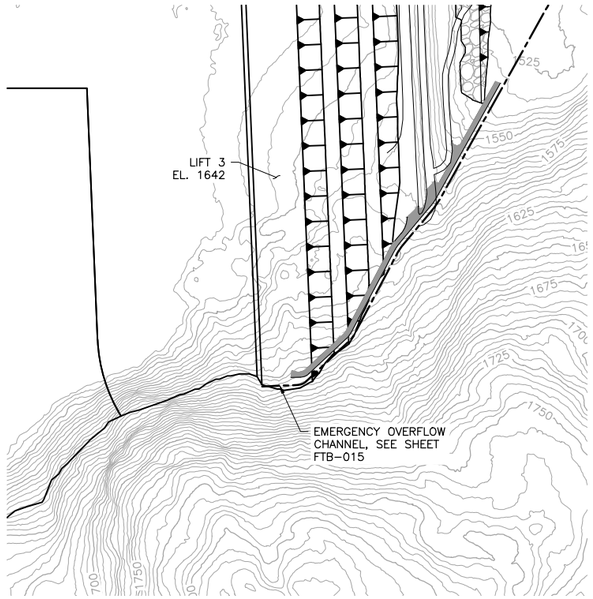
INCHES 1 2



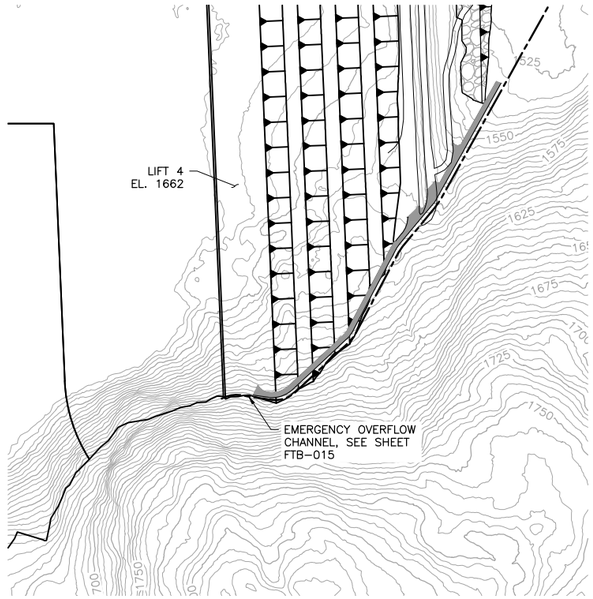
1 – PLAN: EMERGENCY OVERFLOW CHANNEL – LIFT 1



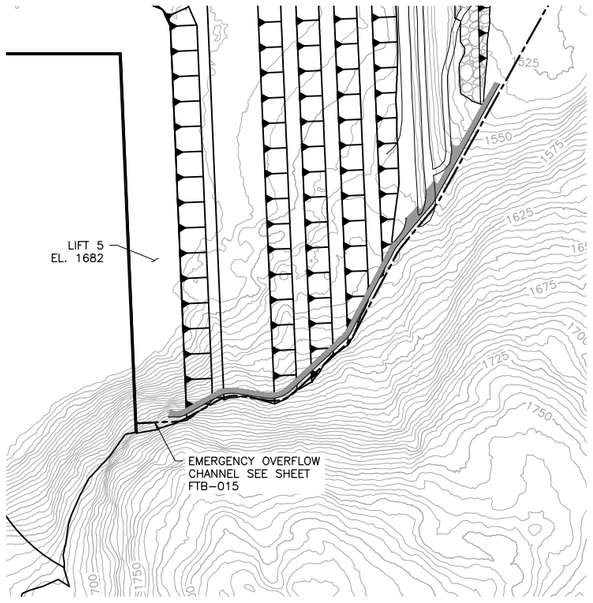
2 – PLAN: EMERGENCY OVERFLOW CHANNEL – LIFT 2



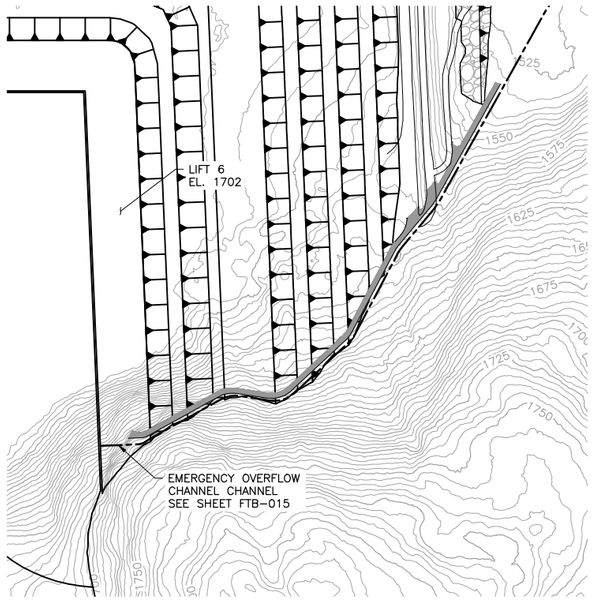
3 – PLAN: EMERGENCY OVERFLOW CHANNEL – LIFT 3



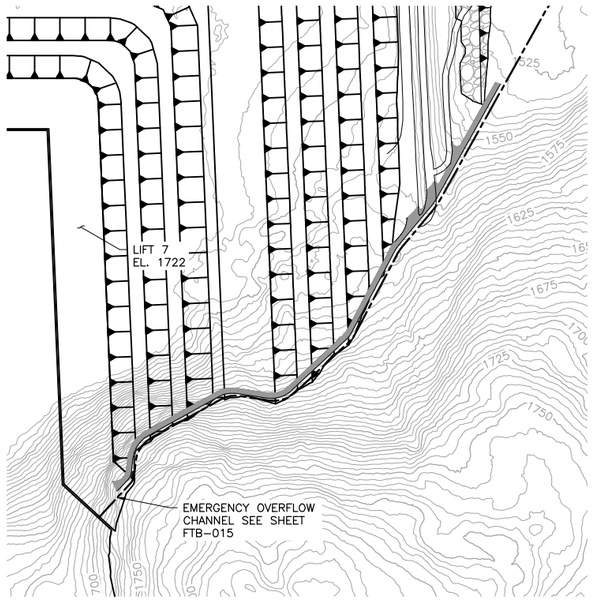
4 – PLAN: EMERGENCY OVERFLOW CHANNEL – LIFT 4



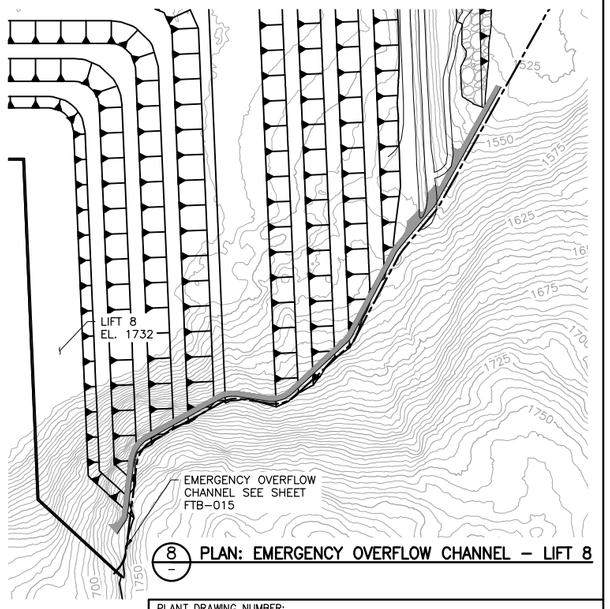
5 – PLAN: EMERGENCY OVERFLOW CHANNEL – LIFT 5



6 – PLAN: EMERGENCY OVERFLOW CHANNEL – LIFT 6



7 – PLAN: EMERGENCY OVERFLOW CHANNEL – LIFT 7



8 – PLAN: EMERGENCY OVERFLOW CHANNEL – LIFT 8

INCHES 1 2

0 300 600
SCALE IN FEET

NOTES:

1. EMERGENCY OVERFLOW CHANNEL PLAN VIEW NOT SHOWN, SEE SHEET FTB-015 FOR REFERENCE.

VER NO	DATE	DESCRIPTION
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CHECKED: TJR
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

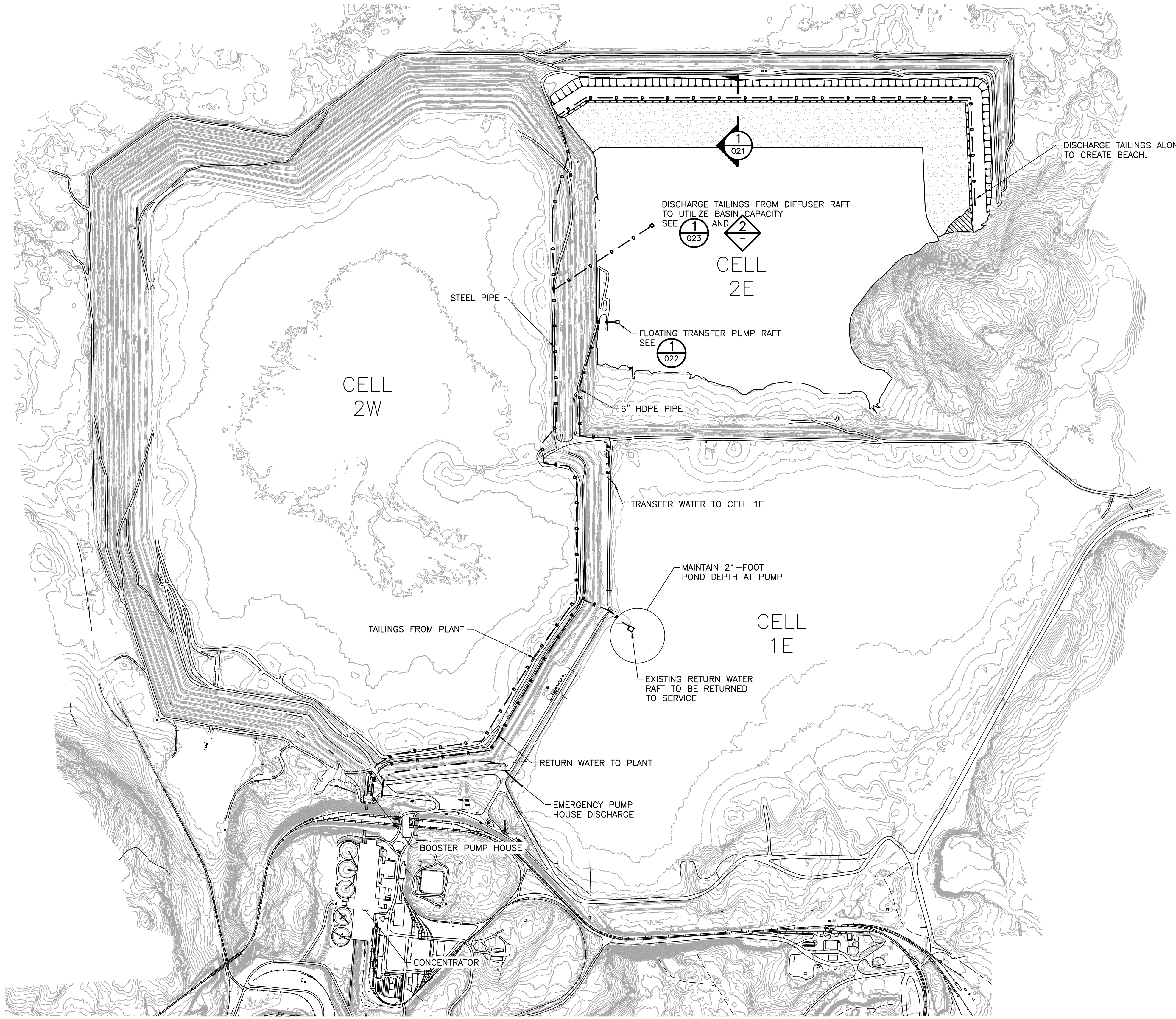
PLANT DRAWING NUMBER:

FLOTATION TAILINGS BASIN EMERGENCY OVERFLOW CHANNEL SEQUENCING

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

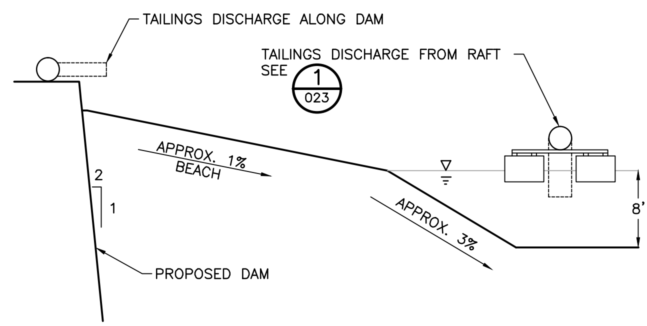
BARR ENGINEERING COMPANY
4700 WEST 77TH STREET
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. FTB-018
REV



1 PLAN: PIPING LAYOUT CELL 2E

0 800 1600 SCALE IN FEET



2 DETAIL: TAILINGS DISCHARGE ALONG DAM
NTS

NOTES:

1. CONTOURS DO NOT REFLECT BORROW REMOVAL.
2. PIPELINE LOCATIONS ARE PRELIMINARY.

VER NO	DATE	DESCRIPTION
1	10/14/11	FLOTATION TAILINGS MANAGEMENT PLAN – VERSION 1 – ATTACHMENT A
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6	5/20/15	ISSUED FOR PERMIT TO MINE APPLICATION

ISSUE STATUS		
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SIGNATURE Thomas J. Radue
DATE 5/20/15 LICENSE# 20951

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CHECKED: TJR
BARR PROJECT NO.: 23/69-0C29
SCALE: AS SHOWN

PLANT DRAWING NUMBER:

FLOTATION TAILINGS BASIN
PIPING LAYOUT CELL 2E

POLYMET MINING

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

BARR ENGINEERING COMPANY
4700 WEST 77TH STREET
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. FTB–019

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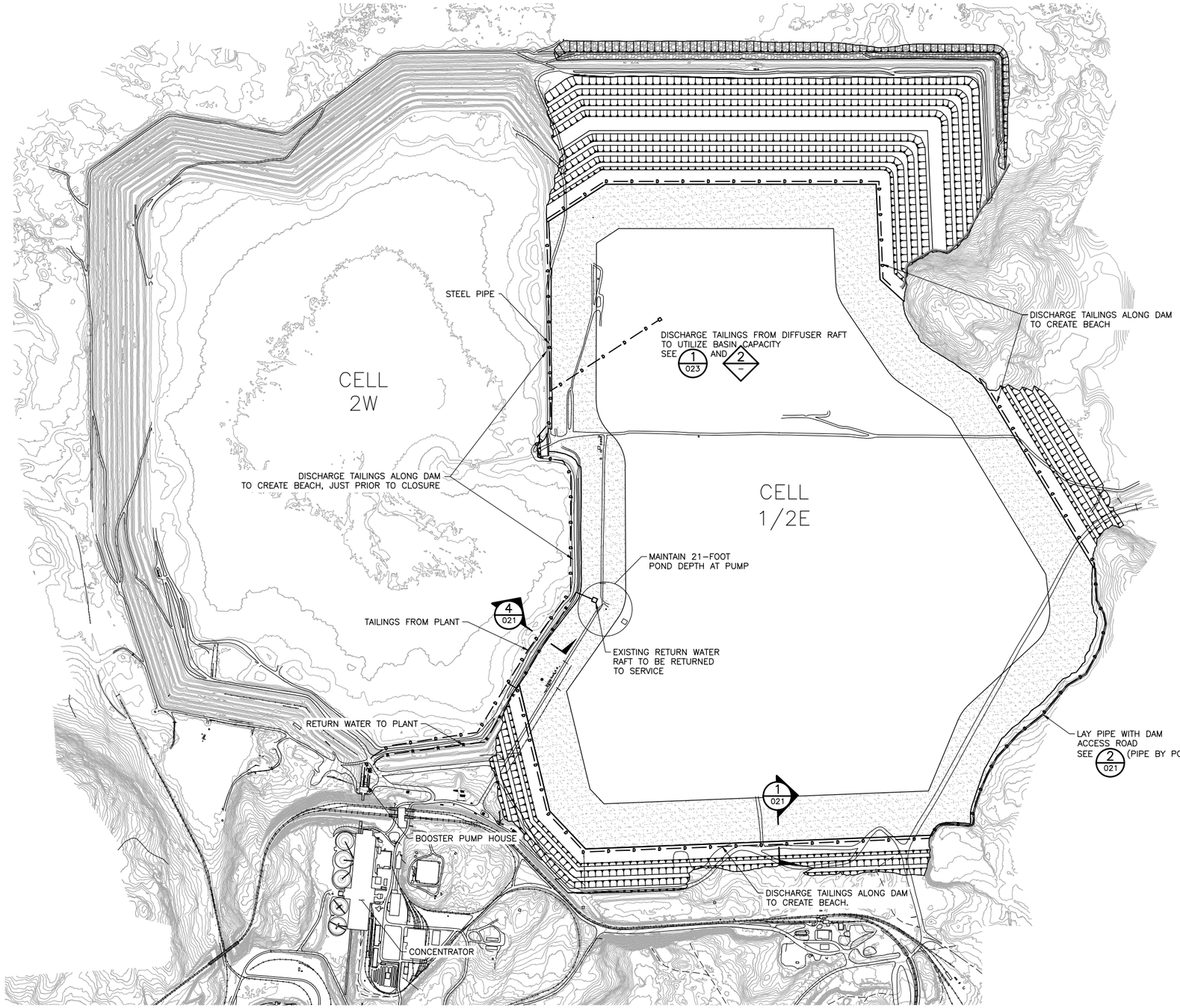
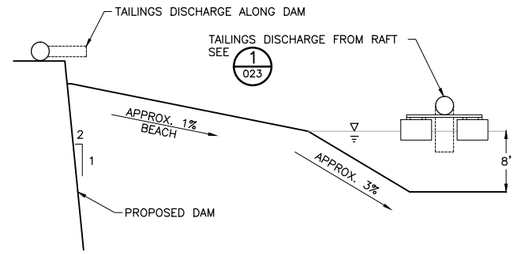
INCHES 1 2





2/– DETAIL: TAILINGS DISCHARGE ALONG DAM
NTS

1/– PLAN: PIPING LAYOUT CELL 1/2E
0 800 1600
SCALE IN FEET

NOTES:

1. PIPELINE LOCATIONS ARE PRELIMINARY.

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PIPING LAYOUT CELL 1/2E

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NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR

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4700 WEST 77TH STREET
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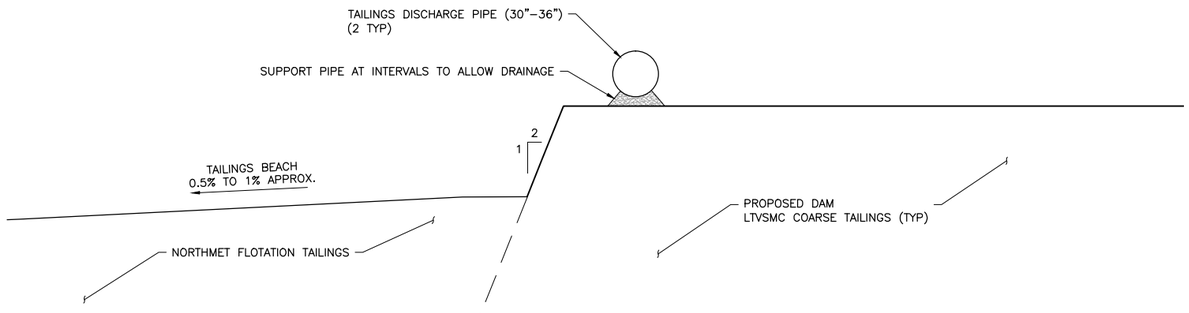
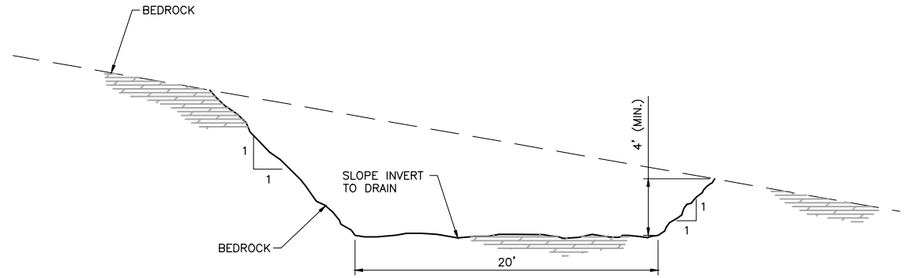
Ph: 1–800–632–2277

DWG. NO. FTB–020
REV

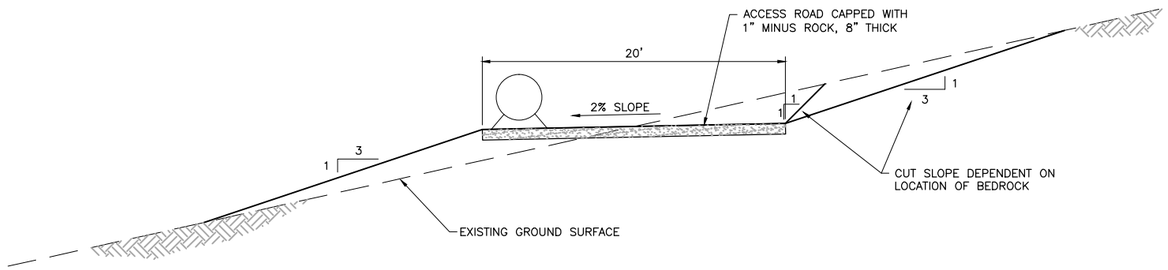
INCHES 1 2



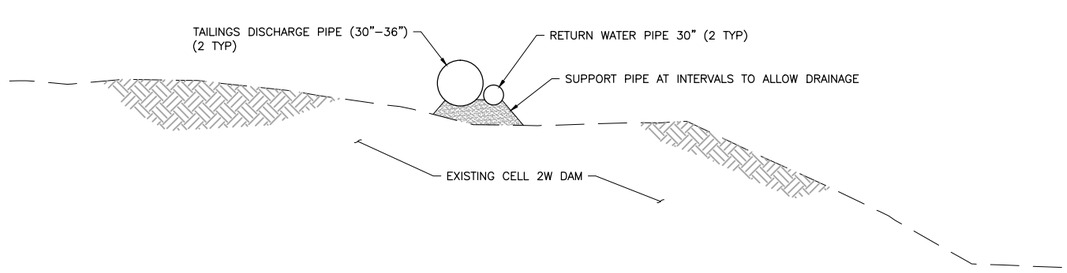
1 / 019 SECTION: TYPICAL PIPE LAYOUT
NTS



3 / 011 SECTION: CLOSURE EMERGENCY OVERFLOW
0 5 10
SCALE IN FEET



2 / 011,013,020 SECTION: DAM ACCESS ROAD
5 10
SCALE IN FEET



4 / 020 SECTION: TYPICAL RETURN PIPE LAYOUT
NTS

NOTES:

1. EMERGENCY OVERFLOW SIZING AND CONFIGURATION IS PRELIMINARY.
2. PIPELINE INFORMATION IS PRELIMINARY.
3. CONSTRUCT CLOSURE EMERGENCY OVERFLOW AT CLOSURE. OPERATIONS–PHASE EMERGENCY OVERFLOW TO BE MAINTAINED OR REMOVED AT OWNER'S DETERMINATION.
4. ALL PIPE SIZES SHOWN ARE PRELIMINARY.

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PLANT DRAWING NUMBER:

FLOTATION TAILINGS BASIN DETAILS

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

BARR ENGINEERING COMPANY
4700 WEST 77TH STREET
MINNEAPOLIS, MN.
Ph: 1–800–632–2277

DWG. NO. FTB–021 REV

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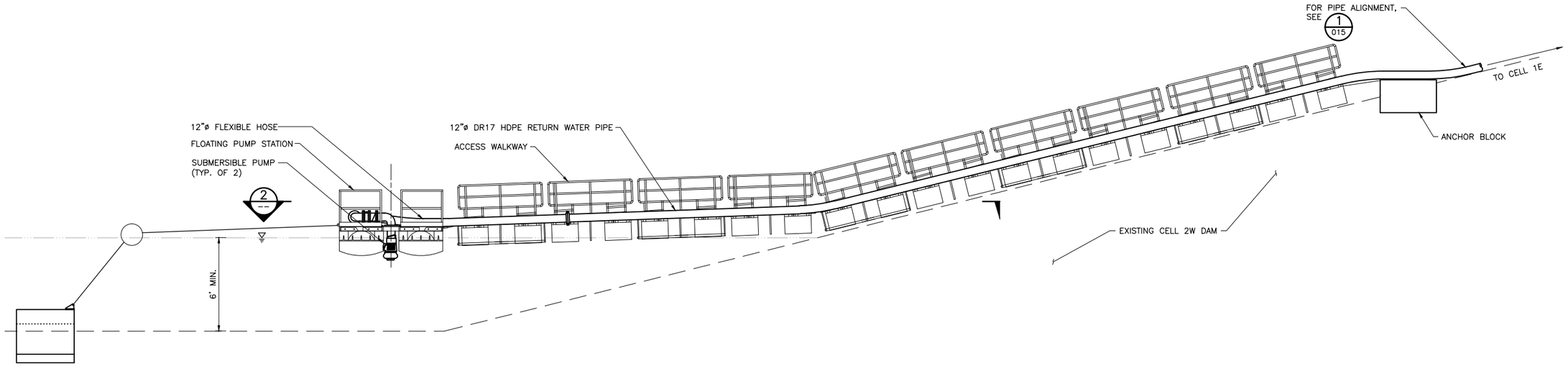
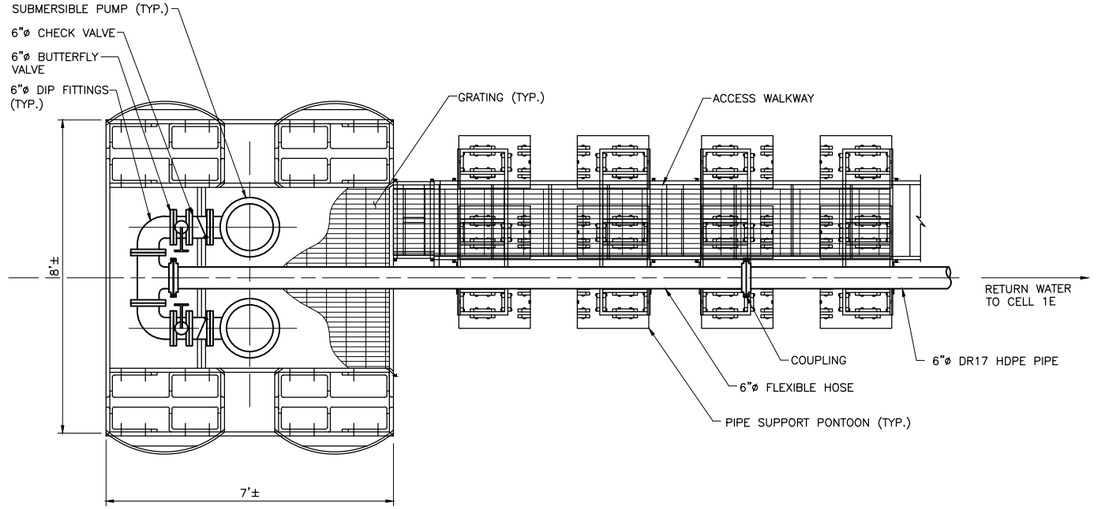


1/– ELEVATION: TRANSFER PUMP RAFT

0 2 4 6 8
SCALE IN FEET



2/– PLAN: TRANSFER PUMP RAFT

0 2 4
SCALE IN FEET

NOTES:

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SCALE: AS SHOWN

PLANT DRAWING NUMBER:

FLOTATION TAILINGS BASIN TRANSFER PUMP VENT

POLYMET MINING

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NORTHMET PROJECT
HOYT LAKES, MINNESOTA

BARR ENGINEERING COMPANY
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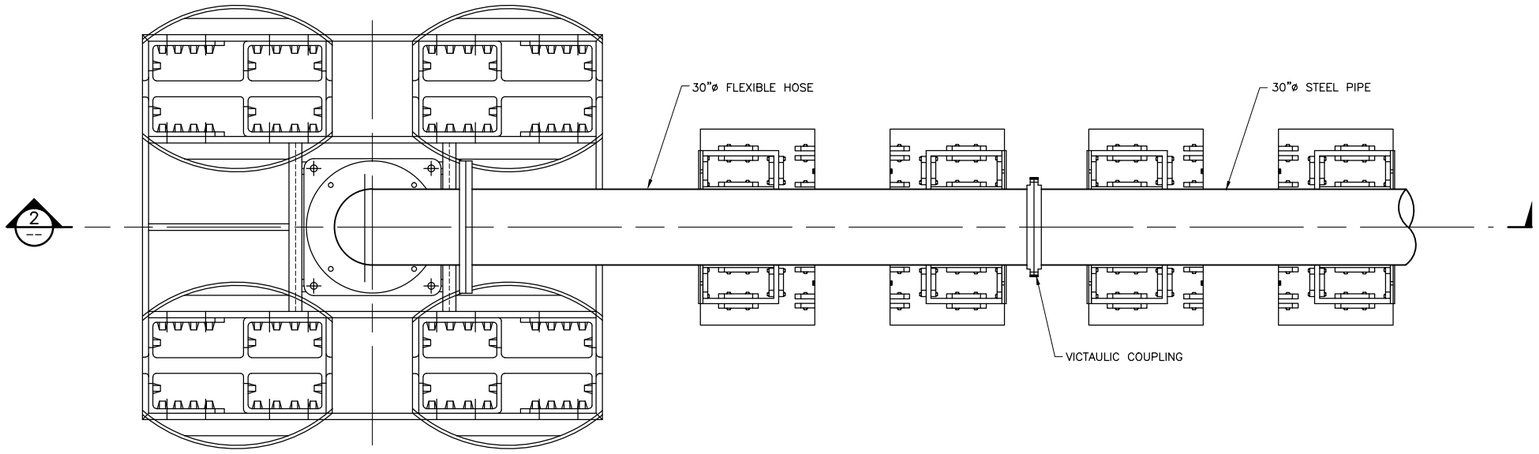
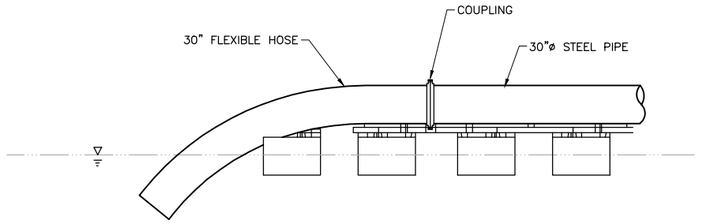
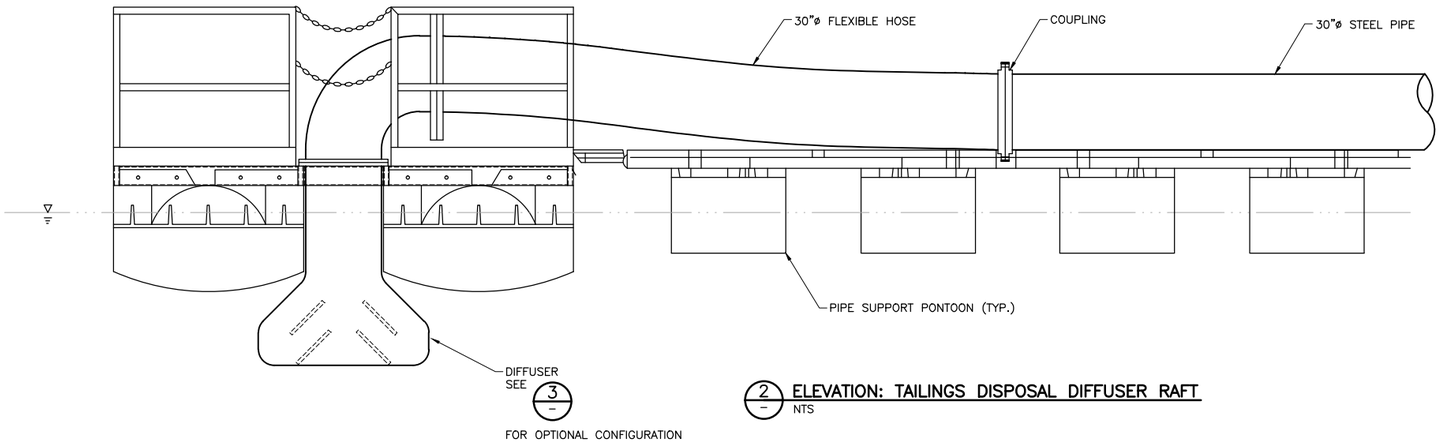
INCHES 1 2



1 PLAN: TAILINGS DISPOSAL DIFFUSER RAFT
NTS



3 ELEVATION: PIPE OPEN END OPTION
NTS



2 ELEVATION: TAILINGS DISPOSAL DIFFUSER RAFT
NTS

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FLOTATION TAILINGS BASIN
TAILINGS DISPOSAL DIFFUSER RAFT

POLYMET MINING

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NORTHMET PROJECT
HOYT LAKES, MINNESOTA

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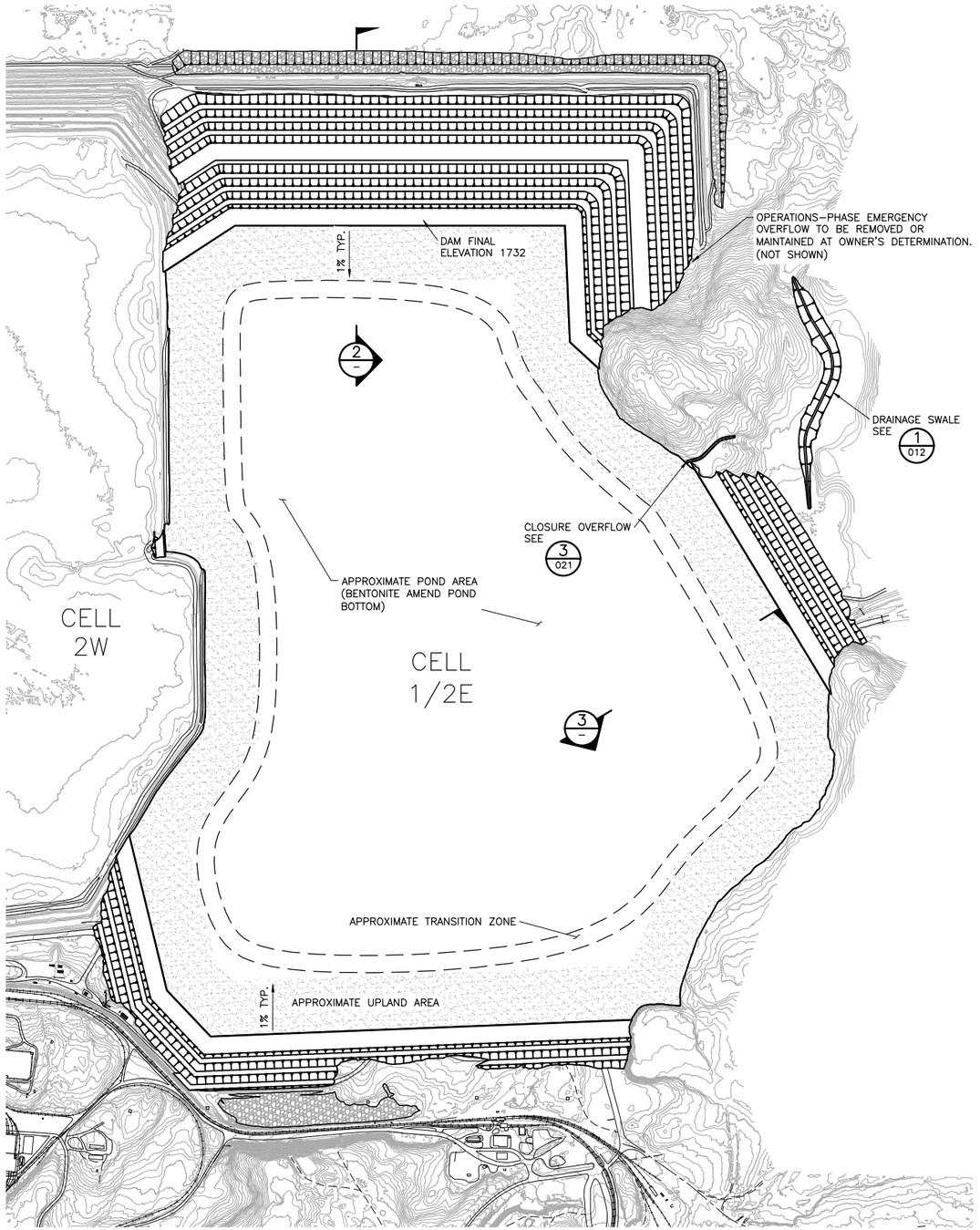
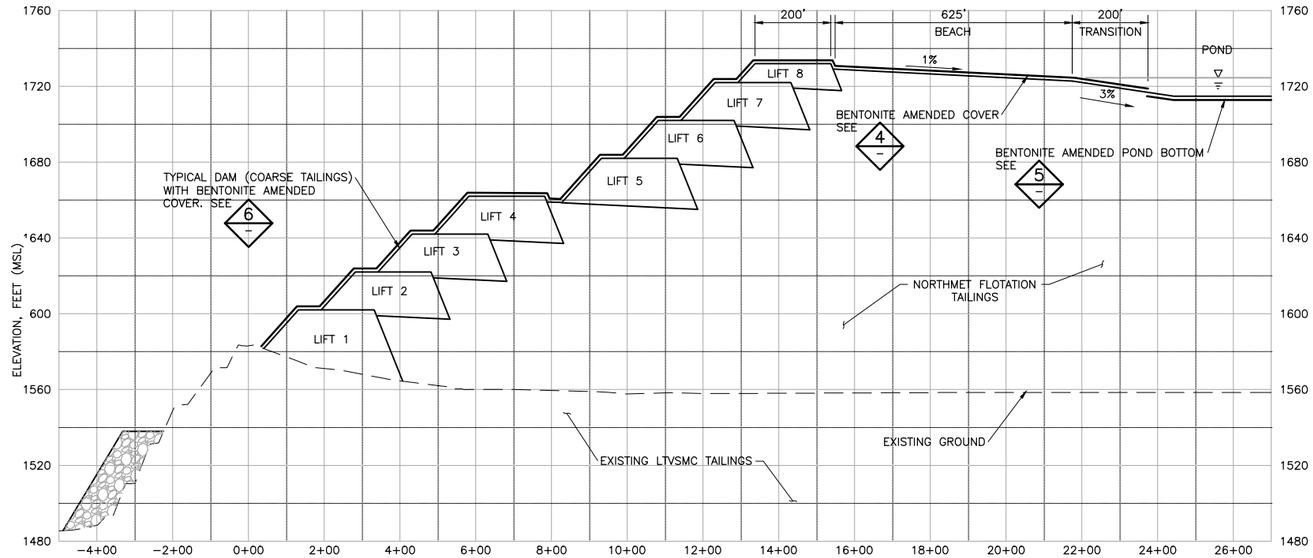


1/– PLAN: PROPOSED CLOSURE PLAN

0 800 1600

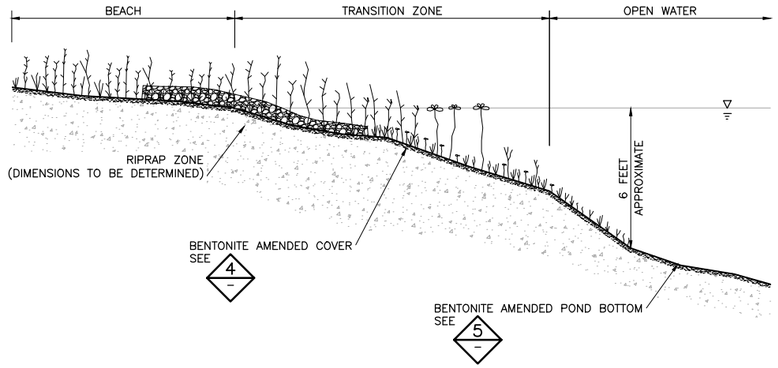
SCALE IN FEET



2/– SECTION: CELL 2E TAILINGS BASIN CLOSURE TYPICAL SECTION

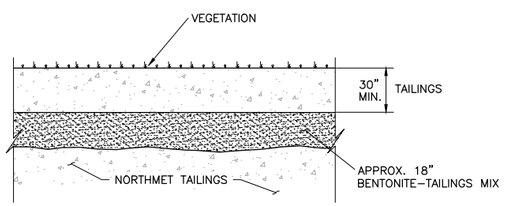
0 200 400

HORIZONTAL SCALE IN FEET



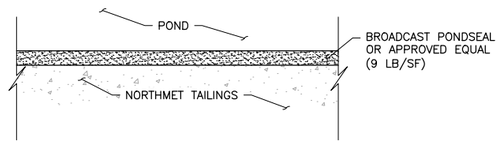
3/– SECTION: SCHEMATIC TAILINGS BASIN CLOSURE SURFACE

NTS



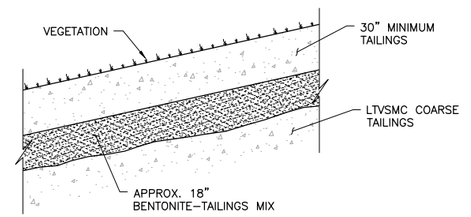
4/– DETAIL: BENTONITE AMENDED COVER

NTS



5/– DETAIL: BENTONITE AMENDED POND BOTTOM

NTS



6/– DETAIL: DAM SLOPE BENTONITE AMENDED COVER

NTS

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SCALE: AS SHOWN

PLANT DRAWING NUMBER:

FLOTATION TAILINGS BASIN CLOSURE PLAN

POLYMET MINING

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

BARR

BARR ENGINEERING COMPANY
4700 WEST 77TH STREET
MINNEAPOLIS, MN.
Ph: 1-800-632-2277

DWG. NO. FTB-024

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Appendix B

Chemical Additives Safety Data Sheets

Appendix B
Chemical Additives Safety Data Sheets

July 2016

Contents

CHARLES TENNANT & CO/CIE,
div of CHARLES TENNANT & CO (CANADA) LTD
34 CLAYSON RD., TORONTO, ONTARIO
M9M 2G8

PRODUCT: SODIUM ISOPROPYL XANTHATE

Section 01: CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MANUFACTURERS.....	SUPPLIED BY: CHARLES TENNANT & COMPANY 34 CLAYSON ROAD WESTON, ONTARIO M9M 2G8 (416) 741 9264
PRODUCT NAME	SODIUM ISOPROPYL XANTHATE
CHEMICAL NAME:.....	SEE SECTION 3 "HAZARDOUS INGREDIENTS " . SODIUM ISOPROPYL XANTHATE.
MATERIAL USE:.....	ORE PROCESSING.
CHEMICAL FAMILY:.....	SALTS OF CARBONIC ACID DITHIO ESTERS.
CHEMICAL FORMULA:.....	(CH3)2CHOCSSNa.
MOLECULAR WEIGHT:.....	NOT APPLICABLE.

Section 02: HAZARDS IDENTIFICATION

ROUTE OF ENTRY:.....	EYE, SKIN CONTACT, INHALATION, INGESTION.
SKIN CONTACT:.....	DUST OR VAPORS MAY BE IRRITATING.
SKIN ABSORPTION:.....	NOT AVAILABLE.
EYE	DUST OR VAPORS MAY IRRITATE. CAUSES EYE BURNS.
INHALATION	BREATHING DUST MAY IRRITATE THE NOSE AND THROAT AND CAUSE COUGHING AND CHEST DISCOMFORT.
INHALATION CHRONIC:.....	NOT AVAILABLE.
INGESTION:.....	CAN CAUSE GASTRO-INTESTINAL IRRITATION, NAUSEA, VOMITING AND DIARRHEA. CAN CAUSE UNCONSCIOUSNESS.
EFFECTS OF ACUTE EXPOSURE:.....	REFER TO ROUTE OF ENTRY.
EFFECTS OF CHRONIC EXPOSURE:.....	REFER TO ROUTE OF ENTRY.

Section 03: COMPOSITION/INFORMATION ON INGREDIENTS

Hazardous Ingredients	%	Exposure Limit	C.A.S.#	LD/50, Route,Species	LC/50 Route,Species
SODIUM ISOPROPYL XANTHATE	>84	NOT AVAILABLE	140-93-2	ORAL RAT 250-2000mg/ Kg	NOT AVAILABLE
SODIUM HYDROXIDE	1.5	2 mg/m3 (CEILING) ACGIH	1310-73-2	140 - 340 MG/KG RAT ORAL	NOT AVAILABLE
ISOPROPANOL	0.5-1.0	400 ppm	67-63-0	ORAL RAT 5045 mg/kg DERMAL RABBIT 8.00 ml/kg	RAT 12000 ppm/8h
SODIUM SULFIDE	1				

Section 04: FIRST AID MEASURES

SKIN:.....	REMOVE ALL CONTAMINATED CLOTHING. WASH SKIN AREAS FOR 20 MINUTES OR UNTIL CHEMICAL IS REMOVED WITH SOAP AND WATER. DO NOT USE SOLVENTS. LAUNDER CLOTHES BEFORE RE-USE.
EYE:.....	FLUSH CONTINUOUSLY WITH WATER FOR 15 MINUTES. FORCIBLY HOLD EYELIDS APART TO ENSURE IRRIGATION OF ALL EYE TISSUE. IF IRRITATION PERSISTS GET MEDICAL ATTENTION.
INHALATION:.....	REMOVE TO FRESH AIR. GIVE ARTIFICIAL RESPIRATION, OR CARDIOPULMONARY RESUSCITATION (CPR) IF REQUIRED. IF BREATHING IS DIFFICULT, GIVE OXYGEN. KEEP WARM AND QUIET, AND OBTAIN MEDICAL ATTENTION.
INGESTION:.....	IF CONSCIOUS:. GIVE A MINIMUM OF 500 ml WATER. INDUCE VOMITING. HAVE VICTIM RINSE MOUTH THOROUGHLY WITH WATER. IF VOMITING OCCURS NATURALLY, HAVE VICTIM LEAN FORWARD TO REDUCE RISK OF ASPIRATION. DO NOT GIVE AN UNCONSCIOUS PERSON ANYTHING BY MOUTH. SEEK IMMEDIATE MEDICAL ATTENTION.
NOTES TO PHYSICIAN:.....	THERE IS NO SPECIFIC ANTIDOTE. TREATMENT OF EXPOSURE SHOULD BE DIRECTED AT THE CONTROL OF SYMPTOMS AND THE CLINICAL CONDITION OF THE PATIENT.

PRODUCT: SODIUM ISOPROPYL XANTHATE

Section 04: FIRST AID MEASURES

GENERAL ADVICE:.....	CONSULT A PHYSICIAN AND/OR THE NEAREST POISON CONTROL CENTRE FOR ALL BUT MINOR INSTANCES OF INHALATION OR SKIN CONTACT. AVOID HIGH LEVELS OF DUST, USE DUST MASK OR RESPIRATOR WHEN NECESSARY. PRECAUTIONS SHOULD ALWAYS BE TAKEN TO AVOID SKIN/EYE CONTACT WITH ANY CHEMICAL SUBSTANCE.

Section 05: FIRE FIGHTING MEASURES

FLAMMABLE LIMITS IN AIR.....	NOT AVAILABLE.
IF YES, UNDER WHICH CONDITIONS?.....	SOLID XANTHATES WHEN EXPOSED TO HEAT AND/OR MOISTURE CAUSES DECOMPOSITION, AND VAPOURS ARE VERY FLAMMABLE AND SPONTANEOUS COMBUSTION CAN RESULT.
MEANS OF EXTINCTION:.....	CARBON DIOXIDE. DRY CHEMICAL. WATER.
SPECIAL PROCEDURES:.....	SELF-CONTAINED, POSITIVE PRESSURE BREATHING APPARATUS AND PROPER PROTECTIVE CLOTHING SHOULD BE WORN IN FIGHTING FIRES INVOLVING ANY CHEMICAL SUBSTANCE. HEAT WILL DECOMPOSE BOTH SOLID AND LIQUID XANTHATES YIELDING CARBON DISULPHIDE WHICH IS EXTREMELY FLAMMABLE AND TOXIC.
FLASH POINT, F, COC.....	NOT APPLICABLE. -30 oC FOR CARBON DISULPHIDE VAPOURS.
AUTO IGNITION TEMPERATURE °C:.....	NOT AVAILABLE.
T.D.G. FLAMMABLE CLASS:.....	CLASS 4.2, SELF-HEATING SUBSTANCES.
UPPER EXPLOSION LIMIT:.....	50% (RESIDUAL CARBON DISULPHIDE).
LOWER EXPLOSION LIMIT:.....	1.25% (RESIDUAL CARBON DISULPHIDE).
HAZARDOUS COMBUSTION PRODUCTS	
EXPLOSION DATA:	
SENSITIVITY TO STATIC DISCHARGE:	
SENSITIVITY TO IMPACT:.....	NOT AVAILABLE.
RATE OF BURNING:.....	NOT AVAILABLE.
EXPLOSIVE POWER:.....	NOT AVAILABLE.

Section 06: ACCIDENTAL RELEASE MEASURES

CLEAN-UP PROCEDURES, LEAK/SPILL:...	IF IN THE LIQUID STATE:. STOP SPILL AT SOURCE. CONTAIN ANY SPILLED MATERIAL TO PREVENT DISCHARGE INTO THE ENVIRONMENT. ELIMINATE ALL SOURCES OF IGNITION. PERSONS NOT WEARING PROTECTIVE EQUIPMENT SHOULD BE EXCLUDED FROM THE AREA. ABSORB WITH INERT DRY MATERIAL. PUT INTO AN APPROVED METAL SALVAGE DRUM FOR DISPOSAL. IF IN THE SOLID STATE:. ELIMINATE ALL SOURCES OF IGNITION. RESTRICT ACCESS TO AREA UNTIL COMPLETION OF CLEAN-UP. ENSURE CLEAN-UP IS CONDUCTED BY TRAINED PERSONNEL ONLY. DO NOT TOUCH SPILLED MATERIAL. DO NOT USE WATER ON SPILLED MATERIAL AS HEAT WILL BE GENERATED. PUT SPILLED MATERIAL INTO APPROVED SALVAGE DRUMS FOR DISPOSAL. FLUSH CLEANED AREA WITH WATER, MAKING SURE NO WATER ENTERS XANTHATE CONTAINERS.

Section 07: HANDLING AND STORAGE

STORAGE NEEDS:.....	STORE SOLID XANTHATES UNDER COOL, DARK, DRY CONDITIONS. LIQUID PRODUCTS MUST BE KEPT COOL AND USED AS QUICKLY AS POSSIBLE.
HANDLING PROCEDURES AND ..... EQUIPMENT:	AVOID ALL SKIN CONTACT. AVOID CONTACT WITH EYES. AVOID BREATHING VAPOURS. EQUIPMENT SHOULD BE GROUNDED TO AVOID STATIC DISCHARGE. KEEP AWAY FROM HEAT, SPARKS, AND OPEN FLAME. USE NON-SPARKING TOOLS AND DO NOT SMOKE.
SPECIAL SHIPPING INSTRUCTIONS.....	USE PRECAUTION WHEN HANDLING OR SHIPPING ANY CHEMICAL SUBSTANCE. PROTECT AGAINST PHYSICAL DAMAGE.

Section 08: EXPOSURE CONTROLS/PERSONAL PROTECTION

PROTECTIVE EQUIPMENT:	
GLOVES/TYPE:.....	WEAR IMPERVIOUS GLOVES (E.G. NEOPRENE, RUBBER).
RESPIRATOR/TYPE:.....	IF RESPIRATORY PROTECTION IS REQUIRED, INSTITUTE A COMPLETE RESPIRATORY PROTECTION PROGRAM INCLUDING SELECTION, FIT TESTING, TRAINING, MAINTENANCE AND INSPECTION. REFER TO THE CAS STANDARD Z94.4-M1982 "SELECTION, CARE, AND USE OF RESPIRATORS" WHICH IS AVAILABLE FROM CANADIAN STANDARDS ASSOCIATION, REXDALE ONTARIO, M9W 1R3. IF VAPOURS ARE PRESENT, USE A NIOSH OR MSHA APPROVED RESPIRATOR FOR ACIDIC VAPOURS OR A SELF CONTAINED BREATHING APPARATUS. SEE M.S.D.S FOR MORE DETAIL ON THIS SECTION.
EYE/TYPE:.....	FACE SHIELD. SAFETY GLASSES WITH SIDE-SHIELDS.
FOOTWEAR/TYPE:.....	SAFETY BOOTS.
CLOTHING/TYPE:.....	WEAR ADEQUATE PROTECTIVE CLOTHES.
OTHER/TYPE:.....	AN EYE WASH STATION AND SAFETY SHOWER SHOULD BE NEAR THE WORK AREA.

PRODUCT: SODIUM ISOPROPYL XANTHATE

Section 08: EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS:.....	EXPLOSION PROOF MECHANICAL VENTILATION TO LIMIT VAPOUR CONCENTRATION BELOW T.L.V.

Section 09: PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE:.....	SOLID.
ODOUR/APPEARANCE:.....	YELLOW TO YELLOW-GREEN.
ODOUR THRESHOLD:.....	NOT AVAILABLE.
VAPOUR PRESSURE:.....	NOT APPLICABLE.
REL. VAPOUR DENSITY.....	NOT APPLICABLE.
% VOLATILE:	
BY VOLUME.....	< 20.
BY WEIGHT	
EVAPORATION RATE:.....	NOT APPLICABLE.
BOILING POINT °C:.....	NOT APPLICABLE. M.P. 150 - 250 (decomposes).
FREEZING POINT °C:.....	>182 Deg C.
pH:.....	10% H2O 13 +/- 1.
SPECIFIC GRAVITY:.....	1.263.
SOLUBILITY IN WATER (20 °C):.....	SOLUBLE.
COEFFICIENT WATER/OIL DIST.:.....	NOT AVAILABLE.

Section 10: STABILITY AND REACTIVITY

CHEMICAL STABILITY:	
YES.	
NO, WHICH CONDITIONS?	
COMPATIBILITY WITH OTHER SUBSTANCES:	
YES.	
NO, WHICH ONES?.....	STRONG ACIDS. OXIDIZING AGENTS.
REACTS VIOLENTLY WITH.....	VAPORS OR DUSTS MAY EXPLODE.
DECOMPOSITION:.....	CARBON DISULPHIDE. TRITHIOCARBONATE. ISOPROPYL ALCOHOL.

Section 11: TOXICOLOGICAL INFORMATION

ACUTE ORAL TOXICITY.....	NOT AVAILABLE. SEE SECTION 3, HAZARDOUS INGREDIENTS.
LC 50 OF MATERIAL, SPECIES & ROUTE:.	NOT AVAILABLE. SEE SECTION 3, HAZARDOUS INGREDIENTS.
EXPOSURE LIMIT OF MATERIAL:.....	TLV FOR DUST: 2 mg/m3; TLV FOR VAPOURS FROM DECOMP.: 31 mg/m3 (see ACGIH).
IRRITANCY OF MATERIAL:.....	IRRITANT. REFER TO ROUTE OF ENTRY, SECTION 3.
SENSITIZING CAPABILITY OF MATERIAL:	NOT AVAILABLE.
CARCINOGENICITY OF MATERIAL:.....	NOT AVAILABLE.
REPRODUCTIVE EFFECTS:	
REPRODUCTIVE TOXICITY:.....	NOT AVAILABLE.
MUTAGENICITY:.....	NOT AVAILABLE.
TERATOGENICITY & EMBRYOTOXICITY:..	NOT AVAILABLE.
SYNERGISTIC MATERIALS:.....	NOT AVAILABLE.
MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE:	MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE TO THIS PRODUCT HAVE NOT BEEN ESTABLISHED. UNNECESSARY EXPOSURE TO THIS PRODUCT OR ANY OTHER CHEMICAL SHOULD BE AVOIDED.

Section 12: ECOLOGICAL INFORMATION

BIODEGRADABILITY.....	NOT AVAILABLE.
ENVIRONMENTAL.....	NOT AVAILABLE. DO NOT ALLOW TO ENTER SOIL, WATERWAYS OR WASTE WATER. THIS PRODUCT MAY BE HARMFUL TO AQUATIC LIFE. .

Section 13: DISPOSAL CONSIDERATIONS

WASTE DISPOSAL, METHOD AND EQUIPMENT:	ALL WASTE FROM THIS PRODUCT INCLUDING ALL EMPTY CONTAINERS MUST BE DISPOSED OF IN ACCORDANCE WITH MUNICIPAL, PROVINCIAL AND FEDERAL REGULATIONS.

Section 14: TRANSPORT INFORMATION

T.D.G. CLASSIFICATION:.....	CLASS 4.2 UN 3342 P.G. II.
T.D.G. SHIPPING NAME:.....	XANTHATES.
T.D.G. SHIPPING INFORMATION:.....	THE DANGEROUS GOODS ARE DESCRIBED IN ACCORDANCE WITH THE UN RECOMMENDATIONS.

PRODUCT: SODIUM ISOPROPYL XANTHATE

Section 15: REGULATORY INFORMATION

WHMIS CLASSIFICATION:.....	CLASS B DIV. 6. CLASS D DIV. 1 SUB. B.
CPR COMPLIANCE.....	THIS PRODUCT HAS BEEN CLASSIFIED IN ACCORDANCE WITH THE HAZARD CRITERIA OF THE CPR AND THE MSDS CONTAINS ALL OF THE INFORMATION REQUIRED BY THE CPR.

Section 16: OTHER INFORMATION

MANUFACTURERS MSDS DATE:.....	JULY 22, 2010.
MSDS REVISION DATE:.....	JULY 24, 2013.
NOTES:.....	The information on this Material Safety Data Sheet has been obtained from the manufacturer, and where applicable, from other reliable sources such as CCOHS and RTECS. However, CHARLES TENNANT & COMPANY (CANADA) LTD. makes no warranties, expressed or implied, as to the accuracy, completeness or accuracy of the information contained herein, and shall not held liable (regardless of fault) to anyone directly or indirectly for damages or injuries in the use of this product arising out of or in connection with the accuracy, completeness or adequacy of such information. To promote safe handling, each customer or recipient should: (1) notify its employees, agents, contractors and others whom it knows or believes will use this material of the information in this MSDS and any other information regarding hazards or safety, (2) furnish this same information to each of its customers for the product; and (3) requests its customers to notify their employees, customers, and other users of the product of this information.
PREPARED BY	Regulatory Affairs
PREPARATION DATE	Jul24/13

Maximizing the Value of Flotation Chemicals Technology

Flottec, LLC

338 West Main Street

Boonton, New Jersey, USA 07005

TEL: +1.973.588.4717 • FAX: 1.973.588.4719

PROPER SHIPPING NAME:

XANTHATES

TECHNICAL NAME:

SODIUM ISOPROPYL XANTHATE

ID No./HAZARD CLASS/PACKING GROUP/LABELS:

UN3342 / 4.2 / II / SPONTANEOUSLY COMBUSTIBLE

HMIS RATINGS

Flottec SIPX Collector		KEY
HEALTH	2	4 = Severe
FLAMMABILITY	2	3 = Serious
REACTIVITY	2	2 = Moderate
PERSONAL PROTECTION		1 = Slight
See Material Safety Data Sheet		0 = Minimal

C.A.S. No.	Component
140-93-2	Carbonodithioic acid, O-Isopropyl ester, sodium salt
1310-73-2	Sodium hydroxide
1310-73-8	Sodium sulfide

Flottec SIPX Collector

WARNING: BEFORE HANDLING YOU MUST READ AND UNDERSTAND THE MATERIAL SAFETY DATA SHEET FOR THIS PRODUCT. DO NOT DISPOSE OF THIS MATERIAL NOR THE EMPTY CONTAINER IN THE ENVIRONMENT. AVOID CONTACT WITH SKIN AND EYES, MAY CAUSE IRRITATION. WEAR CHEMICAL GOGGLES.

CAUTION: AVOID BREATHING VAPOR. USE ADEQUATE VENTILATION. WEAR SPLASH GOGGLES, FACE SHIELD, LONG SLEEVE SHIRT AND TROUSERS. WASH THOROUGHLY AFTER HANDLING. DO NOT WEAR CONTAMINATED CLOTHING.

FIRST AID: IF INHALED, REMOVE PERSON TO FRESH AIR. IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES. CALL A PHYSICIAN. WASH EXPOSED SKIN AREAS WITH SOAPY WATER. LAUNDER CONTAMINATED CLOTHING BEFORE REUSE.

STORAGE: HEATING OR OVEREXPOSURE TO MOISTURE OF SOLID XANTHATES OR HEATING OR AGING OF XANTHATE SOLUTIONS CAUSES SOME DECOMPOSITION TO POISONOUS AND FLAMMABLE CARBON DISULFIDE. STORAGE TANKS SHOULD HAVE CERTAIN DESIGN FEATURES FOR MAXIMUM SAFETY, AND THE VAPOR SPACE SHOULD BE FREE OF SOURCES OF IGNITION.

FIRE FIGHTING: USE CARBON DIOXIDE, DRY CHEMICAL, OR FOAM TO EXTINGUISH FIRES. AS IN ANY FIRE, WEAR SELF-CONTAINED BREATHING APPARATUS, POSITIVE PRESSURE, MSHA/NIOSH (APPROVED OR EQUIVALENT) AND FULL PROTECTIVE GEAR.

SPILL CONTROL: SWEEP UP INTO CONTAINERS FOR DISPOSAL. FLUSH SPILL AREA WITH WATER. USE APPROPRIATE CONTAINMENT TO AVOID ENVIRONMENTAL CONTAMINATION.

ATTENTION

EMPTY CONTAINERS MAY CONTAIN PRODUCT RESIDUE INCLUDING FLAMMABLE OR EXPLOSIVE VAPOR. DO NOT CUT, PUNCTURE OR WELD ON CONTAINER. ALL LABEL WARNINGS SHOULD BE OBSERVED UNTIL CONTAINER HAS BEEN THOROUGHLY CLEANED OR DESTROYED, COMPLYING WITH LOCAL, STATE AND FEDERAL REGULATIONS.

GROSS Wt.	lbs. or kgs.
TARE Wt.	lbs. or kgs.
NET Wt.	lbs. or kgs.
LOT No.	Insert Here

IN CASE OF EMERGENCY CALL

Chemtrec: North America 1.800.424.9300, International +1.703.527.3887

Maximizing the Value of Flotation Chemicals Technology

MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME:	Flottec PAX Collector
SYNONYMS:	Potassium Amyl Xanthate, Potassium Isoamyl Xanthate
CHEMICAL FAMILY:	Alkyl xanthate salt
MOLECULAR FORMULA:	C6H12OS2K
MOLECULAR WEIGHT	203.4
MANUFACTURER:	Flottec, LLC • 338 West Main Street • Boonton, New Jersey 07005 • USA
PRODUCT INFORMATION:	Tel: +1.973.588.4717 • Fax: +1.973.588.4719 • Web Site: www.flottec.com
EMERGENCY PHONE:	CHEMTREC • North America: +1.800.424.9300 • International: +1.703.527.3887
ISSUE DATE:	February 29, 2012

2. COMPOSITION/INFORMATION ON INGREDIENTS

OSHA REGULATED COMPONENTS

COMPONENT	CAS No.	% (w/w)	OSHA (PEL)	ACGIH (TLV)	Carcinogen
Potassium sulfide	1312-73-8	~ 1	Not established	Not established	-
Carbonodithioic acid, O-(3-methylbutyl) ester, potassium salt	1928-70-1	> 90	Not established	Not established	-
Potassium hydroxide	1310-58-3	0 - 1	2 mg/m^3 (Ceiling)	2 mg/m^3 (Ceiling)	-

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

APPEARANCE AND ODOR

Color: Yellow-green
Appearance: Pellets, flakes, or powder
Odor: Disagreeable

STATEMENT OF HAZARD

DANGER!

SELF-HEATING MATERIAL
MAY BE SPONTANEOUSLY COMBUSTIBLE
MAY FORM EXPLOSIVE DUST-AIR MIXTURES
HARMFUL IF ABSORBED THROUGH SKIN
DUST IRRITATING
CAUSES EYE AND SKIN IRRITATION

POTENTIAL HEALTH EFFECTS

EFFECTS / ROUTES OF EXPOSURE

The acute oral (rat) LD50 and dermal (rabbit) LD50 values are estimated to be >1,000 mg/kg and >500 mg/kg, respectively. Skin or eye contact with solutions of this product may cause moderate skin and eye irritation. Airborne dust may cause significant eye, skin or respiratory tract irritation. Refer to Section 11 for toxicology information on the regulated components of this product.

4. FIRST AID MEASURES

INGESTION:	If swallowed, call a physician immediately. Only induce vomiting at the instruction of a physician. Never give anything by mouth to an unconscious person.
SKIN CONTACT:	Remove contaminated clothing and shoes without delay. Wash immediately with plenty of water. Do not reuse contaminated clothing without laundering. Get medical attention if pain or irritation persists after washing or if signs and symptoms of overexposure appear.
EYE CONTACT:	Rinse immediately with plenty of water for at least 15 minutes. Obtain medical attention immediately.
INHALATION:	Remove to fresh air. If breathing is difficult, give oxygen. Obtain medical advice if there are persistent symptoms.

5. FIREFIGHTING MEASURES.

EXTINGUISHING MEDIA AND FIRE FIGHTING INSTRUCTIONS

Extinguishing Media:	Use carbon dioxide, dry chemical or large quantities of water.
Protective Equipment:	Firefighters, and others exposed, wear self-contained breathing apparatus. Wear full firefighting protective clothing. See MSDS Section 8 (Exposure Controls/Personal Protection).
Special Hazards:	Solid xanthates are stable when kept cool and dry. Exposure to heat and moisture can cause decomposition to flammable and explosive vapor of carbon disulfide. Since xanthates decompose in solution, even at room temperature, fire and explosion hazards can develop with aging.

6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS:	Where exposure level is not known, wear approved, positive pressure, self-contained respirator. Where exposure level is known, wear approved respirator suitable for level of exposure. Refer to Section 8 (Exposure Controls/Personal Protection) for appropriate personal protective equipment.
METHODS FOR CLEAN UP:	Sweep up into containers for disposal. Flush spill area with water.
ENVIRONMENTAL PRECAUTIONS:	Dispose of in accordance with EPA rules and regulations.

7. HANDLING AND STORAGE

HANDLING

Precautionary Measures :	Avoid excessive heat or moisture. Avoid contact with eyes, skin and clothing. Avoid breathing dust. Keep container closed. Wash thoroughly after handling. Use non-sparking tools and do not smoke when opening drum. Use with adequate ventilation. Contains finely divided material. Dust suspended in air may ignite with static discharge, sparks or flame. Equipment, including venting systems, should be grounded. Provide adequate ventilation in areas of use to remove dust. Wash contaminated clothing before reuse□
Special Handling Statements :	Minimize dust. Special precautions against fire and explosion must be observed in (1) pumping xanthate solutions, (2) draining mobile tanks, (3) cleaning mobile tanks, and (4) performing maintenance work on storage tanks and pipelines leading to and from tanks. Use non-sparking tools and do not smoke when opening drums of xanthate. DUST EXPLOSION HAZARD CLASS - 2 Handling of material should be in accordance with standards for venting of deflagrations (e.g. NFPA-68). If handled with flammable or combustible materials the explosion hazard may increase
STORAGE	Heating or overexposure to moisture of solid xanthates or heating or aging of xanthate solutions causes some decomposition to poisonous and flammable carbon disulfide. Storage tanks should have certain design features for maximum safety, and the vapor space should be free of sources of ignition.
Storage Temperature:	Store at <32.2 - 10 °C 90 - 50 °F **Reason:** Safety

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

ENGINEERING MEASURES:	Where this material is not used in a closed system, good enclosure and local exhaust ventilation should be provided to control exposure.

PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY PROTECTION:	Where exposures are below the established exposure limit, no respiratory protection is required. Where exposures exceed the established exposure limit, use respiratory protection recommended for the material and level of exposure.
EYE PROTECTION:	Wear eye/face protection such as chemical splash proof goggles or face shield. Eyewash equipment and safety shower should be provided in areas of potential exposure.
SKIN PROTECTION:	Avoid skin contact. Wear impermeable gloves and suitable protective clothing.
ADDITIONAL ADVICE:	Food, beverage and tobacco products should not be carried, stored or consumed where this material is used. Before eating, drinking, or smoking, wash face and hands with soap and water.

9. PHYSICAL AND CHEMICAL PROPERTIES

COLOR:	Yellow-green
APPEARANCE:	Pellets, flakes, or powder
ODOR:	Disagreeable
BOILING POINT:	Not applicable
MELTING POINT:	491 - 536°F; 255 - 280°C
VAPOR PRESSURE:	Not applicable
SPECIFIC GRAVITY:	Not available
VAPOR DENSITY:	Not applicable
% VOLATILE (BY WT.):	~ 1.5
pH:	Not applicable
SATURATION IN AIR (% by Vol):	Not applicable
EVAPORATION RATE:	Not applicable
SOLUBILITY IN WATER:	35 g/100 g at 20°C
VOLATILE ORGANIC CONTENT:	Not available
FLASH POINT:	Not applicable
FLAMMABLE LIMITS (% BY VOL.):	Not applicable
AUTO IGNITION TEMPERATURE:	>248°F; 120°C (value for carbon disulfide)
DECOMPOSITION TEMPERATURE:	>267.8 - 536°F; 131 - 280°C
PARTIAL COEFFICIENT (n-octanol/water):	Not available
ODOR THRESHOLD:	See Section 2 for exposure limits

10. STABILITY AND REACTIVITY

STABILITY:	Stable
CONDITIONS TO AVOID:	Containers filled with this product should be kept closed when not in use. Keep container in a cool, well-ventilated area. Exposure of the solid xanthate to heat or moisture and heating or aging of xanthate solutions. Avoid prolonged exposure to heat; avoid strong acids, alkalies and oxidizing agents. Keep water and moist air out of container.
POLYMERIZATION:	Will not occur
CONDITIONS TO AVOID:	None known
MATERIALS TO AVOID:	Strong oxidizing agents, acidic material. High temperatures
HAZARDOUS DECOMPOSITION PRODUCTS:	Carbon disulfide, carbon monoxide, carbon dioxide, oxides of sulfur (includes sulfur di and tri oxides), hydrogen sulfide

11. TOXICOLOGICAL INFORMATION

Toxicological information for the product is found under SECTION 3: HAZARDS IDENTIFICATION
Toxicological information on the regulated components of this product is as follows:

Potassium hydroxide has an acute oral (rat) LD50 value of 273 mg/kg. Acute overexposure to potassium hydroxide or dusts causes severe respiratory irritation. Potassium hydroxide is severely irritating to the eyes and skin.

Potassium sulfide may cause eye and skin irritation. Under acidic conditions, potassium sulfide can decompose to produce flammable poisonous hydrogen sulfide gas.

Potassium 3 methyl butyl xanthate has an estimated acute oral (rat) LD50 and acute dermal (rabbit) LD50 values of > 1,000 mg/kg and > 500 mg/kg, respectively, based on similar materials. Direct contact with this material may cause moderate eye and skin irritation. Airborne dust may cause significant eye, skin or respiratory tract irritation.

California Proposition 65 Warning (applicable in California only) - This product contains (a) chemical(s) known to the State of California to cause birth defects or other reproductive harm.

12. ECOLOGICAL INFORMATION

Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
This material is not readily biodegradable.
All ecological information provided was conducted on a structurally similar product.

ALGAE TEST RESULTS

Test	Duration	Procedure	Species	Results	

FISH TEST RESULTS

Test	Duration	Procedure	Species	Results	
Acute toxicity, freshwater (OECD 203)	96 hr.	-	Rainbow Trout (Oncorhyncus mykiss)	> 10 – 100 mg/l	LC50

INVERTEBRATE TEST RESULTS

Test	Duration	Procedure	Species	Results	
Acute Immobilization (OECD 202)	48 hr.	-	Water Flea (Daphnia magna)	>1 - 10 mg/l	EC50

ACCUMULATION TEST RESULTS

Test	Duration	Procedure	Species	Results	

DEGRADATION

Test	Duration	Procedure	Results
Biodegradability	-	-	< 70 %
COMMENTS:	Information based on structurally similar material		

13. DISPOSAL CONSIDERATIONS

RECOMMENDATIONS FOR THE PRODUCT:	In accordance with regulations for special waste, product must be taken, after pretreatment, to an authorized special waste incineration plant.
RECOMMENDATIONS FOR PACKAGING:	Packaging that cannot be cleaned should be disposed of like the product.
RECOMMENDED CLEANSING AGENT:	Water

14. Transportation Information

This section provides basic shipping classification information.
Refer to appropriate transportation regulations for specific requirements.

U.S. DOT				
PROPER SHIPPING NAME:	XANTHATES			
HAZARD CLASS	4.2			
PACKING GROUP:	II			
UN/ID NUMBER:	UN3342			
TRANSPORT LABEL REQUIRED:	Spontaneously Combustible Marine Pollutant			
TECHNICAL NAME (N.O.S.):	Contains potassium amyl xanthate			
HAZARDOUS SUBSTANCE:	Not applicable			
COMMENTS:	Marine Pollutants - DOT requirements specific to Marine Pollutants do not apply to non-bulk packagings transported by motor vehicles, rail cars or aircraft.			
TRANSPORT CANADA				
PROPER SHIPPING NAME:	XANTHATES			
HAZARD CLASS	4.2			
PACKING GROUP:	II			
UN/ID NUMBER:	3342			
TRANSPORT LABEL REQUIRED:	Spontaneously Combustible Marine Pollutant			
TECHNICAL NAME (N.O.S.):	Contains potassium amyl xanthate			
ICAO/IATA				
PROPER SHIPPING NAME:	XANTHATES			
HAZARD CLASS:	4.2			
PACKING GROUP:	II			
UN NUMBER:	3342			
TRANSPORT LABEL REQUIRED:	Spontaneously Combustible			
PACKING INSTRUCTIONS/ MAXIMUM NET QUANTITY:	PASSENGER AIRCRAFT	415	15 kg	
	CARGO AIRCRAFT	417	50 kg	
TECHNICAL NAME (N.O.S.):	Contains potassium amyl xanthate			
IMO				
PROPER SHIPPING NAME:	XANTHATES			
HAZARD CLASS:	4.2			
UN NUMBER:	3342			
PACKING GROUP:	II			
TRANSPORT LABEL REQUIRED:	Spontaneously Combustible Marine Pollutant			
TECHNICAL NAME (N.O.S.):	Contains potassium amyl xanthate			

15. REGULATORY INFORMATION

INVENTORY INFORMATION

United States (USA)	All components of this product are included on the TSCA Chemical Inventory or are not required to be listed on the TSCA Chemical Inventory.
Canada	This product contains components not on the Domestic Substances List. These components are on the Non-Domestic Substances List.
European Union (EU)	All components of this product are included in the European Inventory of Existing Chemical Substances (EINECS) in compliance with Council Directive 67/548/EEC and its amendments.
Australia	All components of this product are included in the Australian Inventory of Chemical Substances (AICS) or are not required to be listed on AICS.
China	All components of this product are included on the Chinese inventory or are not required to be listed on the Chinese inventory.
Japan	All components of this product are included on the Japanese (ENCS) inventory or are not required to be listed on the Japanese inventory.
Korea	All components of this product are NOT included on the Korean (ECL) inventory.
Philippines	All components of this product are NOT included on the Philippine (PICCS) inventory.

OTHER ENVIRONMENTAL INFORMATION

The following components of this product may be subject to reporting requirements pursuant to Section 313 of CERCLA (40 CFR 372), Section 12(b) of TSCA, or may be subject to release reporting requirements (40 CFR 307, 40 CFR 311, etc.) See Section 13 for information on waste classification and waste disposal of this product.

Component	CAS NO.	% (w/w)	TPQ (lbs)	RQ (lbs)	S313	TSCA 12B
Carbon disulfide	75-15-0	~ 0.001	10,000	100	YES	YES

PRODUCT CLASSIFICATION UNDER SECTION 311 OF SARA

ACUTE (N)	CHRONIC (N)	FIRE (Y)	REACTIVE (Y)	PRESSURE (N)

16. OTHER INFORMATION

NFPA HAZARD RATING
(National Fire Protection Association)

HEALTH - 2 -	Materials that, under emergency conditions, can cause temporary incapacitation or residual injury.
FIRE - 1 -	Materials that must be preheated before ignition can occur.
REACTIVITY - 1 -	Materials that in themselves are normally stable, but that can become unstable at elevated temperatures and pressures.

REASON FOR REVISION: Triennial review

Prepared By: F. Cappuccitti **Revised By:** Cathy Yuen

IMPORTANT: The above information is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warrant, expressed or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular uses.

Maximizing the Value of Flotation Chemicals Technology

Flottec PAX Collector

Flottec LLC

338 West Main Street
Boonton • New Jersey, USA • 07005
TEL: +1.973.588.4717 / FAX: +1.973.588.4719
WEB SITE: www.flottec.com

PROPER SHIPPING NAME:

XANTHATES

TECHNICAL NAME:

POTASSIUM AMYL XANTHATE

ID No./HAZARD CLASS/PACKING GROUP/LABELS:

UN3342 / 4.2 / II / SPONTANEOUSLY COMBUSTIBLE

HMIS RATINGS

Flottec PAX Collector		KEY
HEALTH	2	4 = Severe
FLAMMABILITY	1	3 = Serious
REACTIVITY	1	2 = Moderate
PERSONAL PROTECTION		1 = Slight
See Material Safety Data Sheet		0 = Minimal

C.A.S. No.	Component
928-70-1	Carbonodithioic acid, O-(3- methylbutyl) ester, potassium salt
1310-58-3	Potassium hydroxide
1310-73-8	Sodium sulfide

WARNING: BEFORE HANDLING YOU MUST READ AND UNDERSTAND THE MATERIAL SAFETY DATA SHEET FOR THIS PRODUCT. DO NOT DISPOSE OF THIS MATERIAL NOR THE EMPTY CONTAINER IN THE ENVIRONMENT. AVOID CONTACT WITH SKIN AND EYES, MAY CAUSE IRRITATION. WEAR CHEMICAL GOGGLES.

CAUTION: AVOID BREATHING VAPOR. USE ADEQUATE VENTILATION. WEAR SPLASH GOGGLES, FACE SHIELD, LONG SLEEVE SHIRT AND TROUSERS. WASH THOROUGHLY AFTER HANDLING. DO NOT WEAR CONTAMINATED CLOTHING.

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FIRE FIGHTING: USE WATER, CARBON DIOXIDE OR DRY CHEMICAL TO EXTINGUISH FIRES.

SPILL CONTROL: SWEEP UP INTO CONTAINERS FOR DISPOSAL. FLUSH SPILL AREA WITH WATER. USE APPROPRIATE CONTAINMENT TO AVOID ENVIRONMENTAL CONTAMINATION.

ATTENTION

EMPTY CONTAINERS MAY CONTAIN PRODUCT RESIDUE INCLUDING FLAMMABLE OR EXPLOSIVE VAPOR. DO NOT CUT, PUNCTURE OR WELD ON CONTAINER. ALL LABEL WARNINGS SHOULD BE OBSERVED UNTIL CONTAINER HAS BEEN THOROUGHLY CLEANED OR DESTROYED, COMPLYING WITH LOCAL, STATE AND FEDERAL REGULATIONS.

GROSS WT.	lbs. or kgs.
TARE WT.	lbs. or kgs.
NET WT.	lbs. or kgs.
LOT No.	Insert Here

IN CASE OF EMERGENGY CALL CHEMTREC:
North America+1.800.424.9300 International+1.703.527.3887

Revision No. 03

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product identifier

Trade name	:	METHYLISOBUTYLCARBINOL
Product name	:	methyl-2-pentanol
CAS-No.	:	108-11-2

Details of the supplier of the safety data sheet

Company	:	Rhodia Poliamida e Especialidades Ltda Fazenda São Francisco, s/n CEP: 13140-000, Paulínia - SP Tel: (+55 19) 3874 8000
Emergency telephone number	:	MULTI LINGUAL EMERGENCY NUMBER (24/7) Europe/America/Africa : +44 1235 239 670 (UK) Middle East & Africa speaking Arabic : +44 1235 239 671 (UK) Asia Pacific : +65 3158 1074 (Singapore) China : +86 10 5100 3039 (Beijing) Mercosul : (+55 19) 3874 9333
E-mail address	:	information.fds@eu.rhodia.com

2. HAZARDS IDENTIFICATION

Classification

Classification (REGULATION (EC) No 1272/2008)

Flammable liquids, Category 3	H226: Flammable liquid and vapour.
Specific target organ toxicity - single exposure, Category 3	H335: May cause respiratory irritation.

Classification (67/548/EEC,1999/45/EC)

Flammable	R10: Flammable.
Xi: Irritant	R37: Irritating to respiratory system.

Label elements

Hazardous products which must be listed on the label:

- 603-008-00-8 4-methylpentan-2-ol

REGULATION (EC) No 1272/2008

Pictogram :

Signal word : Warning

Hazard statements : H226 Flammable liquid and vapour.
H335 May cause respiratory irritation.

Precautionary statements : **Prevention:**
P210 Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P280 Wear protective gloves/ protective clothing/ eye protection/ face protection.
Response:
P303 + P361 + P353 IF ON SKIN (or hair): Remove/ Take off immediately all contaminated clothing. Rinse skin with water/ shower.
P304 + P340 IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P370 + P378 In case of fire: Use dry sand, dry chemical or alcohol-resistant foam for extinction.
Storage:
P403 + P235 Store in a well-ventilated place. Keep cool.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Synonyms : methyl-2-pentanol
Mibcol
methyl isoamyl alcohol

Substance

CAS-No. : 108-11-2

EINECS-No. : 203-551-7

Information on Components and Impurities

Chemical Name	Identification number	Classification 67/548/EEC	Classification REGULATION (EC) No 1272/2008	Concentration [%]
4-methylpentan-2-ol	Index-No. : 603-008-00-8 CAS-No. : 108-11-2	R10 Xi; R37	H226 : Flammable liquids , Category 3 H335 : Specific target organ toxicity - single exposure , Category 3	>= 95 - < 99
4-methylpentan-2-one	Index-No. : 606-004-00-4 CAS-No. : 108-10-1 EINECS-No. : 203-550-1	F; R11 Xn; R20 Xi; R36/37 R66	H225 : Flammable liquids , Category 2 H332 : Acute toxicity , Category 4 H319 : Eye irritation , Category 2 H335 : Specific target organ toxicity - single exposure , Category 3	>= 1 - < 5

For the full text of the R-phrases mentioned in this Section, see Section 16.
For the full text of the H-Statements mentioned in this Section, see Section 16.

4. FIRST AID MEASURES

Description of necessary first-aid measures

General advice	:	Show this safety data sheet to the doctor in attendance. First aider needs to protect himself. Place affected clothing in a sealed bag for subsequent decontamination.
Inhalation	:	Move to fresh air in case of accidental inhalation of vapours or decomposition products. If breathing is irregular or stopped, administer artificial respiration. Consult a physician if necessary.
Skin contact	:	Take off contaminated clothing and shoes immediately. Wash off immediately with plenty of water for at least 15 minutes. Consult a physician if necessary.
Eye contact	:	Rinse with running water whilst keeping the eyes wide open (at least 15 minutes) If eye irritation persists, consult a physician
Ingestion	:	Do NOT induce vomiting. Rinse mouth with water.

5. FIRE-FIGHTING MEASURES

Extinguishing media

Suitable extinguishing media	:	Foam Dry powder Carbon dioxide (CO2)
Unsuitable extinguishing media	:	High volume water jet

Special hazards arising from the substance or mixture

Specific hazards during fire fighting	:	Flammable liquid Vapour/air mixtures are explosive. Heating increases the inner pressure of the bottle, risk of explosion.

Advice for firefighters

Special protective equipment for fire-fighters	:	Personal protective equipment comprising: suitable protective gloves, safety goggles and protective clothing Wear self contained breathing apparatus for fire fighting if necessary.
Specific fire fighting methods	:	Use appropriate means for fighting adjacent fires.
Further information	:	Use extinguishing measures that are appropriate to local circumstances and

the surrounding environment.
Cool containers / tanks with water spray.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures	:	Evacuate personnel to safe areas. Mark the contaminated area with signs and prevent access to unauthorized personnel. Do not breathe vapour. Avoid contact with the skin and the eyes. Remove all sources of ignition. Keep away from flames and sparks. Do not smoke. Use personal protective equipment. Stop the leak. Turn leaking containers leak-side up to prevent the escape of liquid.
Environmental precautions	:	Dam up. Prevent product from entering drains. Try to prevent the material from entering drains or water courses. Local authorities should be advised if significant spillages cannot be contained.

Methods for Cleaning or Taking Up

Recovery	:	Collect spillage. Pick up and transfer to properly labelled containers. Flammable product. Take all necessary precautions. Earth the containers and the equipment. Keep in suitable, closed containers for disposal.
Neutralization	:	Contain spillage, soak up with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and transfer to a container for disposal according to local / national regulations (see section 13).
Decontamination/cleaning	:	Collect spillage. Pick up contaminated soil. Clean contaminated floors and objects thoroughly while observing environmental regulations. Pick up and transfer to properly labelled containers. Keep in suitable, closed containers for disposal. Contain spillage, soak up with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and transfer to a container for disposal according to local / national regulations (see section 13). Nonsparking tools should be used.
Disposal	:	Dispose of contents/ container to an approved waste disposal plant. The product should not be allowed to enter drains, water courses or the soil. Dispose of in accordance with local regulations.

7. HANDLING AND STORAGE

Handling

Technical measures	:	Earth the equipment. Ground/bond container and receiving equipment. No smoking. Take measures to prevent the build up of electrostatic charge. Vapours may form explosive mixtures with air. Provide adequate ventilation. Provide sufficient air exchange and/or exhaust in work rooms. Electrical installations / working materials must comply with the technological safety standards. No sparking tools should be used.
Advice on safe handling and usage	:	Provide adequate ventilation. Handle in accordance with good industrial hygiene and safety practice. Wear personal protective equipment. Avoid inhalation, ingestion and contact with skin and eyes.

Storage

Technical Measures for storage	:	The floor of the depot should be impermeable and designed to form a water-tight basin. Electrical installations / working materials must comply with the technological safety standards.
Storage conditions		
Recommended	:	Keep away from open flames, hot surfaces and sources of ignition. Store in original container. Keep away from heat. Keep in a dry, cool and well-ventilated place. Store contents under inert gas. Keep under nitrogen.
Packaging Measures		
Packaging materials - Recommended	:	Steel, Stainless steel
Packaging materials - To be avoided	:	Plastic materials.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Components with workplace control parameters

Components	Value type	Value	Update	Basis
4-methylpentan-2-one	TWA Indicative	20 ppm 83 mg/m3	2000-06-16	Europe. Commission Directive 2000/39/EC establishing a first list of indicative occupational exposure limit values
4-methylpentan-2-one	STEL Indicative	50 ppm 208 mg/m3	2000-06-16	Europe. Commission Directive 2000/39/EC establishing a first list of indicative occupational exposure limit values

Personal protective equipment

Respiratory protection : Use a respirator with an approved filter if a risk assessment indicates this is necessary.

Hand protection : Where there is a risk of contact with hands, use appropriate gloves
The selected protective gloves have to satisfy the specifications of EU Directive 89/686/EEC and the standard EN 374 derived from it.
Gloves must be inspected prior to use.

Eye protection : Tightly fitting safety goggles

Skin and body protection : Choose body protection according to the amount and concentration of the dangerous substance at the work place.
Remove and wash contaminated clothing.

Hygiene measures : Ensure that eyewash stations and safety showers are close to the workstation location.
Use clean, well-maintained personal protection equipment.
Wash hands before breaks and at the end of workday.
When using do not eat, drink or smoke.

Protective measures : The protective equipment must be selected in accordance with current CEN standards and in cooperation with the supplier of the protective equipment.
Selection of appropriate personal protective equipment should be based on an evaluation of the performance characteristics of the protective equipment relative to the task(s) to be performed, conditions present, duration of use, and the potential hazards and/or risks that may occur during use.

General advice	:	Dam up. Prevent product from entering drains. Try to prevent the material from entering drains or water courses. Local authorities should be advised if significant spillages cannot be contained.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance

Form	:	liquid
Physical state	:	liquid
Colour	:	colourless
Odour	:	aromatic
Odour Threshold	:	no data available

Safety data

pH	:	not applicable
Crystallization temperature	:	-90 °C
Boiling point/boiling range	:	131,7 °C at 1.013,25 hPa
Flash point	:	44,8 °C closed cup 54,5 °C open cup
Flammability (solid, gas)	:	no data available
Autoignition temperature	:	no data available
Oxidizing properties	:	Non oxidizing material according to EC criteria
Water solubility	:	7 g/l partly miscible
Solubility in other solvents	:	miscible with most organic solvents
Partition coefficient: n-octanol/water	:	POW: 1,43
Vapour pressure	:	4,95 hPa at 20 °C
Henry's Constant	:	4,508962 Pa.m3/mol at 25 °C
Evaporation rate	:	no data available
Relative vapour density	:	3,5
Density	:	0,807 g/cm3 at 20 °C

Oxidation/Reduction Potential	:	no data available
Viscosity, dynamic	:	no data available
Viscosity, kinematic	:	no data available
Explosive properties	:	no data available
Thermal decomposition	:	no data available
Lower explosion limit	:	1,00 %(V)
Upper explosion limit	:	5,50 %(V)
Molecular Weight	:	102,17 g/mol

10. STABILITY AND REACTIVITY

Chemical stability	:	Stable at room temperature. Stable under normal conditions.
Hazardous reactions		
Conditions to avoid	:	Heat, flames and sparks. Prevent the build-up of electrostatic charge. Exposure to moisture.
Materials to avoid	:	Acids Strong oxidizing agents
Decomposition products	:	On combustion or on thermal decomposition (pyrolysis) releases: (Carbon oxides (CO + CO2)).
Other information	:	With oxidizing agents possible.

11. TOXICOLOGICAL INFORMATION

Acute toxicity

Acute oral toxicity	:	LD50 : 2.590 mg/kg - mouse Bibliography Symptoms: Vomiting, Flank pain, Kidney disorders, Liver disorders., Central nervous system depression, Vertigo, Impairment of vision
Acute inhalation toxicity	:	Acute toxicity estimate : 733,33 mg/l Method: Calculation method
Acute dermal toxicity	:	LD50 : 2.870 mg/kg - rabbit

Acute toxicity (other routes of administration)	:	no data available
Aspiration toxicity	:	no data available

Skin corrosion/irritation

Skin irritation	:	May cause skin irritation and/or dermatitis.

Serious eye damage/eye irritation

Eye irritation	:	Irritating to mucous membranes May irritate eyes.

Respiratory or skin sensitization

Sensitisation	:	no data available

Repeated dose toxicity

Repeated dose toxicity	:	no data available

STOT

STOT - single exposure	:	Toxicology Assessment: The substance or mixture is classified as specific target organ toxicant, single exposure, category 3 with respiratory tract irritation.
STOT - repeated exposure	:	no data available

Carcinogenicity

Carcinogenicity	:	Not classifiable as a human carcinogen.

Mutagenicity

Genotoxicity in vitro	:	no data available
Genotoxicity in vivo	:	no data available

Reproductive toxicity

Reproductive toxicity	:	no data available

Experience with human exposure

Experience with human exposure : Inhalation	:	Symptoms: Drowsiness Local irritation Dizziness Vomiting Diarrhoea.

12. ECOLOGICAL INFORMATION

Ecotoxicity effects

Aquatic Compartment (including sediment)

Toxicity to fish	:	LC50 - 24 h : 360 mg/l - Carassius auratus (goldfish)

Persistence and degradability

Biodegradability

Biodegradability	:	Ultimate aerobic biodegradability Readily biodegradable.
Ratio BOD/COD	:	BOD type: BOD5 BOD/COD value: 82 %

Bioaccumulation

Partition coefficient: n-octanol/water	:	Not potentially bioaccumulable

Mobility

Distribution among environmental compartments	:	Product readily filters into the soil
Known distribution to environmental compartments	:	Ultimate destination of the product : Water

13. DISPOSAL CONSIDERATIONS

Product Disposal

Advice on Disposal	:	Do not dispose of with domestic refuse. The product should not be allowed to enter drains, water courses or the soil. Dispose of in accordance with local regulations. Dispose of contents/ container to an approved waste disposal plant. Send to a licensed waste management company.

Advice on cleaning and disposal of packaging

Advice	:	Do not re-use empty containers. Allow it to drain thoroughly. Empty remaining contents. Rinse with an appropriate solvent. Dispose of contents/ container to an approved incineration plant.
Other data	:	Dispose of in accordance with local regulations.

14. TRANSPORT INFORMATION

ADR

UN number	:	2053
Dangerous Good Description	:	UN 2053 METHYL ISOBUTYL CARBINOL, 3, III, (D/E)
Labels	:	3
Packing group	:	III
Tunnel restriction code	:	(D/E)
Class	:	3
Classification Code	:	F1
Environmentally hazardous mark	:	NO
Hazard identification No	:	30

RID

UN number	:	2053
Dangerous Good Description	:	UN 2053 METHYL ISOBUTYL CARBINOL, 3, III
Labels	:	3
Packing group	:	III
Class	:	3
Classification Code	:	F1
Environmentally hazardous mark	:	NO
Hazard identification No	:	30

IMDG

UN number	:	2053
Dangerous Good Description	:	UN 2053 METHYL ISOBUTYL CARBINOL, 3, III, IMDG Code Segregation Group - Not Relevant
Labels	:	3
Packing group	:	III
Class	:	3
Marine pollutant (environmentally hazardous mark)	:	NO
EmS	:	F-E , S-D

IATA

UN number	:	2053
Dangerous Good Description	:	UN 2053 METHYL ISOBUTYL CARBINOL, 3, III
Labels	:	3
Packing group	:	III
Class	:	3
Environmentally hazardous mark	:	NO
Packing instruction (cargo aircraft)	:	366
Max net qty/pkg	:	220,00 L
Packing instruction (passenger aircraft)	:	355
Max net qty/pkg	:	60,00 L

ADN / ADNR

UN number	:	2053
Dangerous Good Description	:	UN 2053 METHYL ISOBUTYL CARBINOL, 3, III
Labels	:	3
Packing group	:	III
Class	:	3
Classification Code	:	F1
Environmentally hazardous mark	:	NO

Note: The above regulatory prescriptions are those valid on the date of publication of this sheet. Given the possible evolution of transport regulations for hazardous materials, it would be advisable to check their validity with your sales office.

15. REGULATORY INFORMATION

According to our knowledge, no specific regulatory information.

16. OTHER INFORMATION

Full text of R-phrases referred to under sections 2 and 3

R10	Flammable.
R11	Highly flammable.
R20	Harmful by inhalation.
R36/37	Irritating to eyes and respiratory system.
R37	Irritating to respiratory system.
R66	Repeated exposure may cause skin dryness or cracking.

Full text of H-Statements referred to under sections 2 and 3.

H225	Highly flammable liquid and vapour.
H226	Flammable liquid and vapour.
H319	Causes serious eye irritation.
H332	Harmful if inhaled.
H335	May cause respiratory irritation.

Full text of P-Statements referred to under sections 2 and 3.

P210	Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P303 + P361 + P353	IF ON SKIN (or hair): Remove/ Take off immediately all contaminated clothing. Rinse skin with water/ shower.
P304 + P340	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam for extinction.
P403 + P235	Store in a well-ventilated place. Keep cool.

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. Such information is only given as a guidance to help the user handle, use, process, store, transport, dispose and release the product in satisfactory safety conditions and is not to be considered as a warranty or quality specification. It should be used in conjunction with technical sheets but do not replace them. Thus, the information only relates to the designated specific product and may not be applicable if such product is used in combination with other materials or in an other manufacturing process, unless otherwise specifically indicated. It does not release the user from ensuring he is in conformity with all regulations linked to its activity.

NB: In this document the numerical separator of the thousands is the "." (point), the decimal separator is "," (comma).

METHYLISOBUTYLCARBINOL

Warning

Flammable liquid and vapor - May cause respiratory irritation; or; May cause drowsiness or dizziness

Keep away from heat/sparks/open flames/hot surfaces. - No smoking. - Wear protective gloves/protective clothing/eye protection/face protection. - IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower. - IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. - In case of fire: Use dry sand, dry chemical or alcohol-resistant foam for extinction for extinction. - Store in a well-ventilated place. Keep cool.

Rhodia Poliamida e Especialidades Ltda.

Please refer to the original SDS for more information

Maximizing the Value of Flotation Chemicals Technology

MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME:	**Flottec F160-05 Frother**
CHEMICAL FAMILY:	Mixed polyglycol ethers
SYNONYMS:	None
MOLECULAR FORMULA:	Mixture
MOLECULAR WEIGHT:	Mixture
MANUFACTURER:	Flottec, LLC • 338 West Main Street • Boonton, New Jersey 07005 • USA
PRODUCT INFORMATION:	Tel: +1.973.588.4717 • Fax: +1.973.588.4719 • Web Site: www.flottec.com
EMERGENCY PHONE:	CHEMTREC • North America: +1.800.424.9300 • International: +1.703.527.3887
ISSUE DATE:	September 30, 2012

2. COMPOSITION/INFORMATION ON INGREDIENTS

OSHA REGULATED COMPONENTS

COMPONENT	CAS No.	% (w/w)	OSHA (PEL)	ACGIH (TLV)	Carcinogen
No Permissible Exposure Limits (PEL/TLV) have been established by OSHA or ACGIH					

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

APPEARANCE AND ODOR

Color: Dark brown
Appearance: Heavy liquid
Odor: Mild polyglycol ether odor

STATEMENT OF HAZARD

CAUTION! MAY CAUSE EYE, SKIN AND MUCOUS MEMBBRANE IRRITATION

POTENTIAL HEALTH EFFECTS

EFFECTS / ROUTES OF EXPOSURE

The acute oral (rat) LD50 and acute dermal (rabbit) LD50 values for this material are estimated to be >2000 mg/kg and >2000 mg/kg, respectively.
Direct contact with this material may cause mild eye and skin irritation.
Refer to Section 11 for toxicology information on the regulated components of this product.

4. FIRST AID MEASURES

INGESTION:	If swallowed, call a physician immediately. ONLY induce vomiting at the instructions of a physician. Never give anything by mouth to an unconscious person.
SKIN CONTACT:	Remove contaminated clothing without delay. Flush skin thoroughly with water. Do not reuse clothing without laundering.
EYES CONTACT:	Rinse immediately with plenty of water for at least 15 minutes. Obtain medical advice if there are persistent symptoms.
INHALATON:	Material is not expected to be harmful if inhaled. If inhaled, remove to fresh air.

5. FIREFIGHTING MEASURES

EXTINGUISHING MEDIA AND FIRE FIGHTING INSTRUCTIONS

Extinguishing Media

Use water spray, alcohol foam, carbon dioxide or dry chemical to extinguish fires.

Protective Equipment

Firefighters, and others exposed, wear self-contained breathing apparatus. Wear full firefighting protective clothing. See MSDS Section 8 (Exposure Controls/personal Protection).

Special Hazards

Keep containers cool by spraying with water if exposed to fire.

6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS

Where exposure level is known, wear approved respirator suitable for level of exposure. Where exposure level is not known, wear approved, positive pressure, self-contained respirator. In addition to the protective clothing/equipment in Section 8 (Exposure Controls/personal Protection). Wear impervious boots.

METHODS FOR CLEAN UP

Remove source of ignition. Cover spills with some inert absorbent material; sweep up and place in a waste disposal container. Flush spill area with water.

ENVIRONMENTAL PRECAUTIONS

Not available

7. HANDLING AND STORAGE

HANDLING

Precautionary Measures

Do not get in eyes, on skin, on clothing. Keep away from heat and flame. Wash thoroughly after handling.

Special Handling Statements

None Known

STORAGE

Do not store in aluminum, brass or copper. Areas containing this material should have fire safe practices and electrical equipment in accordance with applicable regulations and/or guidelines.

Storage Temperature: Room Temperature
Reason: Integrity

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

ENGINEERING CONTROLS

Where this material is not used in a closed system, good enclosure and local exhaust ventilation should be provided to control exposure.

PERSONAL PROTECTIVE EQUIPMENT

EYES:	Wear eye/face protection such as chemical splash proof goggles or face shield. Eyewash equipment and safety shower should be provided in areas of potential exposure.
SKIN:	Avoid skin contact. Wear impermeable gloves and suitable protective clothing.
RESPIRATORY PROTECTION:	Where exposures are below the established exposure limit, no respiratory protection is required. Where exposures exceed the established exposure limit, use respiratory protection recommended for the material and level of exposure.

ADDITIONAL ADVICE

Food, beverage and tobacco products should not be carried, stored or consumed where this material is used. Before eating, drinking, or smoking, wash face and hands with soap and water.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARNCE AND ODOR:	Brown, typical polyglycol odor
BOILING POINT:	Not available
MELTING POINT:	Not available
VAPOR PRESSURE:	0.03 mmHG @ 20ºC
SPECIFIC GRAVITY:	0.96 @ 20ºC
VAPOR DENSITY:	>6 (air = 1)
% VOLATILE (BY WT.):	Not available
pH:	10; (5% aqueous solution)
SATURATION IN AIR (% by Vol):	Not applicable
EVAPORATION RATE:	Not applicable
SOLUBILITY IN WATER:	<5%
VOLATILE ORGANIC CONTENT:	Not available
FLASH POINT:	>263ºF (128ºC) MPCC
FLAMMABLE LIMITS (% BY VOL.):	Not available
AUTOIGNITION TEMPERATURE:	Not available
DECOMPOSITION TEMPERATURE:	Not available
PARTIAL COEFFICIENT (n-octanol/water):	Not available
ODOR TRESHOLD:	See Section 2 for exposure limits

10. STABILITY AND REACTIVITY

STABILITY:	Stable
CONDITIONS TO AVOID:	None known
POLYMERIZATION:	Will not occur
CONDITIONS TO AVOID:	None known
INCOMPATABILE MATERIALS:	Avoid contact with oxidizers, contact with isocyanates due to heat liberation, and strong acids. Corrosive to aluminum, brass, copper
HAZARDOUS DECOMPOSITION PRODUCTS:	Carbon dioxide; carbon monoxide; aldehydes; ketones; organic acids

11. TOXICOLOGICAL INFORMATION

Toxicological information for the product is found under SECTION 3: HAZARDS IDENTIFICATION
Toxicological information on the regulated components of this product is as follows:

This product contains no OSHA regulated (hazardous) components

12. ECOLOGICAL INFORMATION

This product is not classified as dangerous for the environment and is readily biodegradeable.

13. DISPOSAL CONSIDERATIONS

RECOMMENDATIONS FOR THE PRODUCT:	Dispose of product in accordance with local, state, and federal laws and regulations. Do not contaminate any lakes, streams, ponds, ground water or soil.
RECOMMENDATIONS FOR PACKAGING:	DO NOT PRESSURIZE, CUT, WELD, BRAZE, DRILL, GRIND OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SURCES OF IGNINITION. THEY MAY EXPLODE AND CAUSE INJURY OR DEATH. Empty drums should be completely drained, properly bunged and promptly returned to a drum re-conditioner, or properly disposed of.
RECOMMENDED CLEANSING AGENT:	Water

14. Transportation Information

	D.O.T. Shipping Information			IMO Shipping Information
SHIPPING NAME:	Not applicable/Not regulated			Not applicable/Not regulated
HAZARD CLASS	Not applicable			Not applicable
PACKING GROUP:	Not applicable			Not applicable
UN/ID NUMBER:	Not applicable			Not applicable
IMDG PAGE:	Not applicable			Not applicable
DOT HAZARDOUS SUBSTANCE:	Not applicable			Not applicable
TRANSPORT LABEL REQUIRED:	None required			None required
	ICAO/IATA			**Transport Canada**
SHIPPING NAME:	Not applicable			Not applicable/Not regulated
HAZARD CLASS:	Not applicable			Not applicable
SUBSIDIARY CLASS:	Not applicable			Not applicable
UN/ID NUMBER:	Not applicable			Not applicable
PACKING GROUP:	Not applicable			Not applicable
TRANSPORT LABEL REQUIRED:	Not applicable			Not applicable
PACKING INSTRUCTIONS/ MAXIMIMUM NET QUANTITY:	PASSENGER	Not app.	Not app.	Not applicable
	CARGO	Not app.	Not app.	

ADDITIONAL TRANSPORTATION INFORMATION

Technical Name (N.O.S.): Not applicable/not regulated

15. REGULATORY INFORMATION

INVENTORY INFORMATION

United States (USA):	All components of this product are included on the TSCA Inventory in compliance with the Toxic Substances Control Act, 15 U. S. C. 2601 et. seq.
Canada:	Components of this product have been reported to Environment Canada in accordance with subsection 25 of the Canadian Environmental Protection Act and are included on the Domestic Substances List.
European Union (EU):	All components of this product are included in the European Inventory of Existing Chemical Substances (EINECS) or the "No Longer Polymer" list in compliance with Council Directive 67/548/EEC and its amendments.

OTHER ENVIRONMENTAL INFORMATION

The following components of this product may be subject to reporting requirements pursuant to Section 313 of CERCLA (40 CFR 372), Section 12(b) of TSCA, or may be subject to release reporting requirements (40 CFR 307, 40 CFR 311, etc.) See Section 13 for information on waste classification and waste disposal of this product.

Component	CAS NO.	% (w/w)	TPQ (lbs)	RQ (lbs)	S313	TSCA 12B
This product does not contain any components regulated under these sections of the EPA						

PRODUCT CLASSIFICATION UNDER SECTION 311 OF SARA

Not applicable under SARA TITLE III

16. OTHER INFORMATION

NFPA HAZARD RATING
(National Fire Protection Association)

FIRE:	Materials that must be preheated before ignition can occur.
HEALTH:	Materials that, under emergency conditions, can cause significant irritation.
REACTIVITY:	Materials that in themselves are normally stable, even under fire exposure conditions.

REASON FOR REVISION: Triennial review

Prepared By: F. Cappuccitti **Revised By:** C. Yuen

Flottec F160-05 Frother

Maximizing the Value of Flotation Chemicals Technology

Flottec, LLC

338 West Main Street

Boonton, New Jersey 07005 • USA

TEL: +1.973.588.4717 FAX: +1.973.588.4719

Website: www.flottec.com

PROPER SHIPPING NAME:

NOT REGULATED AS HAZARDOUS

TECHNICAL NAME:

Not Applicable

ID No./HAZARD CLASS/PACKING GROUP/LABELS:

NOT REGULATED AS HAZARDOUS

WARNING: BEFORE HANDLING YOU MUST READ AND UNDERSTAND THE MATERIAL SAFETY DATA SHEET FOR THIS PRODUCT. DO NOT DISPOSE OF THIS MATERIA NOR THE EMPTY CONTAINER IN THE ENVIRONMENT. AVOID CONTACT WITH SKIN AND EYES, MAY CAUSE IRRITATION. WEAR CHEMICAL GOGGLES.

CAUTION: AVOID BREATHING VAPOR. USE ADEQUATE VENTILATION. WEAR SPLASH GOGGLES, FACE SHIELD, LONG SLEEVE SHIRT AND TROUSERS. WASH THOROUGHLY AFTER HANDLING. DO NOT WEAR CONTAMINATED CLOTHING.

FIRST AID: IF INHALED, REMOVE PERSON TO FRESH AIR. IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES. CALL A PHYSICIAN. WASH EXPOSED SKIN AREAS WITH SOAPY WATER. LAUNDER CONTAMINATED CLOTHING BEFORE REUSE.

STORAGE: STORE IN TIGHTLY CLOSED CONTAINERS IN A COOL, WELL-VENTILATED PLACE.

FIRE FIGHTING: USE WATER, DRY CHEMICAL, CARBON DIOXIDE, OR "ALCOHOL" FOAM.

SPILL CONTROL: CONTAIN SPILLS WITH SAND OR OTHER ABSORBENT MATERIALS. DISPOSE OF SPILL MATERIAL IN APPROVED MANNER.

HMIS RATINGS

Flottec F160-05 Frother		KEY
HEALTH	1	4 = Severe
FLAMMABILITY	1	3 = Serious
REACTIVITY	0	2 = Moderate
PERSONAL PROTECTION See Material Safety Data Sheet		1 = Slight 0 = Minimal

C.A.S. No.	Component
	Contains No Hazardous Ingredients

ATTENTION

EMPTY CONTAINERS MAY CONTAIN PRODUCT RESIDUE INCLUDING FLAMMABLE OR EXPLOSIVE VAPOR. DO NOT CUT, PUNCTURE OR WELD ON CONTAINER. ALL LABEL WARNINGS SHOULD BE OBSERVED UNTIL CONTAINER HAS BEEN THOROUGHLY CLEANED OR DESTROYED, COMPLYING WITH LOCAL, STATE AND FEDERAL REGULATIONS.

GROSS WT.	lbs.
TARE WT.	lbs.
NET WT.	lbs.
LOT No.	

IN CASE OF EMERGENCY CALL CHEMTREC

North America +1.800.424.9300 International +1.703.527.3887

Maximizing the Value of Flotation Chemicals Technology

MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME:	**Flottec F160-13 Frother**
CHEMICAL FAMILY:	Mixed glycol, glycol ethers
SYNONYMS:	None
MOLECULAR FORMULA:	Mixture
MOLECULAR WEIGHT:	Mixture
MANUFACTURER:	Flottec, LLC • 338 West Main Street • Boonton, New Jersey 07005 • USA
PRODUCT INFORMATION:	Tel: +1.973.588.4717 • Fax: +1.973.588.4719 • Web Site: www.flottec.com
EMERGENCY PHONE:	CHEMTREC • North America: +1.800.424.9300 • International: +1.703.527.3887
ISSUE DATE:	April 30, 2012

2. COMPOSITION/INFORMATION ON INGREDIENTS

OSHA REGULATED COMPONENTS

COMPONENT	CAS No.	% (w/w)	OSHA (PEL)	ACGIH (TLV)	Carcinogen
No Permissible Exposure Limits (PEL/TLV) have been established by OSHA or ACGIH					

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

APPEARANCE AND ODOR

Color: Dark brown
Appearance: Heavy liquid
Odor: Mild polyglycol ether odor

STATEMENT OF HAZARD

CAUTION! MAY CAUSE EYE, SKIN AND MUCOUS MEMBBRANE IRRITATION

POTENTIAL HEALTH EFFECTS

EFFECTS / ROUTES OF EXPOSURE

The acute oral (rat) LD50 and acute dermal (rabbit) LD50 values for this material are estimated to be >2000 mg/kg and >2000 mg/kg, respectively.
Direct contact with this material may cause mild eye and skin irritation.
Refer to Section 11 for toxicology information on the regulated components of this product.

4. FIRST AID MEASURES

INGESTION:	If swallowed, call a physician immediately. ONLY induce vomiting at the instructions of a physician. Never give anything by mouth to an unconscious person.
SKIN CONTACT:	Remove contaminated clothing without delay. Flush skin thoroughly with water. Do not reuse clothing without laundering.
EYES CONTACT:	Rinse immediately with plenty of water for at least 15 minutes. Obtain medical advice if there are persistent symptoms.
INHALATON:	Material is not expected to be harmful if inhaled. If inhaled, remove to fresh air.

5. FIREFIGHTING MEASURES

EXTINGUISHING MEDIA AND FIRE FIGHTING INSTRUCTIONS

Extinguishing Media

Use water spray, alcohol foam, carbon dioxide or dry chemical to extinguish fires.

Protective Equipment

Firefighters, and others exposed, wear self-contained breathing apparatus. Wear full firefighting protective clothing. See MSDS Section 8 (Exposure Controls/personal Protection).

Special Hazards

Keep containers cool by spraying with water if exposed to fire.

6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS

Where exposure level is known, wear approved respirator suitable for level of exposure. Where exposure level is not known, wear approved, positive pressure, self-contained respirator. In addition to the protective clothing/equipment in Section 8 (Exposure Controls/personal Protection). Wear impervious boots.

METHODS FOR CLEAN UP

Remove source of ignition. Cover spills with some inert absorbent material; sweep up and place in a waste disposal container. Flush spill area with water.

ENVIRONMENTAL PRECAUTIONS

Not available

7. HANDLING AND STORAGE

HANDLING

Precautionary Measures

Do not get in eyes, on skin, on clothing. Keep away from heat and flame. Wash thoroughly after handling.

Special Handling Statements

None Known

STORAGE

Do not store in aluminum, brass or copper. Areas containing this material should have fire safe practices and electrical equipment in accordance with applicable regulations and/or guidelines.

Storage Temperature: Room Temperature

Reason: Integrity

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

ENGINEERING CONTROLS

Where this material is not used in a closed system, good enclosure and local exhaust ventilation should be provided to control exposure.

PERSONAL PROTECTIVE EQUIPMENT

EYES:	Wear eye/face protection such as chemical splash proof goggles or face shield. Eyewash equipment and safety shower should be provided in areas of potential exposure.
SKIN:	Avoid skin contact. Wear impermeable gloves and suitable protective clothing.
RESPIRATORY PROTECTION:	Where exposures are below the established exposure limit, no respiratory protection is required. Where exposures exceed the established exposure limit, use respiratory protection recommended for the material and level of exposure.

ADDITIONAL ADVICE

Food, beverage and tobacco products should not be carried, stored or consumed where this material is used. Before eating, drinking, or smoking, wash face and hands with soap and water.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARNCE AND ODOR:	Brown, typical polyglycol odor
BOILING POINT:	225ºC
MELTING POINT:	Not available
VAPOR PRESSURE:	0.02 mmHG@20ºC
SPECIFIC GRAVITY:	0.98 – 1.05@ 25ºC
VAPOR DENSITY:	Not available
% VOLATILE (BY WT.):	Not available
pH:	10; (5% aqueous solution)
SATURATION IN AIR (% by Vol):	Not applicable
EVAPORATION RATE:	Not applicable
SOLUBILITY IN WATER:	Soluble
VOLATILE ORGANIC CONTENT:	Not available
FLASH POINT:	>220ºF (104ºC) MPCC
FLAMMABLE LIMITS (% BY VOL.):	Not available
AUTOIGNITION TEMPERATURE:	Not available
DECOMPOSITION TEMPERATURE:	Not available
PARTIAL COEFFICIENT (n-octanol/water):	Not available
ODOR TRESHOLD:	See Section 2 for exposure limits

10. STABILITY AND REACTIVITY

STABILITY:	Stable
CONDITIONS TO AVOID:	None known
POLYMERIZATION:	Will not occur
CONDITIONS TO AVOID:	None known
INCOMPATABILE MATERIALS:	Avoid contact with oxidizers, contact with isocyanates due to heat liberation, and strong acids. Corrosive to aluminum, brass, copper
HAZARDOUS DECOMPOSITION PRODUCTS:	Carbon dioxide; carbon monoxide; aldehydes; ketones; organic acids

11. TOXICOLOGICAL INFORMATION

Toxicological information for the product is found under SECTION 3: HAZARDS IDENTIFICATION
Toxicological information on the regulated components of this product is as follows:

This product contains no OSHA regulated (hazardous) components

12. ECOLOGICAL INFORMATION

This product is not classified as dangerous for the environment and is readily biodegradeable.

13. DISPOSAL CONSIDERATIONS

RECOMMENDATIONS FOR THE PRODUCT:	Dispose of product in accordance with local, state, and federal laws and regulations. Do not contaminate any lakes, streams, ponds, ground water or soil.
RECOMMENDATIONS FOR PACKAGING:	DO NOT PRESSURIZE, CUT, WELD, BRAZE, DRILL, GRIND OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SURCES OF IGNINITION. THEY MAY EXPLODE AND CAUSE INJURY OR DEATH. Empty drums should be completely drained, properly bunged and promptly returned to a drum re-conditioner, or properly disposed of.
RECOMMENDED CLEANSING AGENT:	Water

14. Transportation Information

	D.O.T. Shipping Information			IMO Shipping Information
SHIPPING NAME:	Not applicable/Not regulated			Not applicable/Not regulated
HAZARD CLASS	Not applicable			Not applicable
PACKING GROUP:	Not applicable			Not applicable
UN/ID NUMBER:	Not applicable			Not applicable
IMDG PAGE:	Not applicable			Not applicable
DOT HAZARDOUS SUBSTANCE:	Not applicable			Not applicable
TRANSPORT LABEL REQUIRED:	None required			None required
	ICAO/IATA			**Transport Canada**
SHIPPING NAME:	Not applicable			Not applicable/Not regulated
HAZARD CLASS:	Not applicable			Not applicable
SUBSIDIARY CLASS:	Not applicable			Not applicable
UN/ID NUMBER:	Not applicable			Not applicable
PACKING GROUP:	Not applicable			Not applicable
TRANSPORT LABEL REQUIRED:	Not applicable			Not applicable
PACKING INSTRUCTIONS/ MAXIMIMUM NET QUANTITY:	PASSENGER	Not app.	Not app.	Not applicable
	CARGO	Not app.	Not app.	

ADDITIONAL TRANSPORTATION INFORMATION

Technical Name (N.O.S.): Not applicable/not regulated

15. REGULATORY INFORMATION

INVENTORY INFORMATION

United States (USA):	All components of this product are included on the TSCA Inventory in compliance with the Toxic Substances Control Act, 15 U. S. C. 2601 et. seq.
Canada:	Components of this product have been reported to Environment Canada in accordance with subsection 25 of the Canadian Environmental Protection Act and are included on the Domestic Substances List.
European Union (EU):	All components of this product are included in the European Inventory of Existing Chemical Substances (EINECS) or the "No Longer Polymer" list in compliance with Council Directive 67/548/EEC and its amendments.

OTHER ENVIRONMENTAL INFORMATION

The following components of this product may be subject to reporting requirements pursuant to Section 313 of CERCLA (40 CFR 372), Section 12(b) of TSCA, or may be subject to release reporting requirements (40 CFR 307, 40 CFR 311, etc.) See Section 13 for information on waste classification and waste disposal of this product.

Component	CAS NO.	% (w/w)	TPQ (lbs)	RQ (lbs)	S313	TSCA 12B
Potassium Hydroxide	001310-58-3	0.1 – 1.0		1000		

PRODUCT CLASSIFICATION UNDER SECTION 311 OF SARA

Not applicable under SARA TITLE III

WHMIS Classification: D2B Eye and Skin irritant

16. OTHER INFORMATION

NFPA HAZARD RATING
(National Fire Protection Association)

FIRE:	Materials that must be preheated before ignition can occur.
HEALTH:	Materials that, under emergency conditions, can cause temporary incapacitation or residual injury.
REACTIVITY:	Materials that in themselves are normally stable, even under fire exposure conditions.

REASON FOR REVISION: Triennial review

Prepared By: F. Cappuccitti **Revised By:** C. Yuen

Flottec F160-13 Frother

Maximizing the Value of Flotation Chemicals Technology

Flottec, LLC
338 West Main Street
Boonton, New Jersey 07005 • USA
TEL: +1.973.588.4717 FAX: +1.973.588.4719
Website: www.flottec.com

PROPER SHIPPING NAME:
NOT REGULATED AS HAZARDOUS

TECHNICAL NAME:
Not Applicable

ID No./HAZARD CLASS/PACKING GROUP/LABELS:
NOT REGULATED AS HAZARDOUS

WARNING: BEFORE HANDLING YOU MUST READ AND UNDERSTAND THE MATERIAL SAFETY DATA SHEET FOR THIS PRODUCT. DO NOT DISPOSE OF THIS MATERIA NOR THE EMPTY CONTAINER IN THE ENVIRONMENT. AVOID CONTACT WITH SKIN AND EYES, MAY CAUSE IRRITATION. WEAR CHEMICAL GOGGLES.

CAUTION: AVOID BREATHING VAPOR. USE ADEQUATE VENTILATION. WEAR SPLASH GOGGLES, FACE SHIELD, LONG SLEEVE SHIRT AND TROUSERS. WASH THOROUGHLY AFTER HANDLING. DO NOT WEAR CONTAMINATED CLOTHING.

FIRST AID: IF INHALED, REMOVE PERSON TO FRESH AIR. IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES. CALL A PHYSICIAN. WASH EXPOSED SKIN AREAS WITH SOAPY WATER. LAUNDER CONTAMINATED CLOTHING BEFORE REUSE.

STORAGE: STORE IN TIGHTLY CLOSED CONTAINERS IN A COOL, WELL-VENTILATED PLACE.

FIRE FIGHTING: USE WATER, DRY CHEMICAL, CARBON DIOXIDE, OR "ALCOHOL" FOAM.

SPILL CONTROL: CONTAIN SPILLS WITH SAND OR OTHER ABSORBENT MATERIALS. DISPOSE OF SPILL MATERIAL IN APPROVED MANNER.

HMIS RATINGS

Flottec F160-13 Frother		KEY
HEALTH	2	4 = Severe
FLAMMABILITY	1	3 = Serious
REACTIVITY	0	2 = Moderate
PERSONAL PROTECTION See Material Safety Data Sheet		1 = Slight 0 = Minimal

C.A.S. No.	Component
1310-58-3	Potassium hydroxide

ATTENTION

EMPTY CONTAINERS MAY CONTAIN PRODUCT RESIDUE INCLUDING FLAMMABLE OR EXPLOSIVE VAPOR. DO NOT CUT, PUNCTURE OR WELD ON CONTAINER. ALL LABEL WARNINGS SHOULD BE OBSERVED UNTIL CONTAINER HAS BEEN THOROUGHLY CLEANED OR DESTROYED, COMPLYING WITH LOCAL, STATE AND FEDERAL REGULATIONS.

GROSS WT.	
TARE WT.	
NET WT.	
LOT No.	

IN CASE OF EMERGENCY CALL CHEMTREC
North America +1.800.424.9300 International +1.703.527.3887

Section: 1. PRODUCT AND COMPANY IDENTIFICATION

Product name	:	NALCO® DVS4U038
Other means of identification	:	Not applicable.
Recommended use	:	FROTHER
Restrictions on use	:	Refer to available product literature or ask your local Sales Representative for restrictions on use and dose limits.
Company	:	Nalco Company 1601 W. Diehl Road Naperville, Illinois 60563-1198 USA TEL: (630)305-1000
Emergency telephone number	:	(800) 424-9300 (24 Hours) CHEMTREC
Issuing date	:	09/29/2014

Section: 2. HAZARDS IDENTIFICATION

GHS Classification

Flammable liquids	:	Category 4
Serious eye damage/eye irritation	:	Category 1
Skin sensitization	:	Category 1
Germ cell mutagenicity	:	Category 2

GHS Label element

Hazard pictograms :

Signal Word : Danger

Hazard Statements : Combustible liquid
May cause an allergic skin reaction.
Causes serious eye damage.
Suspected of causing genetic defects.

Precautionary Statements : **Prevention:**
Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Keep away from heat/sparks/open flames/hot surfaces. - No smoking. Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray. Contaminated work clothing should not be allowed out of the workplace. Wear protective gloves/ eye protection/ face protection. Use personal protective equipment as required.
Response:
IF ON SKIN: Wash with plenty of soap and water. IF IN EYES:

Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. IF exposed or concerned: Get medical advice/attention. Immediately call a POISON CENTER or doctor/ physician. If skin irritation or rash occurs: Get medical advice/ attention. Wash contaminated clothing before reuse. In case of fire: Use dry sand, dry chemical or alcohol-resistant foam for extinction.
Storage:
Store in a well-ventilated place. Keep cool. Store locked up.
Disposal:
Dispose of contents/ container to an approved waste disposal plant.

Other hazards : None known.

Section: 3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS-No.	Concentration: (%)
C4-C16 Alcohols, Aldehydes, Esters	Proprietary	60 - 100
Alkane distn. residues	Proprietary	5 - 10
Butanal	123-72-8	5 - 10

Section: 4. FIRST AID MEASURES

In case of eye contact : Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention immediately.

In case of skin contact : Wash off immediately with plenty of water for at least 15 minutes. Use a mild soap if available. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

If swallowed : Rinse mouth. Get medical attention if symptoms occur.

If inhaled : Remove to fresh air. Treat symptomatically. Get medical attention if symptoms occur.

Protection of first-aiders : In event of emergency assess the danger before taking action. Do not put yourself at risk of injury. If in doubt, contact emergency responders.Use personal protective equipment as required.

Notes to physician : Treat symptomatically.

See toxicological information (Section 11)

Section: 5. FIREFIGHTING MEASURES

Suitable extinguishing media : Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable extinguishing media : High volume water jet

Specific hazards during firefighting : Not flammable or combustible.

Hazardous combustion products : Carbon oxides

Special protective equipment for firefighters	:	Use personal protective equipment.
Specific extinguishing methods	:	Fire residues and contaminated fire extinguishing water must be disposed of in accordance with local regulations. In the event of fire and/or explosion do not breathe fumes.

Section: 6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures	:	Ensure adequate ventilation. Keep people away from and upwind of spill/leak. Avoid inhalation, ingestion and contact with skin and eyes. When workers are facing concentrations above the exposure limit they must use appropriate certified respirators. Ensure clean-up is conducted by trained personnel only. Refer to protective measures listed in sections 7 and 8.
Environmental precautions	:	Do not allow contact with soil, surface or ground water.
Methods and materials for containment and cleaning up	:	Stop leak if safe to do so. Contain spillage, and then collect with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and place in container for disposal according to local / national regulations (see section 13). Flush away traces with water. For large spills, dike spilled material or otherwise contain material to ensure runoff does not reach a waterway. Do not flush into surface water or sanitary sewer system.

Section: 7. HANDLING AND STORAGE

Advice on safe handling	:	Do not breathe dust/fume/gas/mist/vapours/spray. Do not get in eyes, on skin, or on clothing. Wash hands thoroughly after handling. Use only with adequate ventilation.
Conditions for safe storage	:	Keep out of reach of children. Keep container tightly closed. Store in suitable labeled containers.
Suitable material	:	The following compatibility data is suggested based on similar product data and/or industry experience: Compatibility with Plastic Materials can vary; we therefore recommend that compatibility is tested prior to use.
Unsuitable material	:	not determinednot determined

Section: 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Components with workplace control parameters

Components	CAS-No.	Form of exposure	Permissible concentration	Basis
Butanal	123-72-8	TWA	25 ppm	WEEL

Engineering measures	:	Effective exhaust ventilation system Maintain air concentrations below occupational exposure standards.

Personal protective equipment

Eye protection	:	Safety goggles Face-shield
Hand protection	:	Wear the following personal protective equipment: Standard glove type. Gloves should be discarded and replaced if there is any indication of degradation or chemical breakthrough.
Skin protection	:	Wear suitable protective clothing.
Respiratory protection	:	No personal respiratory protective equipment normally required.
Hygiene measures	:	Handle in accordance with good industrial hygiene and safety practice. Remove and wash contaminated clothing before re-use. Wash face, hands and any exposed skin thoroughly after handling. Provide suitable facilities for quick drenching or flushing of the eyes and body in case of contact or splash hazard.

Section: 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	:	Liquid
Colour	:	Dark Amber
Odour	:	Alcoholic
Flash point	:	60.5 - 93.3 °C Method: Pensky-Martens closed cup
pH	:	no data available
Odour Threshold	:	no data available
Melting point/freezing point	:	no data available
Initial boiling point and boiling range	:	no data available
Evaporation rate	:	no data available
Flammability (solid, gas)	:	no data available
Upper explosion limit	:	no data available
Lower explosion limit	:	no data available
Vapour pressure	:	no data available
Relative vapour density	:	no data available
Relative density	:	0.85 (20.0 °C)
Density	:	7.0 lb/gal
Water solubility	:	immiscible
Solubility in other solvents	:	no data available
Partition coefficient: n-octanol/water	:	no data available
Auto-ignition temperature	:	no data available
Thermal decomposition	:	Carbon oxides
Viscosity, dynamic	:	no data available
Viscosity, kinematic	:	no data available

VOC	:	92.5 %

Section: 10. STABILITY AND REACTIVITY

Chemical stability	:	Stable under normal conditions.
Possibility of hazardous reactions	:	No dangerous reaction known under conditions of normal use.
Conditions to avoid	:	Extremes of temperature Heat, flames and sparks.
Incompatible materials	:	Contact with strong oxidizers (e.g. chlorine, peroxides, chromates, nitric acid, perchlorate, concentrated oxygen, permanganate) may generate heat, fires, explosions and/or toxic vapors.
Hazardous decomposition products	:	Carbon oxides

Section: 11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure	:	Inhalation, Eye contact, Skin contact

Potential Health Effects

Eyes	:	Causes serious eye damage.
Skin	:	May cause allergic skin reaction.
Ingestion	:	Health injuries are not known or expected under normal use.
Inhalation	:	Health injuries are not known or expected under normal use.
Chronic Exposure	:	Suspected of causing genetic defects.

Experience with human exposure

Eye contact	:	Redness, Pain, Corrosion
Skin contact	:	Redness, Irritation, Allergic reactions
Ingestion	:	No symptoms known or expected.
Inhalation	:	No symptoms known or expected.

Toxicity

Product

Acute oral toxicity	:	no data available
Acute inhalation toxicity	:	no data available
Acute dermal toxicity	:	no data available
Skin corrosion/irritation	:	no data available

Serious eye damage/eye irritation	:	no data available
Respiratory or skin sensitization	:	no data available
Carcinogenicity	:	no data available
Reproductive effects	:	no data available
Germ cell mutagenicity	:	no data available
Teratogenicity	:	no data available
STOT - single exposure	:	no data available
STOT - repeated exposure	:	no data available
Aspiration toxicity	:	no data available

Components

Acute oral toxicity	:	C4-C16 Alcohols, Aldehydes, Esters LD50 rat: > 5,000 mg/kg

Section: 12. ECOLOGICAL INFORMATION

Ecotoxicity

Environmental Effects	:	Toxic to aquatic life.

Components

Toxicity to fish	:	C4-C16 Alcohols, Aldehydes, Esters LC50 : 6 mg/l Exposure time: 96 h

Components

Toxicity to daphnia and other aquatic invertebrates	:	Alkane distn. residues EC50 : 29.2 mg/l Exposure time: 48 h

Persistence and degradability

The organic portion of this preparation is expected to be inherently biodegradable.

Mobility

The environmental fate was estimated using a level III fugacity model embedded in the EPI (estimation program interface) Suite TM, provided by the US EPA. The model assumes a steady state condition between the total input and output. The level III model does not require equilibrium between the defined media. The information provided is intended to give the user a general estimate of the environmental fate of this product under the defined conditions of the models.
If released into the environment this material is expected to distribute to the air, water and soil/sediment in the approximate respective percentages;

Air	:	5 - 10%
Water	:	30 - 50%

Soil : 50 - 70%

The portion in water is expected to float on the surface.

Bioaccumulative potential

Component substances have a potential to bioaccumulate.

Other information

no data available

Section: 13. DISPOSAL CONSIDERATIONS

If this product becomes a waste, it is not a hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA) 40 CFR 261, since it does not have the characteristics of Subpart C, nor is it listed under Subpart D.

Disposal methods : The product should not be allowed to enter drains, water courses or the soil. Where possible recycling is preferred to disposal or incineration. If recycling is not practicable, dispose of in compliance with local regulations. Dispose of wastes in an approved waste disposal facility.

Disposal considerations : Dispose of as unused product. Empty containers should be taken to an approved waste handling site for recycling or disposal. Do not re-use empty containers.

Section: 14. TRANSPORT INFORMATION

The shipper/consignor/sender is responsible to ensure that the packaging, labeling, and markings are in compliance with the selected mode of transport.

Land transport (DOT)

For Packages Less Than Or Equal To 119 Gallons:

Proper shipping name : PRODUCT IS NOT REGULATED DURING TRANSPORTATION

For Packages Greater Than 119 Gallons:

Proper shipping name : COMBUSTIBLE LIQUID, N.O.S.
Technical name(s) : Butanal
UN/ID No. : NA 1993
Hazard Class - Primary : COMBUSTIBLE LIQUID
Packing group : III

Air transport (IATA)

Proper shipping name : PRODUCT IS NOT REGULATED DURING TRANSPORTATION

Sea transport (IMDG/IMO)

Proper shipping name : PRODUCT IS NOT REGULATED DURING TRANSPORTATION

Section: 15. REGULATORY INFORMATION

EPCRA - Emergency Planning and Community Right-to-Know Act

CERCLA Reportable Quantity

This material does not contain any components with a CERCLA RQ.

SARA 304 Extremely Hazardous Substances Reportable Quantity

This material does not contain any components with a section 304 EHS RQ.

SARA 311/312 Hazards	:	Fire Hazard Acute Health Hazard Chronic Health Hazard
SARA 302	:	No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.
SARA 313	:	This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

California Prop 65

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

INTERNATIONAL CHEMICAL CONTROL LAWS :

TOXIC SUBSTANCES CONTROL ACT (TSCA)
The substances in this preparation are included on or exempted from the TSCA 8(b) Inventory (40 CFR 710)

AUSTRALIA
All substances in this product comply with the National Industrial Chemicals Notification & Assessment Scheme (NICNAS).

CHINA
This product contains substance(s) which are not in compliance with the Provisions on the Environmental Administration of New Chemical Substances and may require additional review.

JAPAN
This product contains substance(s) which are not in compliance with the Law Regulating the Manufacture and Importation Of Chemical Substances and are not listed on the Existing and New Chemical Substances list (ENCS).

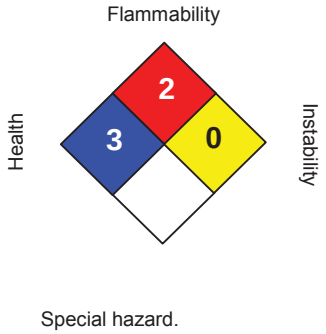
KOREA
This product contains substance(s) which are not in compliance with the Toxic Chemical Control Law (TCCL) and may require additional review.

PHILIPPINES
This product contains substance(s) which are not in compliance with the Republic Act 6969 (RA 6969) and may require additional review.

Section: 16. OTHER INFORMATION

NALCO® DVS4U038

NFPA:



HMIS III:

HEALTH	3*
FLAMMABILITY	2
PHYSICAL HAZARD	0

0 = not significant, 1 =Slight,
2 = Moderate, 3 = High
4 = Extreme, * = Chronic

Revision Date	:	09/29/2014
Version Number	:	1.0
Prepared By	:	Regulatory Affairs

REVISED INFORMATION: Significant changes to regulatory or health information for this revision is indicated by a bar in the left-hand margin of the SDS.

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.
For additional copies of an MSDS visit www.nalco.com and request access.

NALCO

An Ecolab Company

Nalco Company
Corporate Administration 1601 West Diehl Road, NAPERVILLE, IL, USA 60563-1198
630-305-1000

NALCO® DVS4U038

FROTHER

EMERGENCY TELEPHONE NUMBER(S):
(800) 424-9300 (24 Hours)
CHEMTREC

MATERIAL	DVS4U038.91
NET WEIGHT	
GENERATED	1/22/2015

U.S. DOT Shipping Name:

NA1993

COMBUSTIBLE LIQUID, N.O.S., (Butanal), CBL, III

MARINE TRANSPORT (IMDG/IMO):

PRODUCT IS NOT REGULATED DURING TRANSPORTATION

Danger! Combustible liquid May cause an allergic skin reaction. Causes serious eye damage. Suspected of causing genetic defects.

Prevention: Obtain special instructions before use., Do not handle until all safety precautions have been read and understood., Keep away from heat/sparks/open flames/hot surfaces. - No smoking., Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray., Contaminated work clothing should not be allowed out of the workplace., Wear protective gloves/ eye protection/ face protection., Use personal protective equipment as required.

Response: IF ON SKIN: Wash with plenty of soap and water., IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing., IF exposed or concerned: Get medical advice/attention., Immediately call a POISON CENTER or doctor/ physician., If skin irritation or rash occurs: Get medical advice/ attention., Wash contaminated clothing before reuse., In case of fire: Use dry sand, dry chemical or alcohol-resistant foam for extinction.

Storage: Store in a well-ventilated place. Keep cool., Store locked up.

Disposal: Dispose of contents/ container to an approved waste disposal plant.

ATTENTION: For more information refer to the material safety data sheet. Empty containers may contain residual product. DO NOT reuse containers unless properly reconditioned.

SAFETY DATA SHEET

Issue Date 02-May-2013 **Revision Date** 03-May-2013 **Version** 1

1. PRODUCT AND COMPANY IDENTIFICATION

Product Identifier

Product Name Copper Sulfate Pentahydrate

Other Means of Identification

SDS # OBC-007

UN/ID No UN3077

Synonyms Blue Vitrol, Bluestone, Cupric Sulfate

Recommended Use of the Chemical and Restrictions on Use

Recommended Use For industrial use.

Details of the Supplier of the Safety Data Sheet

Manufacturer Address

Old Bridge Chemicals, Inc.
554 Waterworks Rd.
Old Bridge, NJ 08857

Emergency Telephone Number

Company Phone Number (732) 727-2225 (normal business hours)
(800) 275-3924 (24 hour number)

Emergency Telephone Chemtrec 1-800-424-9300 (North America) 1-703-527-3887 (International)

2. HAZARDS IDENTIFICATION

Classification

Acute toxicity - Oral	Category 4
Acute toxicity - Dermal	Category 4

Signal Word

Warning

Hazard Statements

Harmful if swallowed
Harmful in contact with skin

Appearance Transparent blue crystals or blue powder **Physical State** Solid **Odor** Odorless

Precautionary Statements - Prevention
Wash face, hands and any exposed skin thoroughly after handling
Do not eat, drink or smoke when using this product
Wear protective gloves/protective clothing

Precautionary Statements - Response

IF ON SKIN: Wash with plenty of soap and water
Take off contaminated clothing and wash it before reuse
Call a POISON CENTER or doctor/physician if you feel unwell
IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell
Rinse mouth

Precautionary Statements - Storage
Store locked up

Precautionary Statements - Disposal
Dispose of contents/container to an approved waste disposal plant

Other Hazards
Toxic to aquatic life

3. COMPOSITION/INFORMATION ON INGREDIENTS

Synonyms Blue Vitrol, Bluestone, Cupric Sulfate.

Chemical Name	CAS No	Weight-%
Copper sulfate pentahydrate	7758-99-8	100

4. FIRST AID MEASURES

First Aid Measures

Eye Contact Rinse thoroughly with plenty of water for at least 15 minutes, lifting lower and upper eyelids. Consult a physician.

Skin Contact IF ON SKIN: Wash with plenty of soap and water. Take off contaminated clothing and wash it before reuse. Call a POISON CENTER or doctor/physician if you feel unwell.

Inhalation Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.

Ingestion IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell. Rinse mouth. Do NOT induce vomiting. Promptly drink large quantities of milk, egg white, gelatin solution, or if these are not available, drink large quantities of water. Never give anything by mouth to an unconscious person. Avoid alcohol.

Most Important Symptoms and Effects, both Acute and Delayed

Symptoms Causes skin irritation. Repeated or prolonged contact may cause allergic dermatitis. May cause irritation or burns on wet skin. May cause eye irritation. Irritates the digestive tract. Abdominal discomfort. Inhalation of dust can result in irritation of nasal mucous membranes and sometimes of the pharynx. On occasion ulceration with perforation of the nasal septum.

Indication of any Immediate Medical Attention and Special Treatment Needed

Note to Physicians Treat symptomatically. Material may be corrosive. Possible mucosal damage may contraindicate the use of gastric lavage. Measures against circulatory shock, respiratory depression and convulsions may be necessary. Wilson's disease can be aggravated by excessive exposure. Symptoms include nausea, vomiting, epigastria pain, diarrhea, jaundice, and general debility.

5. FIRE-FIGHTING MEASURES

Suitable Extinguishing Media

Dry chemical, CO2 or water spray. Copper Sulfate does not burn nor will it support combustion.

Unsuitable Extinguishing Media If dry heated above 600 °C/ 1112 °F, SO2 is evolved. If water is used it will solubilize the Copper Sulfate and care should be taken to keep such water out of streams or other bodies of water.

Specific Hazards Arising from the Chemical

Not determined.

Hazardous Combustion Products If heated above 400°C/ 752°F product can decompose to emit toxic fumes of oxide and sulfur.

Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions, Protective Equipment and Emergency Procedures

Personal Precautions Use personal protective equipment as required.

Methods and Material for Containment and Cleaning Up

Methods for Containment Prevent further leakage or spillage if safe to do so.

Methods for Cleaning Up Avoid the generation of dusts during clean-up. Wear NIOSH or MSHA approved respirator if dust will be generated. Dry sweep up, using a sweeping compound. Shovel spill material into plastic bags and seal with tape. Place in appropriate containers for disposal. Dispose of contents/container to an approved waste disposal plant. Prevent run off to storm sewers and ditches leading to natural waterways.

7. HANDLING AND STORAGE

Precautions for Safe Handling

Advice on Safe Handling Use personal protection recommended in Section 8. Wash face, hands and any exposed skin thoroughly after handling. Do not eat, drink or smoke when using this product. Wash thoroughly after handling before eating, drinking, smoking, or using toilet facilities. Wear protective gloves/protective clothing. Wash outside of gloves before removing. Wash and change into clean clothing as soon as possible.

Conditions for Safe Storage, Including any Incompatibilities

Storage Conditions Keep containers tightly closed in a dry, cool and well-ventilated place. Store locked up. Store away from reducing agents. Keep away from galvanized pipe, aluminum and nylon. Store in original containers. Place damaged containers in plastic bags. Iron and moisture should be avoided. With exposure to air it will oxidize and turn whitish.

Packaging Materials Solutions are mildly corrosive to steel. Store in plastic or rubber or 304, 347 or 316 stainless steel.

Incompatible Materials Aluminum powders. Acetylene. Hydroxylamine. Magnesium. Moisture. Contact with magnesium can generate dangerous levels of hydrogen gas.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Exposure Guidelines

Chemical Name	ACGIH TLV	OSHA PEL	NIOSH IDLH
Copper sulfate pentahydrate 7758-99-8	TWA: 1 mg/m^3 Cu dust and mist	TWA: 1 mg/m^3 Cu dust and mist	IDLH: 100 mg/m^3 Cu dust and mist TWA: 1 mg/m^3 Cu dust and mist

Appropriate Engineering Controls

Engineering Controls Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits. Eyewash stations. Showers.

Individual Protection Measures, such as Personal Protective Equipment

Eye/Face Protection Wear safety glasses with side shields (or goggles).

Skin and Body Protection Wear long-sleeved shirt, long pants, and shoes plus socks. Wear waterproof gloves. Discard clothing and other absorbent materials that have been drenched or heavily contaminated with product's concentrate. Do not reuse them. Keep and wash PPE separately from other laundry.

Respiratory Protection If necessary, wear an approved respirator for dusts or mists: MSHA/NIOSH approved number prefix TC-21C, or a NIOSH approved respirator with any R, P or HE filter. Alternatively, provide respiratory protection in accordance with Paragraph 1910.134 of Title 29 of the Code of Federal Regulations.

General Hygiene Considerations Handle in accordance with good industrial hygiene and safety practice.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on Basic Physical and Chemical Properties

Physical State	Solid		
Appearance	Transparent blue crystals or blue powder	**Odor**	Odorless
Color	Blue	**Odor Threshold**	Not determined

Property	Values	Remarks • Method
pH	Not Applicable	
Melting Point/Freezing Point	110 °C / 230 °F	
Boiling Point/Boiling Range	150 °C / 302 °F	
Flash Point	Not determined	
Evaporation Rate	Not Applicable	
Flammability (Solid, Gas)	Not determined	

Upper Flammability Limits	Not determined	
Lower Flammability Limit	Not determined	
Vapor Pressure	Not Applicable	
Vapor Density	Not Applicable	
Specific Gravity	2.284	
Water Solubility	22.37%	@ 0 °C / 32 °F
Solubility in Other Solvents	Soluble in methanol, glycerol and slightly soluble in ethanol	
Partition Coefficient	Not determined	
Autoignition Temperature	Not determined	
Decomposition Temperature	Not determined	
Kinematic Viscosity	Not determined	
Dynamic Viscosity	Not determined	
Explosive Properties	Not determined	
Oxidizing Properties	Not determined	

10. STABILITY AND REACTIVITY

Reactivity
Not reactive under normal conditions.

Chemical Stability
Stable under recommended storage conditions.

Possibility of Hazardous Reactions
None under normal processing. Does not react with water.

Hazardous Polymerization Hazardous polymerization does not occur.

Conditions to Avoid
Keep out of reach of children. Solutions are mildly corrosive to steel. Store in plastic or rubber or 304, 347 or 316 stainless steel.

Incompatible Materials
Aluminum powders. Acetylene. Hydroxylamine. Magnesium. Moisture. Contact with magnesium can generate dangerous levels of hydrogen gas.

Hazardous Decomposition Products

Under normal conditions of storage and use, hazardous decomposition products should not be produced. If dry heated above 600° C/ 1112°F toxic sulfur may evolve.

11. TOXICOLOGICAL INFORMATION

Information on Likely Routes of Exposure

Product Information

Eye Contact Avoid contact with eyes.

Skin Contact Harmful in contact with skin.

Inhalation Avoid inhalation of dust.

Ingestion Harmful if swallowed.

Component Information

Chemical Name	Oral LD50	Dermal LD50	Inhalation LC50
Copper sulfate pentahydrate 7758-99-8	= 472 mg/kg (Rat)	> 2 g/kg (Rat)	> 2.95 mg/L (Rat)

Information on Physical, Chemical and Toxicological Effects

Symptoms Please see section 4 of this SDS for symptoms.

Delayed and Immediate Effects as well as Chronic Effects from Short and Long-term Exposure

Carcinogenicity This product does not contain any carcinogens or potential carcinogens as listed by OSHA, IARC or NTP.

Numerical Measures of Toxicity
Not determined

12. ECOLOGICAL INFORMATION

Ecotoxicity
Very toxic to aquatic life with long lasting effects.

Chemical Name	Algae/aquatic plants	Fish	Toxicity to microorganisms	Crustacea
Copper sulfate pentahydrate 7758-99-8		0.66 - 1.15: 96 h Lepomis macrochirus mg/L LC50 semi-static 0.96 - 1.8: 96 h Lepomis macrochirus mg/L LC50 static 0.1478 - 0.165: 96 h Oncorhynchus mykiss mg/L LC50 flow-through 0.09 - 0.19: 96 h Oncorhynchus mykiss mg/L LC50 static 0.6752: 96 h Pimephales promelas mg/L LC50 static		0.147 - 0.227: 48 h Daphnia magna mg/L EC50 Static

Persistence and Degradability
Not determined

Bioaccumulation
Not determined

Mobility
Not determined

Other Adverse Effects
Not determined

13. DISPOSAL CONSIDERATIONS

Waste Treatment Methods

Disposal of Wastes Disposal should be in accordance with applicable regional, national and local laws and regulations. With prior approval the material can be returned to the manufacturer.

Contaminated Packaging Disposal should be in accordance with applicable regional, national and local laws and regulations.

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Chemical Name	California Hazardous Waste Status
Copper sulfate pentahydrate 7758-99-8	Toxic

14. TRANSPORT INFORMATION

Note Please see current shipping paper for most up to date shipping information, including exemptions and special circumstances.

DOT When shipped domestically in non-bulk packages weighing less than 10 lbs., product is NOT REGULATED for ground transportation. The following DOT description for shipping as REGULATED only applies when shipping in packages containing more than 10 lbs. of product. When this is the case, drivers are required to have Hazmat Certification.

UN/ID No	UN3077
Proper Shipping Name	Environmentally Hazardous Substance, solid, n.o.s. (Cupric Sulfate)
Hazard Class	9
Packing Group	III
Reportable Quantity (RQ)	10 lbs
Marine Pollutant	This product contains a chemical which is listed as a severe marine pollutant according to DOT.
Emergency Response Guide Number	171

IATA

UN/ID No	UN3077
Proper Shipping Name	Environmentally Hazardous Substance, solid, n.o.s. (Cupric Sulfate)
Hazard Class	9
Packing Group	III

IMDG

UN/ID No	UN3077
Proper Shipping Name	Environmentally Hazardous Substance, solid, n.o.s. (Cupric Sulfate)
Hazard Class	9
Packing Group	III
Marine Pollutant	This product contains a chemical which is listed as a severe marine pollutant according to IMDG/IMO

15. REGULATORY INFORMATION

International Inventories

TSCA	Listed

Legend:

TSCA *- United States Toxic Substances Control Act Section 8(b) Inventory*

DSL/NDSL *- Canadian Domestic Substances List/Non-Domestic Substances List*

EINECS/ELINCS *- European Inventory of Existing Chemical Substances/European List of Notified Chemical Substances*

ENCS *- Japan Existing and New Chemical Substances*

IECSC *- China Inventory of Existing Chemical Substances*

KECL *- Korean Existing and Evaluated Chemical Substances*

PICCS *- Philippines Inventory of Chemicals and Chemical Substances*

US Federal Regulations

CERCLA

Chemical Name	Hazardous Substances RQs	CERCLA/SARA RQ	Reportable Quantity (RQ)
Copper sulfate pentahydrate 7758-99-8	10 lbs	10 lbs	10 lbs

SARA 311/312 Hazard Categories

Acute health hazard	Yes

SARA 313

Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product contains a chemical or chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372

Chemical Name	CAS No	Weight-%	SARA 313 - Threshold Values %
Copper sulfate pentahydrate - 7758-99-8	7758-99-8	100	1.0

CWA (Clean Water Act)

Component	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants	CWA - Hazardous Substances
Copper sulfate pentahydrate 7758-99-8 (100)		X		

US State Regulations

U.S. State Right-to-Know Regulations

Chemical Name	New Jersey	Massachusetts	Pennsylvania
Copper sulfate pentahydrate 7758-99-8	X		X

16. OTHER INFORMATION

NFPA	**Health Hazards**	**Flammability**	**Instability**	**Special Hazards** Not determined **Personal**
	3	0	0	
HMIS	**Health Hazards**	**Flammability**	**Physical Hazards**	**Protection** Not determined
	3	0	0	

Issue Date	02-May-2013
Revision Date	03-May-2013
Revision Note	New format

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

End of Safety Data Sheet

COPPER SULFATE PENTAHYDRATE

Warning

Harmful in contact with skin - Harmful if swallowed

Do not eat, drink or smoke when using this product. - IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell. - IF ON SKIN: Wash with plenty of soap and water. - Take off contaminated clothing and wash before reuse.

Old Bridge Chemicals, Inc.

Please refer to the original SDS for more information

Safety Data Sheet
MAGNAFLOC® 10 (US)

1. Product and Company Identification

Company
BASF CORPORATION
100 Campus Drive
Florham Park, NJ 07932, USA

24 Hour Emergency Response Information
CHEMTREC: 1-800-424-9300
BASF HOTLINE: 1-800-832-HELP

Registrant:

Chemical family: polyacrylamide, anionic

2. Hazards Identification

Emergency overview

Signal word:	NOTICE! !
Colour:	off-white
Appearance:	powder
State of matter:	solid
Odour:	odourless
Health:	Dust may cause mechanical irritation to eyes and skin., May cause some irritation to the respiratory system if dust is inhaled.
Physical/Chemical hazards:	Slip hazard when wet.

Potential health effects

Primary routes of entry:

Eyes, Skin, Inhalation, Ingestion

3. Composition/Information on Ingredients

This material is classified as not hazardous under OSHA regulations.

4. First-aid Measures

Inhalation:

Remove to fresh air, if not breathing give artificial respiration. If breathing is difficult, give oxygen and get immediate medical attention.

Skin:

Remove contaminated clothing. Wash affected skin with plenty of water, shower if necessary.
Get medical attention if irritation occurs.

Eyes:

Immediately flush the eye(s) with lukewarm, gently flowing water for 15 minutes or until the chemical is removed. Get immediate medical attention if irritation persists.

Ingestion:

Do not induce vomiting. If vomiting occurs naturally, have casualty lean forward to reduce the risk of aspiration. Seek medical attention immediately.

5. Fire-fighting Measures

Suitable extinguishing media:

water, water spray, foam, carbon dioxide, dry powder

Unsuitable Extinguishing Media:

If water is used, restrict pedestrian and vehicular traffic in areas where slip hazard may exist.

Hazardous combustion products:

Carbon and nitrogen oxides.

Hazards during fire-fighting:

Very slippery when wet.
Do not release chemically contaminated water into drains, soil or surface water. Sufficient measures must be taken to retain the water used for extinguishing. Dispose of contaminated water and soil according to local regulations.

Protective equipment for fire-fighting:

Wear self-contained breathing apparatus and chemical-protective clothing.

6. Accidental Release Measures

Cleanup:

Sweep up and shovel into suitable containers for disposal.
Wear suitable protective equipment.
Avoid raising dust.
Should not be released into the environment.

7. Handling and Storage

Handling

General advice:

As with all industrial chemicals, use good industrial practices when handling. Avoid eye, skin, and clothing contact. Do not inhale. Do not taste or swallow. Use only with adequate ventilation.

Storage

General advice:

Keep containers tightly closed in a dry, cool and well ventilated place.
Store between 0 - 35°C (32 - 95°F)

> for industrial use only <

8. Exposure Controls and Personal Protection

Engineering Controls:

Work in well ventilated areas. Do not breathe dust.

Personal protective equipment

Respiratory protection:

Wear a NIOSH-certified respirator as necessary.

Eye protection:

Safety glasses with side-shields (frame goggles) (EN 166)

Body protection:

Wear chemical resistant gloves and protective clothing.

General safety and hygiene measures:

There are no OSHA or ACGIH exposure guidelines available for component(s) in this product.

9. Physical and Chemical Properties

Colour:	off-white	
Form:	powder	
State of matter:	solid	
Odour:	odourless	
pH value:	4 - 9	(5 g/l)
Evaporation rate:		Not tested
Flash point:		Not applicable
Melting point:		Not applicable
Boiling point:		Not applicable
Vapour pressure:		Not applicable
Bulk density:	approx. 800 kg/m3	
Partitioning coefficient n-octanol/water (log Pow):		Not tested
Viscosity, dynamic:	approx. 1,000 mPa.s	(0.5 %(m))
Solubility in water:		Forms a viscous solution
Autoignition:		Not applicable

10. Stability and Reactivity

Stability:

Stable.

Conditions to avoid: Avoid extreme temperatures.

Substances to avoid: oxidizing agent

Possibility of Hazardous Reactions: No hazardous reactions if stored and handled as prescribed/indicated.

Hazardous decomposition products: No decomposition expected under normal storage conditions.

11. Toxicological Information

Acute oral toxicity:

LD50 / oral / rat: > 5,000 mg/kg

Acute inhalation toxicity:

Not tested

Acute dermal toxicity:

dermal:
not determined

Skin irritation:

rabbit: non-irritant

Eye irritation:

: non-irritant

Skin Sensitization:

Sensitization / guinea pig: Non-sensitizing.

Subacute Toxicity:

not determined

Subchronic Toxicty:

not determined

Chronic toxicity:

(Rat) 2-year oral study showed no significant toxic effects.

Genetic toxicity:

Not determined.

Carcinogenicity:

None of the components in this product at concentrations greater than 0.1% are listed by IARC; NTP, OSHA or ACGIH as a carcinogen.

Reproductive toxicity:

not determined

Developmental toxicity/teratogenicity:

not determined

12. Ecological Information

Toxicity to fish:

Brachydanio rerio/96 h/LC50: > 100 mg/l (OECD 203/EC C.1)
By analogy with a product of similar composition

Toxicity to aquatic invertebrates:

Daphnia magna/48 h/EC50: > 100 mg/l (OECD 202)
By analogy with a product of similar composition

Toxicity to aquatic plants:

Scenedesmus subspicatus/72 h/IC50: > 100 mg/l (OECD 201/EC C. 3)
By analogy with a product of similar composition

Toxicity to microorganisms:

Not tested

Biodegradation:

Evaluation: Not readily biodegradable.

Bioaccumulation:

Does not accumulate in organisms.

13. Disposal Considerations

Waste disposal of substance:

Dispose of in accordance with national, state and local regulations.

Resource Conservation and Recovery Act (RCRA): Not a hazardous waste under RCRA (40 CFR 261).

14. Transport Information

U.S. Department of Transportation

The listed Transportation Classification does not address regulatory variations due to changes in package size, mode of shipment or other regulatory descriptors.

Road transport:

Special shipping information: Not classified as a dangerous good under transport regulations.

Air transport:

Special shipping information: Not classified as a dangerous good under transport regulations.

Inland-waterway transport:

Special shipping information: Not classified as a dangerous good under transport regulations.

15. Regulatory Information

US: Toxic Substances Control Act (TSCA):	All component(s) comprising this product are either exempt or listed on the TSCA inventory
Canada: Domestic Substances List (DSL):	All components either exempt or listed on the DSL

United States - Regulations

SARA Section 311/312 Hazard Communication Standard:

Acute Health:	N	Fire:	N
Chronic Health:	N	Reactivity:	N
		Sudden release of pressure:	N

SARA Section 313 Toxic Chemical List:

This product does not contain any components reportable under Sec 313 (40 CFR 372).

OSHA hazard category:

This material is classified as not hazardous under OSHA regulations.

Toxic Substances Control Act (TSCA) Significant New Use Rule (SNUR):

This product is not subject to a Significant New Use Rule (SNUR).

Toxic Substances Control Act (TSCA) Section 5(e) Consent Orders:

This product is not subject to a Section 5(e) Consent Order.

Toxic Substances Control Act (TSCA) Section 5(f):

This product is not subject to a Section 5(f)/6(a) rule.

Toxic Substances Control Act (TSCA) Section 12(b) Export Notification:

No components listed.

Clean Air Act - Hazardous Air Pollutants (HAP):

Chemical name	CAS Number	Notification
2-Propenamide	79-06-1	Listed

Clean Air Act 602 - Ozone Depleting Substances (ODS):

This product neither contains, nor was manufactured with, a Class I or Class II ozone depleting substance (ODS), as defined by the U.S. Clean Air Act Section 602 (40 CFR 82, Subpt. A, App. A+B).

Clean Water Act - Priority Pollutants (PP):

This product does not contain any priority pollutants listed under the U.S. Clean Water Act Section 307(2)(1) Priority Pollutant List (40 CFR 401.15).

Pennsylvania Right to Know:

Chemical name	CAS Number	Notification
2-Propenamide	79-06-1	Environmental hazard.
2-Propenamide	79-06-1	Listed

California Proposition 65 - Chemicals Known to the State to Cause Cancer:

Chemical name	CAS Number	Notification
2-Propenamide	79-06-1	Carcinogenic.

WARNING: This product contains a chemical known to the State of California to cause cancer.

International Regulations

Chemical Weapons Convention:

This product does not contain any component(s) listed under the Chemical Weapons Convention Schedule of Chemicals.

16. Other Information

INFRINGING THE INTELLECTUAL PROPERTY RIGHTS OF OTHERS. IN NO CASE SHALL THE DESCRIPTIONS, INFORMATION, DATA OR DESIGNS PROVIDED BE CONSIDERED A PART OF OUR TERMS AND CONDITIONS OF SALE. FURTHER, YOU EXPRESSLY UNDERSTAND AND AGREE THAT THE DESCRIPTIONS, DESIGNS, DATA, AND INFORMATION FURNISHED BY BASF HEREUNDER ARE GIVEN GRATIS AND BASF ASSUMES NO OBLIGATION OR LIABILITY FOR THE DESCRIPTION, DESIGNS, DATA AND INFORMATION GIVEN OR RESULTS OBTAINED, ALL SUCH BEING GIVEN AND ACCEPTED AT YOUR RISK.

Due to the merger of CIBA and BASF Group all Material Safety Data Sheets have been reassessed on the basis of consolidated information. This may have resulted in changes of the Material Safety Data Sheets. In case you have questions concerning such changes please contact us at the address mentioned in Section I.

END OF DATA SHEET

BASF
We create chemistry

MAT NO: 56458981

LOT:

V1.7

Magnafloc® 10

Caution - Slippery when wet!

May cause some eye irritation which should cease after removal of the product., May cause some irritation to the respiratory system if dust is inhaled., MAY CAUSE SKIN IRRITATION., This type of product has a tendency to create dust if roughly handled. It does not burn readily but as with many organic powders, flammable dust clouds may be formed in air. Use NIOSH approved respirator as needed to mitigate exposure. Wear NIOSH-certified chemical goggles. Take precautionary measures against static discharges.

FIRST AID: GENERAL: Remove contaminated clothing. SKIN: Wash thoroughly with soap and water. If irritation develops, seek medical attention. EYES: Wash affected eyes for at least 15 minutes under running water with eyelids held open. Seek medical attention. INGESTION: Rinse mouth and then drink plenty of water. Do not induce vomiting. Immediate medical attention required. INHALATION: If difficulties occur after dust has been inhaled, remove to fresh air and seek medical attention.

IN CASE OF FIRE: EXTINGUISHING MEDIA: dry powder, foam MAY BE EMITTED: carbon oxides nitrogen oxides The substances/groups of substances mentioned can be released in case of fire. Very slippery when wet. Wear a self-contained breathing apparatus. The degree of risk is governed by the burning substance and the fire conditions. Contaminated extinguishing water must be disposed of in accordance with official regulations.

IN CASE OF SPILLS OR LEAKS: Use personal protective clothing. Do not discharge into drains/surface waters/groundwater. Spilled product which becomes wet or spilled aqueous solution create a hazard because of their slippery nature. Avoid raising dust.

EMPTY CONTAINERS: Dispose of in a licensed facility. Recommend crushing, puncturing or other means to prevent unauthorized use of used containers.

DISPOSAL: Must be disposed of or incinerated in accordance with local regulations.

HANDLING AND STORAGE: Breathing must be protected when large quantities are decanted without local exhaust ventilation. Handle in accordance with good industrial hygiene and safety practice. Forms slippery surfaces with water. Store in unopened original containers in a cool and dry place. Avoid wet, damp or humid conditions, temperature extremes and ignition sources.

IN CASE OF CHEMICAL EMERGENCY: Call CHEMTREC day or night for assistance and information concerning spilled material, fire, explosive, and other chemical accidents. 800-424-9300 or 703-527-3887 outside the US.

ATTENTION: Refer to our technical bulletin and material safety data sheet regarding safety, usage, application, hazards, procedures and disposal of this product. Consult your supervisor for additional information.

RTK: Proprietary Copolymer TSRN 161090809-5200; urea 57-13-6; Water 7732-18-5; Proprietary Alcohol TSRN 161090809-5222

PROPER SHIPPING NAME:
NOT REQUIRED

H	0
F	1
R	0
P	X

BASF CORPORATION
2301 WILROY RD.
SUFFOLK, VA, 23434 USA

PKG NO:1

	NET	GROSS
KG	25.0	25.2
LB	55.1	55.6

BASF
The Chemical Company

Magnafloc® 10

Anionic flocculant

Description

Magnafloc 10 is a very high molecular weight, slightly anionic polyacrylamide flocculant supplied as a free flowing granular powder.

Principal uses

Magnafloc 10 has found application in a wide variety of mineral processing operations including the following:

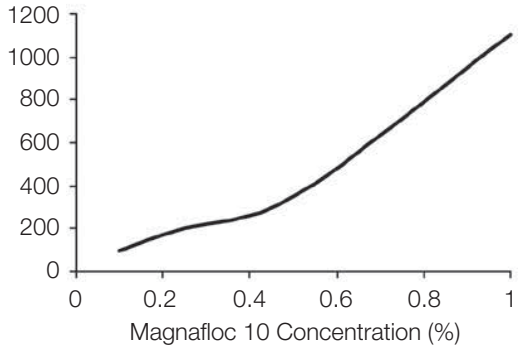
1. Acid leach CCD (uranium)
2. Potash slimes clarification and dewatering
3. Acid leach CCD (copper)
4. Acid leach (zinc)
5. Iron ore tailings clarification
6. Base metal concentrates thickenings and filtration
7. Thickening of coal tailings

Dosage depends on application but normally lies in the range 2 – 200 g/tonne of dry substrate flocculated.

Typical properties

Physical form:	Off-white granular powder
Particle size:	98 % < 1000 µm
Bulk density:	0.7 g/cm^3
pH of 1 % solution at 25 °C:	6.5
Viscosity at 25 °C:	See graph and table

Apparent Viscosity-Concentration Graph (Fann Viscometer-Shear Rate 5.11 sec^{-1})



Application & Storage

Recommended solution concentrations:

Stock solution: 0.25 – 0.5 % max.
Feed solution: 0.025 – 0.1 % max.

Shelf life

2 years from receipt of goods

Stock solution: 1 – 2 days

Storage of polymer should be in a cool, dry place.

Details on preparation and application can be obtained from a BASF representative.

Solution viscosity data (Fann viscometer – 25 °C – solvent – deionised water)

Magnafloc 10 concentration (%)	**Shear rate (sec^{-1})**					
	5.11	10.22	170	340	511	1022
	Viscosity (cP)					
1.0	1100	700	126	87	74	63
0.5	350	250	48	35	29	24
0.25	200	125	24	18	15	12
0.10	100	63	12	9	7	6

Shipping & Handling

Magnafloc 10 is supplied in 25 kg nett plastic bags shrinkwrapped onto a pallet suitable for export shipment. The product can also be supplied via intermediate big bags or bulk tanker. Specific details of bag and tanker sizes can be obtained on request.

Corrosivity towards most standard materials of construction is low, but aluminium and galvanised equipment should be avoided.

Technical service

Advice and assistance in the running of laboratory and plant tests to select the correct product and determine the best application can be provided by representatives of BASF, who are experienced in mineral processing applications.

Health & Safety

Magnafloc 10 exhibits a very low order of oral toxicity and does not present any abnormal problems in its handling or general use.

Detailed information on handling and any precautions to be observed in the use of the product(s) described in this leaflet can be found in our relevant health and safety information sheet.

Note

March 2013

BASF SE
Global Mining Solutions
67056 Ludwigshafen, Germany
www.basf.com/miningsolutions

The Chemical Company

Safety Data Sheet
MAGNAFLOC® 455 (US)

1. Product and Company Identification

Company
BASF CORPORATION
100 Campus Drive
Florham Park, NJ 07932, USA

24 Hour Emergency Response Information
CHEMTREC: 1-800-424-9300
BASF HOTLINE: 1-800-832-HELP

Registrant:

2. Hazards Identification

Emergency overview

Signal word:	CAUTION: !
Colour:	white
Appearance:	powder
State of matter:	solid
Odour:	ammonia-like
Health:	This product is an eye, skin and respiratory irritant.
Physical/Chemical hazards:	Slip hazard when wet., Organic powders may be capable of generating static discharges and creating explosive mixtures in air. Handle with caution., Refer to MSDS Section 7 for Dust Explosion information.

Potential health effects

Primary routes of entry:

Eyes, Skin, Inhalation, Ingestion

Potential environmental effects

Releases to the environment are to be avoided.

3. Composition/Information on Ingredients

Chemical name	CAS Number	Content (Weight)	Hazardous
Urea	57-13-6	1.0 - 3.0 %	Y
Acrylamide Copolymerc	Trade Secret	86.0 - 90.0 %	Y
Hexanedioic-acid-	124-04-9	3.0 - 5.0 %	Y

This material is classified as hazardous under OSHA regulations.

4. First-aid Measures

Inhalation:

Remove to fresh air, if not breathing give artificial respiration. If breathing is difficult, give oxygen and get immediate medical attention.

Skin:

If clothing is contaminated, remove and launder before reuse.
After contact with skin, wash immediately with plenty of water and soap.
Get medical attention if irritation occurs.

Eyes:

Immediately flush the eye(s) with lukewarm, gently flowing water for 15 minutes or until the chemical is removed. Get immediate medical attention if irritation persists.

Ingestion:

Do not induce vomiting. If vomiting occurs naturally, have casualty lean forward to reduce the risk of aspiration. Seek medical attention immediately.

5. Fire-fighting Measures

Suitable extinguishing media:

carbon dioxide, dry powder, foam

Unsuitable Extinguishing Media:

If water is used, restrict pedestrian and vehicular traffic in areas where slip hazard may exist.

Hazardous combustion products:

Carbon and nitrogen oxides.

Hazards during fire-fighting:

Standard procedure for chemical fires.
Dust in sufficient concentration can result in an explosive mixture in air. Handle to minimize dusting and eliminate open flame and other sources of ignition.

Protective equipment for fire-fighting:

Wear self-contained breathing apparatus and chemical-protective clothing.

6. Accidental Release Measures

Cleanup:

Product becomes slippery and difficult to handle when wet.
Sweep up and shovel into suitable containers for disposal.
Avoid raising dust.
Wear suitable protective equipment.
Should not be released into the environment.

7. Handling and Storage

Handling

General advice:

As with all industrial chemicals, use good industrial practices when handling. Avoid eye, skin, and clothing contact. Do not inhale. Do not taste or swallow. Use only with adequate ventilation. Slip hazard when wet. Clean up spills promptly

Protection against fire and explosion:

Combustible powder. Avoid creating dusty conditions. - Grounding is required when emptying into a conductive container. - When flammable solvents are present, the container must be inerted or the system otherwise designed to prevent or contain an explosion. Seek expert advice. In addition, for products packaged in fused-lined (coated) fiberdrums, fiber drums with conductive liners, steel drums, steel pails, andType " C " FIBC (bulk bags), or other conductive the following instructions also apply: - Always ground this package before emptying. The user is responsible for designing the system to handle solid and ensuring proper training of employees in the system's use.

Storage

General advice:

Keep container tightly closed in a dry, cool and well-ventilated place.
Avoid wet, damp or humid conditions, temperature extremes and ignition sources.

> for industrial use only <

8. Exposure Controls and Personal Protection

Exposure Guidelines

ORGANIC DUST	ACGIH	TWA value: 10 mg/m3 Inhalable particles.
		TWA value: 3 mg/m3 Respirable particles.
	OSHA	PEL: 5 mg/m3 Respirable fraction.
		PEL: 15 mg/m3 Total dust.
	Z1A	TWA value: 5 mg/m3 Respirable fraction.
		TWA value: 15 mg/m3 Total dust.
	OSHA	TWA value: 15 millions of particles per cubic foot of air Respirable fraction.
		TWA value: 50 millions of particles per cubic foot of air Total dust.
		TWA value: 5 mg/m3 Respirable fraction.
		TWA value: 15 mg/m3 Total dust.
Hexanedioic-acid- (124-04-9)	ACGIH	TWA value: 5 mg/m3

Engineering Controls:

Work in well ventilated areas. Do not breathe dust.
Ensure good ventilation and local exhaust.

Personal protective equipment

Respiratory protection:

Wear a NIOSH-certified respirator as necessary.

Eye protection:

Wear safety goggles (chemical goggles) if there is potential for airborne dust exposures.

Body protection:

Wear chemical resistant gloves and protective clothing.

General safety and hygiene measures:

Eye wash station and safety shower should be available in immediate work area., Select additional protective equipment based upon potential for exposure.

9. Physical and Chemical Properties

Colour:	white	
Form:	powder	
State of matter:	solid	
Odour:	ammonia-like	
pH value:		Not tested
Evaporation rate:		Not tested
Flash point:		Not applicable
Melting point:		Not applicable
Boiling point:		Not applicable
Vapour pressure:		Not tested
Bulk density:	approx. 600 kg/m3	
Vapour density:		Not tested
Partitioning coefficient n-octanol/water (log Pow):		Not applicable
Viscosity, dynamic:		Not tested
% Volatiles:		not determined
Solubility in water:		Forms a viscous solution
Solubility in other solvents:		Not tested

10. Stability and Reactivity

Stability:

Stable.

Conditions to avoid: Avoid humidity. Avoid high temperatures. Avoid handling conditions that create dust. Avoid electro-static discharge. Avoid sources of ignition.

Substances to avoid: Strong oxidizing agents., (may degrade polymer)

Possibility of Hazardous Reactions: Product has a high minimum ignition energy; however, dust may be ignited under some conditions.

Hazardous decomposition products: No decomposition expected under normal storage conditions.

11. Toxicological Information

Acute oral toxicity:

LD50 / oral / rat: > 2,000 mg/kg

Acute inhalation toxicity:

Not determined.

Acute dermal toxicity:

dermal:

Not tested

Skin irritation:

not determined

Information on: Urea

(Humans) Mild skin irritant.

Eye irritation:

Not determined.

Information on: Urea

: Irritant.
(Humans)

Information on: Hexanedioic-acid-

(Rabbits) Severe Irritant.

Skin Sensitization:

not determined

Chronic toxicity:

not determined

Subacute Toxicity:

not determined

Subchronic Toxicty:

Information on: Hexanedioic-acid-

Contains adipic acid, which exhibited the following - male and female rats exposed to adipic acid in the form of an aerosol dust (126 mcg/l) for 6 hours a day for 15 days showed no signs of toxicity.

Genetic toxicity:

Not determined.

Information on: Hexanedioic-acid-

Information on: Urea

Information on: Hexanedioic-acid-

Carcinogenicity:

None of the components in this product at concentrations greater than 0.1% are listed by IARC; NTP, OSHA or ACGIH as a carcinogen.

Information on: Hexanedioic-acid-

Information on: Urea

Information on: Hexanedioic-acid-

Reproductive toxicity:

not determined

Information on: Hexanedioic-acid-

Information on: Urea

Information on: Hexanedioic-acid-

Developmental toxicity/teratogenicity:

not determined

Information on: Hexanedioic-acid-

(Mice)
Pregnant mice were exposed to 263 mg/kg on days 6 through 15 of gestation. No effects on maternal or fetal survival, or fetal abnormalities was observed

---

Information on: Urea

Information on: Hexanedioic-acid-

(Mice)
Pregnant mice were exposed to 263 mg/kg on days 6 through 15 of gestation. No effects on maternal or fetal survival, or fetal abnormalities was observed

---

12. Ecological Information

Toxicity to fish:

Fish general (Pisces)/96 h/LC50: 1 - 10 mg/l

Toxicity to aquatic invertebrates:

48 h/EC50: 10 - 100 mg/l

Toxicity to aquatic plants:

/72 h/EC50: 1 - 10 mg/l

Toxicity to microorganisms:

Not tested

Biodegradation:

Not tested

Bioaccumulation:

Considered to be zero due to charge and high molecular weight

13. Disposal Considerations

Waste disposal of substance:

Dispose of in accordance with national, state and local regulations.

Resource Conservation and Recovery Act (RCRA): Not a hazardous waste under RCRA (40 CFR 261).

14. Transport Information

U.S. Department of Transportation

The listed Transportation Classification does not address regulatory variations due to changes in package size, mode of shipment or other regulatory descriptors.

Road transport:

Special shipping information: Not classified as a dangerous good under transport regulations.

Air transport:

Special shipping information: Not classified as a dangerous good under transport regulations.

Inland-waterway transport:

Special shipping information: Not classified as a dangerous good under transport regulations.

15. Regulatory Information

US: Toxic Substances Control Act (TSCA):	All component(s) comprising this product are either exempt or listed on the TSCA inventory
Canada: Domestic Substances List (DSL):	All components either exempt or listed on the DSL

United States - Regulations

SARA Section 311/312 Hazard Communication Standard:

Acute Health:	Y	Fire:	N
Chronic Health:	N	Reactivity:	N
		Sudden release of pressure:	N

SARA Section 313 Toxic Chemical List:

No components listed.

OSHA hazard category:

This material is classified as hazardous under OSHA regulations.

Toxic Substances Control Act (TSCA) Significant New Use Rule (SNUR):

This product is not subject to a Significant New Use Rule (SNUR).

Toxic Substances Control Act (TSCA) Section 5(e) Consent Orders:

This product is not subject to a Section 5(e) Consent Order.

Toxic Substances Control Act (TSCA) Section 5(f):

This product is not subject to a Section 5(f)/6(a) rule.

Toxic Substances Control Act (TSCA) Section 12(b) Export Notification:

No components listed.

Clean Air Act - Hazardous Air Pollutants (HAP):

Chemical name	CAS Number	Notification
2-Propenamide	79-06-1	Listed

This product does not contain any Hazardous Air Pollutants (HAP), as defined by the U.S. Clean Air Act Section 112 (40 CFR 61).

Clean Air Act 111 - Volatile Organic Compounds (VOC):

Chemical name	CAS Number	Notification
Urea	57-13-6	Listed
2-Propenamide	79-06-1	Listed
Hexanedioic-acid-	124-04-9	Listed

Clean Air Act 602 - Ozone Depleting Substances (ODS):

This product neither contains, nor was manufactured with, a Class I or Class II ozone depleting substance (ODS), as defined by the U.S. Clean Air Act Section 602 (40 CFR 82, Subpt. A, App. A+B).

Clean Water Act - Priority Pollutants (PP):

This product does not contain any priority pollutants listed under the U.S. Clean Water Act Section 307(2)(1) Priority Pollutant List (40 CFR 401.15).

Pennsylvania Right to Know:

Chemical name	CAS Number	Notification
2-Propenamide	79-06-1	Environmental hazard.
2-Propenamide	79-06-1	Listed
Hexanedioic-acid-	124-04-9	Environmental hazard.
Hexanedioic-acid-	124-04-9	Listed

California Proposition 65 - Chemicals Known to the State to Cause Cancer:

Chemical name	CAS Number	Notification
2-Propenamide	79-06-1	Carcinogenic.

WARNING: This product contains a chemical known to the State of California to cause cancer.

California Proposition 65 - Chemicals Known to the State to Cause Reproductive Toxicity:

No components listed.

International Regulations

Chemical Weapons Convention:

This product does not contain any component(s) listed under the Chemical Weapons Convention Schedule of Chemicals.

16. Other Information

SET FORTH, OR THAT THE PRODUCTS, DESIGNS, DATA OR INFORMATION MAY BE USED WITHOUT INFRINGING THE INTELLECTUAL PROPERTY RIGHTS OF OTHERS. IN NO CASE SHALL THE DESCRIPTIONS, INFORMATION, DATA OR DESIGNS PROVIDED BE CONSIDERED A PART OF OUR TERMS AND CONDITIONS OF SALE. FURTHER, YOU EXPRESSLY UNDERSTAND AND AGREE THAT THE DESCRIPTIONS, DESIGNS, DATA, AND INFORMATION FURNISHED BY BASF HEREUNDER ARE GIVEN GRATIS AND BASF ASSUMES NO OBLIGATION OR LIABILITY FOR THE DESCRIPTION, DESIGNS, DATA AND INFORMATION GIVEN OR RESULTS OBTAINED, ALL SUCH BEING GIVEN AND ACCEPTED AT YOUR RISK.

Due to the merger of CIBA and BASF Group all Material Safety Data Sheets have been reassessed on the basis of consolidated information. This may have resulted in changes of the Material Safety Data Sheets. In case you have questions concerning such changes please contact us at the address mentioned in Section I.

END OF DATA SHEET

BASF
We create chemistry

MAT NO: 50184792

LOT:

V1.7

MAGNAFLOC® 455 US

CAUTION:
The product can cause skin and eye irritation., May cause some irritation to the respiratory system if dust is inhaled., Avoid the formation and deposition of dust., Avoid sources of ignition. Refer to MSDS Section 7 for Dust Explosion information. Caution - Slippery when wet! Combustible organic powder. Avoid creating dusty conditions, dust build-up or formation of dust clouds. Avoid all sources of ignition: heat, sparks, open flame.

FIRST AID: GENERAL: Remove contaminated clothing. SKIN: Wash thoroughly with soap and water. If irritation develops, seek medical attention. EYES: Wash affected eyes for at least 15 minutes under running water with eyelids held open. Seek medical attention. INGESTION: Rinse mouth and then drink plenty of water. Do not induce vomiting. Immediate medical attention required. INHALATION: If difficulties occur after dust has been inhaled, remove to fresh air and seek medical attention.

IN CASE OF FIRE: EXTINGUISHING MEDIA: dry powder, foam MAY BE EMITTED: carbon oxides nitrogen oxides The substances/groups of substances mentioned can be released in case of fire. Very slippery when wet. Wear a self-contained breathing apparatus. The degree of risk is governed by the burning substance and the fire conditions. Contaminated extinguishing water must be disposed of in accordance with official regulations.

IN CASE OF SPILLS OR LEAKS: Use personal protective clothing. Do not discharge into drains/surface waters/groundwater. Spilled product which becomes wet or spilled aqueous solution create a hazard because of their slippery nature. Avoid raising dust.

EMPTY CONTAINERS: Dispose of in a licensed facility. Recommend crushing, puncturing or other means to prevent unauthorized use of used containers.

DISPOSAL: Dispose of in accordance with national, state and local regulations.

HANDLING AND STORAGE: Breathing must be protected when large quantities are decanted without local exhaust ventilation. Handle in accordance with good industrial hygiene and safety practice. Forms slippery surfaces with water. Store in unopened original containers in a cool and dry place. Avoid wet, damp or humid conditions, temperature extremes and ignition sources.
Avoid extreme heat.

IN CASE OF CHEMICAL EMERGENCY: Call CHEMTREC day or night for assistance and information concerning spilled material, fire, explosive, and other chemical accidents. 800-424-9300 or 703-527-3887 outside the US.

ATTENTION: Refer to our technical bulletin and material safety data sheet regarding safety, usage, application, hazards, procedures and disposal of this product. Consult your supervisor for additional information.

RTK: Ethanaminium, N,N,N-trimethyl-2-[(1-oxo-2-propenyl)oxy]-, chloride, polymer with 2-propenamide 69418-26-4; Water 7732-18-5; adipic acid 124-04-9; urea 57-13-6; Ethanaminium, N,N,N-trimethyl-2-[(1-oxo-2-propenyl)oxy]-, chloride 44992-01-0; acrylamide 79-06-1

PROPER SHIPPING NAME:
NOT REQUIRED

H	2
F	1
R	0
P	X

BASF CORPORATION
2301 WILROY RD.
SUFFOLK, VA, 23434 USA

PKG NO:1

	NET	GROSS
KG	0.0	0.0
LB	0.0	0.0

BASF
The Chemical Company

Magnafloc® 455

Cationic flocculant

Description

Magnafloc 455 is a high molecular weight slightly cationic polyacrylamide flocculant supplied as a free flowing granular powder.

Principal uses

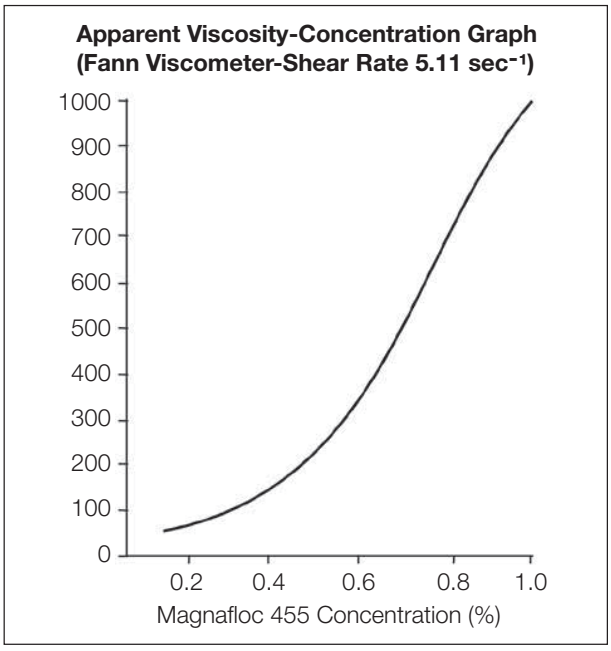
Magnafloc 455 has found application in a variety of mineral processing operations including the following:

1. Acid leach CCD (uranium)
2. Metal hydroxide thickening and filtration
3. Acid leach (zinc)
4. Base metal concentrates thickening and filtration

Dosage depends on application but normally lies in the range 2 – 200 g/tonne of dry substrate flocculated.

Typical properties

Physical form:	Off-white granular powder
Particle size:	98 % < 1400 µm
Bulk density:	0.75 g/cm^3
pH of 1 % solution at 25 °C:	4.0
Viscosity at 25 °C:	See graph and table



Application & Storage

Recommended solution concentrations:

Stock solution: 0.25 – 0.5 % max.
Feed solution: 0.025 – 0.1 % max.

Recommended storage periods:

Solid: up to two years
Stock solution: 1 – 2 days

Storage of polymer should be in a cool, dry place.

Details on preparation and application can be obtained from a BASF representative.

Solution viscosity data (Fann viscometer – 25 °C – solvent – deionised water)

Magnafloc 455 concentration (%)	**Shear rate (sec^{-1})**					
	5.11	10.22	170	340	511	1022
	Viscosity (cP)					
1.0	990	650	113	80	70	55
0.5	200	150	30	27	24	19
0.25	80	50	15	12	10	8
0.10	50	25	6	5	5	4

Shipping & Handling

Magnafloc 455 is supplied in 25 kg nett plastic bags shrinkwrapped onto a pallet suitable for export shipment. The product can also be supplied via intermediate big bags. Specific details of bag sizes can be obtained on request.

Corrosivity towards most standard materials of construction is low, but aluminium and galvanised equipment should be avoided.

Technical service

Advice and assistance in the running of laboratory and plant tests to select the correct product and determine the best application can be provided by representatives of BASF, who are experienced in mineral processing applications.

Health & Safety

Magnafloc 455 has a low order of oral toxicity and does not present any abnormal problems in its handling or general use. However as with all cationic polyelectrolytes the product exhibits toxicity towards fish. It is important that precautions are taken where the product may come into direct contact with fresh water courses, streams and rivers.

Detailed information on handling and any precautions to be observed in the use of the product(s) described in this leaflet can be found in our relevant health and safety information sheet.

Note

The data contained in this publication are based on our current knowledge and experience. In view of the many factors that may affect processing and application of our product, these data do not relieve processors from carrying out their own investigations and tests; neither do these data imply any guarantee of certain properties, nor the suitability of the product for a specific purpose. Any descriptions, drawings, photographs, data, proportions, weights etc. given herein may change without prior information and do not constitute the agreed contractual quality of the product. It is the responsibility of the recipient of our products to ensure that any proprietary rights and existing laws and legislation are observed.

March 2013

BASF SE
Global Mining Solutions
67056 Ludwigshafen, Germany
www.basf.com/miningsolutions

MATERIAL SAFETY DATA SHEET

Rev. Date: 6/09/2009

1. IDENTIFICATION OF THE PRODUCT AND THE COMPANY

Product Name: **NS 6655**

Company: **Neo Solutions, Inc.**
P.O. Box 26
Beaver, PA 15009

Emergency Telephone Number: (724) 728-1847 Fax: (724) 728-3440

Product Use: Process aid for industrial applications.

2. HAZARDS IDENTIFICATION

Appearance and Odor: Form: Granular solid Color: White Odor: None

Emergency Overview

Aqueous solutions or powders that become wet render surfaces extremely slippery.

3. COMPOSITION / INFORMATION ON INGREDIENTS

Identification: Anionic water-soluble polymer.

Regulated Components: None

4. FIRST AID MEASURES

Inhalation: No hazards which require special first aid measures.

Skin contact: Wash with water and soap as a precaution. In case of persistent skin irritation, consult a physician.

Eye contact: Rinse thoroughly with plenty of water, also under the eyelids. In case of persistent eye irritation, consult a physician.

Ingestion: No hazards which require special first aid measures. The product is not considered toxic based on studies on laboratory animals.

5. FIRE-FIGHTING MEASURES

Unsuitable extinguishing media: None

Suitable extinguishing media:	Carbon dioxide (CO_2). Foam. Dry powder. Water. Water spray.
Special fire-fighting precautions:	Aqueous solutions or powders that become wet render surfaces extremely slippery.
Special protective equipment for firefighters:	No special protective equipment required.
Flash point:	Not applicable
Autoignition temperature:	Not applicable

6. ACCIDENTAL RELEASE MEASURES

Personal precautions:	No special precautions required.
Environmental precautions:	As with all chemical products, **DO NOT** flush into surface water.
Methods for cleaning up:	**DO NOT** flush with water. Clean up promptly by scoop or vacuum. Keep in suitable and closed containers for disposal. After cleaning, flush away traces with water.

7. HANDLING AND STORAGE

Handling

Safe handling advice:	Avoid contact with skin and eyes. Avoid dust formation. **DO NOT** breathe dust. Wash hands before breaks and at the end of workday.
Storage:	Keep in a cool, dry place (5 - 35° C).

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Occupational Exposure Limits

No exposure limits noted for ingredient(s).

Engineering measures

Use local exhaust if dusting occurs. Natural ventilation is adequate in absence of dusts.

Personal protection equipment

Respiratory protection:	Dust safety masks are recommended where concentration of total dust is more than 10 mg / m^3.
Hand protection:	Rubber gloves.
Eye protection:	Safety glasses with side-shields. **DO NOT** wear contact lenses.

Skin and body protection: Chemical resistant apron or protective suit if splashing or repeated contact with solution is likely.

Hygiene measure

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

9. PHYSICAL AND CHEMICAL PROPERTIES

Form:	granular solid
Color:	white
Odor:	none
pH:	4 - 9 @ 5 g/L
Melting point (° C):	Not applicable.
Flash point (° C):	Not applicable.
Autoignition temperature (° C):	Not applicable.
Approx. bulk density:	0.80
Water solubility:	Completely miscible
$L_{og}P_{ow}$:	~0

10. STABILITY AND REACTIVITY

Stability: Hazardous polymerization does not occur. Stable.

Materials to avoid: Oxidizing agents may cause exothermic reactions.

Hazardous decomposition products: Thermal decomposition may produce: Nitrogen oxides (NOx). Carbon oxides (COx).

11. TOXICOLOGICAL INFORMATION

Acute toxicity

Skin: The results of testing on rabbits showed this material to be non-toxic even at high dose levels.

Oral: LD50 / oral / rat > 5000 mg / kg

Inhalation: The product is not expected to be toxic by inhalation.

Irritation

Skin: The results of testing on rabbits showed this material to be non-irritating to the skin.

Eyes: Testing conducted according to the Draize technique showed the material produces no corneal or iridial effects and only slight transitory conjuctival effects similar to those which all granular materials have on conjuctivae.

Sensitization

The results of testing on guinea pigs showed this material to be non-sensitizing.

Chronic toxicity: A two-year feeding study on rats did not reveal adverse health effects. A one-year feeding study on dogs did not reveal adverse health effects.

12. ECOLOGICAL INFORMATION

Aquatic toxicity

Toxicity to fish: LC50 / 96 hours > 100 mg/L (OECD 203)

Toxicity to daphnia: LC50 / Daphnia m./ 48 hours > 100 mg/L (OECD 202)

Toxicity to algae: IC50 / Scenedesmus subspicatus / 72 hours > 100 mg/L (OECD 201)

Environmental fate

Persistence and degradability: Not readily biodegradable

Hydrolysis: Does not hydrolyze.

$L_{og}P_{ow}$: ~0

Bioaccumulation: Does not bioaccumulate.

13. DISPOSAL CONSIDERATIONS

Disposal: Not classified as dangerous in the meaning of DOT regulations.

Contaminated packaging: Rinse empty containers with water and use the rinse water to prepare the working solution. Can be landfilled or incinerated, when in compliance with local, state/provincial and federal regulations.

14. TRANSPORT INFORMATION

Remarks: Not classified as dangerous in the meaning of transport regulations.

15. REGULATORY INFORMATION

US SARA Reporting Requirements

SARA Title III Sections

State Regulations

California Proposition 65 Information: The following statement is made in order to comply with the California Safe Drinking Water and Toxic Enforcement Act of 1986. This product contains the following substance(s) known to the State of California to cause cancer: Acrylamide.

International Inventories

USA (TSCA):	All components of this product are either listed on the inventory or are exempt from listing.
Australia (AICS):	All components of this product are either listed on the inventory or are exempt from listing.
Canada (DSL):	All components of this product are either listed on the inventory or are exempt from listing.
China (IECSC):	All components of this product are either listed on the inventory or are exempt from listing.
European Union (EINECS/ELINCS):	All components of this product are either listed on the inventory or are exempt from listing.
Japan (ENCS):	All components of this product are either listed on the inventory or are exempt from listing.
Korea (ECL):	All components of this product are either listed on the inventory or are exempt from listing.
Philippines (PICCS):	All components of this product are either listed on the inventory or are exempt from listing.

16. OTHER INFORMATION

Person to contact: Product Manager

NFPA and HMIS Ratings

	NFPA	HMIS
Health	1	1
Flammability	1	1
Instability	0	
Physical Hazard		0

This MSDS was prepared in accordance with the following:

ISO 11014-1: Material Safety Data Sheet for Chemical Products

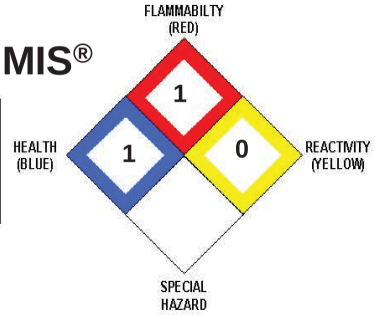
ANSI Z4000.1-2004; Material Safety Data Sheets - Preparation

NS 6655

NEO-SOLUTIONS, INC.
PO Box 26, Beaver, PA 15009
Emergency Phone Number 724-728-1847

NFPA/HMIS®

DEGREE OF HAZARD
4 = EXTREME
3 = HIGH
2 = MODERATE
1 = SLIGHT
0 = INSIGNIFICANT



DOT: Not classified as dangerous in the meaning of transport regulations.

First Aid Measures

Inhalation: Move to fresh air. No hazards which require special first aid measures.

Skin contact: Wash with water and soap as a precaution. Get medical attention if irritation develops and persists.

Eye contact: Rinse thoroughly with plenty of water, also under the eyelids. Get medical attention.

Ingestion: Rinse mouth with water. **DO NOT** induce vomiting. No hazards which require first aid measures.

Fire-Fighting Measures

Suitable extinguishing media: Water. Water spray. Foam. Dry powder. Carbon dioxide (CO_2).

Special fire-fighting precautions: Aqueous solutions or powders that become wet render surfaces extremely slippery.

Special protective equipment for firefighters: No special protective equipment required.
This product **MUST NOT** be discharged into drains.

Accidental Release

Personal precautions: No special precautions required.

Environmental precautions: As with all chemical products, **DO NOT** flush into surface water.

Methods for cleaning up: **DO NOT** flush with water. Clean up promptly by scoop or vacuum. Keep in suitable and closed containers for disposal. After cleaning, flush away traces with water.

Disposal

Disposal: Dispose of in accordance with local, state, provincial and federal regulations.

Container: Can be landfilled or incinerated, when in compliance with local, state, provincial and federal regulations.

Label Elements

Hazard symbol(s): none
Signal Word: none
Hazard statement(s): Aqueous solutions or powders that become wet render surfaces extremely slippery
Precautionaly Statement(s):. none
Prevention
P280 – Wear protective gloves / protective clothing / eye protection / face protection.
P273 – Avoid release to the environment.
Response
IF INHALED: P304+P341 – If breathing is difficult, remove victim to fresh air.
IF ON SKIN: P302+352 – Wash with plenty of soap and water.
IF IN EYES: P313+P337 – If eye irritation persists: Get medical advice/attention.
IF SWALLOWED: P301+P331 – Rinse mouth. Do NOT induce vomiting.
Disposal
P501 – Dispose of contents/container in an approved waste disposal plant.

Fill Weight: _____ lbs.

Gross Weight: _____ lbs.

Lot Number: _____

Fill Date: _____

Refer to current SDS for further information.

SAFETY DATA SHEET

OPTIMER® 83949

Section: 1. PRODUCT AND COMPANY IDENTIFICATION

Product name	:	OPTIMER® 83949
Other means of identification	:	Not applicable.
Recommended use	:	FLOCCULANT
Restrictions on use	:	Refer to available product literature or ask your local Sales Representative for restrictions on use and dose limits.
Company	:	Nalco Company 1601 W. Diehl Road Naperville, Illinois 60563-1198 USA TEL: (630)305-1000
Emergency telephone number	:	(800) 424-9300 (24 Hours) CHEMTREC
Issuing date	:	04/24/2014

Section: 2. HAZARDS IDENTIFICATION

GHS Classification

Not a hazardous substance or mixture.

GHS Label element

Precautionary Statements : **Prevention:**
Wash hands thoroughly after handling.
Response:
Specific measures: consult MSDS Section 4.
Storage:
Store in accordance with local regulations.

Other hazards : None known.

Section: 3. COMPOSITION/INFORMATION ON INGREDIENTS

No hazardous ingredients

Section: 4. FIRST AID MEASURES

In case of eye contact	:	Rinse with plenty of water. Get medical attention if symptoms occur.
In case of skin contact	:	Wash off with soap and plenty of water. Get medical attention if symptoms occur.
If swallowed	:	Rinse mouth. Get medical attention if symptoms occur.
If inhaled	:	Get medical attention if symptoms occur.
Protection of first-aiders	:	In event of emergency assess the danger before taking action. Do not put yourself at risk of injury. If in doubt, contact emergency responders.Use personal protective equipment as required.

Notes to physician	:	No specific measures identified.

See toxicological information (Section 11)

Section: 5. FIREFIGHTING MEASURES

Suitable extinguishing media	:	Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.
Unsuitable extinguishing media	:	None known.
Specific hazards during firefighting.	:	Not flammable or combustible.
Hazardous combustion products	:	Carbon oxides
Special protective equipment for firefighters	:	Use personal protective equipment
Specific extinguishing methods	:	Fire residues and contaminated fire extinguishing water must be disposed of in accordance with local regulations. In the event of fire and/or explosion do not breathe fumes.

Section: 6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures	:	Refer to protective measures listed in sections 7 and 8.
Environmental precautions	:	Do not allow contact with soil, surface or ground water.
Methods and materials for containment and cleaning up	:	Stop leak if safe to do so. Contain spillage, and then collect with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and place in container for disposal according to local / national regulations (see section 13). Flush away traces with water. For large spills, dike spilled material or otherwise contain material to ensure runoff does not reach a waterway.

Section: 7. HANDLING AND STORAGE

Advice on safe handling	:	Do not ingest. Wash hands thoroughly after handling. Use only with adequate ventilation.
Conditions for safe storage	:	Keep out of reach of children. Keep container tightly closed. Store in suitable labeled containers.
Packaging material	:	Suitable material: Keep in properly labelled containers. Unsuitable material: not determined

Section: 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Components with workplace control parameters

Contains no substances with occupational exposure limit values.

Engineering measures	:	Good general ventilation should be sufficient to control worker exposure to airborne contaminants.

Personal protective equipment

Eye protection	:	Safety glasses
Hand protection	:	Wear protective gloves. Gloves should be discarded and replaced if there is any indication of degradation or chemical breakthrough.
Skin protection	:	Wear suitable protective clothing.
Respiratory protection	:	No personal respiratory protective equipment normally required.
Hygiene measures	:	Handle in accordance with good industrial hygiene and safety practice. Remove and wash contaminated clothing before re-use. Wash face, hands and any exposed skin thoroughly after handling.

HUMAN EXPOSURE CHARACTERIZATION :
Based on our recommended product application and personal protective equipment, the potential human exposure is: Low

Section: 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	:	Powder
Colour	:	White
Odour	:	Slight
Flash point	:	Not applicable.
pH	:	7.4, 0.3 % Method: ASTM E 70
Odour Threshold	:	no data available
Melting point/freezing point	:	no data available
Initial boiling point and boiling range	:	no data available
Evaporation rate	:	no data available
Flammability (solid, gas)	:	no data available
Upper explosion limit	:	no data available
Lower explosion limit	:	no data available
Vapour pressure	:	no data available
Relative vapour density	:	no data available
Relative density	:	no data available
Density	:	no data available
Water solubility	:	completely soluble
Solubility in other solvents	:	no data available
Partition coefficient: n-octanol/water	:	no data available

Auto-ignition temperature	:	no data available
Thermal decomposition	:	Carbon oxides
Viscosity, dynamic	:	no data available
Viscosity, kinematic	:	no data available
VOC	:	0.05 %

Section: 10. STABILITY AND REACTIVITY

Chemical stability	:	Stable under normal conditions.
Possibility of hazardous reactions	:	No dangerous reaction known under conditions of normal use.
Conditions to avoid	:	None known.
Incompatible materials	:	Contact with strong oxidizers (e.g. chlorine, peroxides, chromates, nitric acid, perchlorate, concentrated oxygen, permanganate) may generate heat, fires, explosions and/or toxic vapors.
Hazardous decomposition products	:	Oxides of carbon Oxides of nitrogen

Section: 11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure	:	Eye contact, Skin contact

Potential Health Effects

Eyes	:	Health injuries are not known or expected under normal use.
Skin	:	Health injuries are not known or expected under normal use.
Ingestion	:	Health injuries are not known or expected under normal use.
Inhalation	:	Health injuries are not known or expected under normal use.
Chronic Exposure	:	Health injuries are not known or expected under normal use.

Experience with human exposure

Eye contact	:	No symptoms known or expected
Skin contact	:	No symptoms known or expected
Ingestion	:	No symptoms known or expected
Inhalation	:	No symptoms known or expected

Toxicity

Product

Acute oral toxicity	:	Acute toxicity estimate : > 5,000 mg/kg
Acute inhalation toxicity	:	no data available

Acute dermal toxicity	:	no data available
Skin corrosion/irritation	:	no data available
Serious eye damage/eye irritation	:	no data available
Respiratory or skin sensitization	:	no data available
Carcinogenicity	:	no data available
Reproductive effects	:	no data available
Germ cell mutagenicity	:	no data available
Teratogenicity	:	no data available
STOT - single exposure	:	no data available
STOT - repeated exposure	:	no data available
Aspiration toxicity	:	no data available

HUMAN HAZARD CHARACTERIZATION
Based on our hazard characterization, the potential human hazard is: Low

Section: 12. ECOLOGICAL INFORMATION

Ecotoxicity

Environmental Effects	:	This product has no known ecotoxicological effects.

Product

Toxicity to fish	:	LC50 Zebra Danio: > 100 mg/l Exposure time: 96 hrs Test substance: Representative polymer tested in water with DOC
Toxicity to daphnia and other aquatic invertebrates.	:	LC50 Ceriodaphnia dubia: 56.1 mg/l Exposure time: 48 hrs Test substance: Product LC50 Daphnia magna: > 100 mg/l Exposure time: 48 hrs Test substance: Representative polymer tested in water with DOC
Toxicity to algae	:	no data available
Toxicity to daphnia and other aquatic invertebrates. (Chronic toxicity)	:	LOEC: 5 mg/l Exposure time: 7 Days Species: Ceriodaphnia dubia Test substance: Product EC50: 9.04 mg/l Exposure time: 7 Days Species: Ceriodaphnia dubia

Test substance: Product

EC25 / IC25: 4.58 mg/l
Exposure time: 7 Days
Species: Ceriodaphnia dubia
Test substance: Product

Persistence and degradability

The organic portion of this preparation is expected to be poorly biodegradable.

Mobility

The environmental fate was estimated using a level III fugacity model embedded in the EPI (estimation program interface) Suite TM, provided by the US EPA. The model assumes a steady state condition between the total input and output. The level III model does not require equilibrium between the defined media. The information provided is intended to give the user a general estimate of the environmental fate of this product under the defined conditions of the models.
If released into the environment this material is expected to distribute to the air, water and soil/sediment in the approximate respective percentages;

Air	:	<5%
Water	:	5 - 10%
Soil	:	> 90%

The portion in water is expected to be soluble or dispersible.

Bioaccumulative potential

This preparation or material is not expected to bioaccumulate.

Other information

no data available

ENVIRONMENTAL HAZARD AND EXPOSURE CHARACTERIZATION
Based on our hazard characterization, the potential environmental hazard is: Moderate

Based on our recommended product application and the product's characteristics, the potential environmental exposure is: Low

Section: 13. DISPOSAL CONSIDERATIONS

If this product becomes a waste, it is not a hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA) 40 CFR 261, since it does not have the characteristics of Subpart C, nor is it listed under Subpart D.

Disposal methods	:	Where possible recycling is preferred to disposal or incineration. If recycling is not practicable, dispose of in compliance with local regulations. Dispose of wastes in an approved waste disposal facility.
Disposal considerations	:	Dispose of as unused product. Empty containers should be taken to an approved waste handling site for recycling or disposal. Do not re-use empty containers.

Section: 14. TRANSPORT INFORMATION

The shipper/consignor/sender is responsible to ensure that the packaging, labeling, and markings are in compliance with the selected mode of transport.

Land transport (DOT)

Proper shipping name : PRODUCT IS NOT REGULATED DURING TRANSPORTATION

Air transport (IATA)

Proper shipping name : PRODUCT IS NOT REGULATED DURING TRANSPORTATION

Sea Transport (IMDG/IMO)

Proper shipping name : PRODUCT IS NOT REGULATED DURING TRANSPORTATION

Section: 15. REGULATORY INFORMATION

EPCRA - Emergency Planning and Community Right-to-Know Act

CERCLA Reportable Quantity

This material does not contain any components with a CERCLA RQ.

SARA 304 Extremely Hazardous Substances Reportable Quantity

This material does not contain any components with a section 304 EHS RQ.

SARA 311/312 Hazards : No SARA Hazards

SARA 302 : SARA 302: No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 : SARA 313: This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

California Prop 65

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

INTERNATIONAL CHEMICAL CONTROL LAWS :

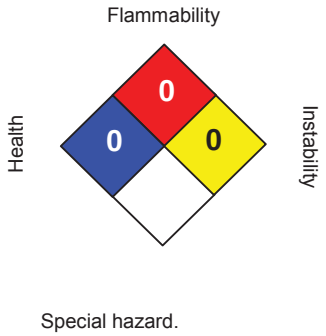
TOXIC SUBSTANCES CONTROL ACT (TSCA)
The substances in this preparation are included on or exempted from the TSCA 8(b) Inventory (40 CFR 710)

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA)
The substance(s) in this preparation are included in or exempted from the Domestic Substance List (DSL).

EUROPE
The substance(s) in this preparation are included in or exempted from the EINECS or ELINCS inventories

Section: 16. OTHER INFORMATION

NFPA:



HMIS III:

HEALTH	0
FLAMMABILITY	0
PHYSICAL HAZARD	0

0 = not significant, 1 =Slight,
2 = Moderate, 3 = High
4 = Extreme, * = Chronic

Due to our commitment to Product Stewardship, we have evaluated the human and environmental hazards and exposures of this product. Based on our recommended use of this product, we have characterized the product's general risk. This information should provide assistance for your own risk management practices. We have evaluated our product's risk as follows:

* The human risk is: Low

* The environmental risk is: Low

Any use inconsistent with our recommendations may affect the risk characterization. Our sales representative will assist you to determine if your product application is consistent with our recommendations. Together we can implement an appropriate risk management process.

Revision Date : 04/24/2014
Version Number : 1.0
Prepared By : Regulatory Affairs

REVISED INFORMATION: Significant changes to regulatory or health information for this revision is indicated by a bar in the left-hand margin of the SDS.

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

For additional copies of an MSDS visit www.nalco.com and request access.

NALCO

An Ecolab Company

OPTIMER® 83949

FLOCCULANT

LOT NO.	DENSITY	NET WEIGHT

FDA: 21 CFR 176.170 Components of paper and paperboard in contact with aqueous and fatty foods and 21 CFR 176.180 Components of paper and paperboard in contact with dry foods. Limitation: For use as an adjuvant in the manufacture of paper and paperboard in an amount not to exceed that necessary to accomplish the technical effect and not to exceed 2 percent (as polymer) by weight of the paper or paperboard.

CAUTION! May cause irritation with prolonged contact. Do not get in eyes, on skin, on clothing. Do not take internally. Avoid generating dusts. Do not breathe dust. Use with adequate ventilation. In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. After contact with skin, wash immediately with plenty of water. Use a mild soap if available. Wear suitable protective clothing.

ATTENTION: For more information refer to the material safety data sheet. Empty containers may contain residual product. DO NOT reuse containers unless properly reconditioned.

NFPA		HMIS
	0	0
0	0	0
		0
		^

Degree of Hazard
4 = Extreme
3 = High
2 = Moderate
1 = Low
0 = Insignificant
* = Chronic Health Hazard
^ = See MSDS
UNLESS OTHERWISE INDICATED

EMERGENCY TELEPHONE NUMBER(S): (800) 424-9300 (24 Hours) CHEMTREC

Nalco Global Eqt Soln, Door 29
6233 West 65th Street, CHICAGO, IL, USA 60638
630-305-CHEM

Material: 83949.02 Generated: 1/22/2015

U.S. DOT Shipping Name: PRODUCT IS NOT REGULATED DURING TRANSPORTATION
MARINE TRANSPORT (IMDG/IMO): PRODUCT IS NOT REGULATED DURING TRANSPORTATION

SAFETY DATA SHEET

PRODUCT

OPTIMER® 9877 PULV

EMERGENCY TELEPHONE NUMBER(S)

(800) 424-9300 (24 Hours) CHEMTREC

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME : **OPTIMER® 9877 PULV**

APPLICATION : FLOCCULANT

COMPANY IDENTIFICATION : Nalco Company
1601 W. Diehl Road
Naperville, Illinois
60563-1198

EMERGENCY TELEPHONE NUMBER(S) : (800) 424-9300 (24 Hours) CHEMTREC

NFPA 704M/HMIS RATING
HEALTH : 0 / 1 FLAMMABILITY : 1 / 1 INSTABILITY : 0 / 0 OTHER :
0 = Insignificant 1 = Slight 2 = Moderate 3 = High 4 = Extreme * = Chronic Health Hazard

2. COMPOSITION/INFORMATION ON INGREDIENTS

Based on our hazard evaluation, none of the substances in this product are hazardous.

3. HAZARDS IDENTIFICATION

****EMERGENCY OVERVIEW****

CAUTION
May cause irritation with prolonged contact.
Do not get in eyes, on skin, on clothing. Do not take internally. Avoid generating dusts. Do not breathe dust. Use with adequate ventilation. In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. After contact with skin, wash immediately with plenty of water.
Wear suitable protective clothing.
May form explosive dust-air mixtures. Handling operations may generate combustible dust in the finely divided and suspended state. To reduce the potential for dust explosions and/or fire, do not permit dust to accumulate. Empty product containers may contain product residue. Do not pressurize, cut, heat, weld, or expose containers to flame or other sources of ignition. May evolve oxides of carbon (COx) under fire conditions. May evolve oxides of nitrogen (NOx) under fire conditions.

PRIMARY ROUTES OF EXPOSURE :
Eye, Skin, Inhalation

HUMAN HEALTH HAZARDS - ACUTE :

EYE CONTACT :
May cause irritation with prolonged contact.

SKIN CONTACT :
May cause irritation with prolonged contact.

INGESTION :
Not a likely route of exposure. There may be irritation to the gastro-intestinal tract with nausea and vomiting. May be harmful if swallowed.

INHALATION :
Irritant to respiratory system. If dust is generated, can cause mucous membrane irritation. Repeated or prolonged exposure may irritate the respiratory tract. A single brief inhalation exposure (minutes) is not likely to cause serious effects.

SYMPTOMS OF EXPOSURE :
Acute :
A review of available data does not identify any symptoms from exposure not previously mentioned.
Chronic :
A review of available data does not identify any symptoms from exposure not previously mentioned.

AGGRAVATION OF EXISTING CONDITIONS :
A review of available data does not identify any worsening of existing conditions.

4. FIRST AID MEASURES

EYE CONTACT :
Immediately flush eye with water for at least 15 minutes while holding eyelids open. If only one eye is affected be sure to use care not to contaminate the other eye with the run-off. If irritation persists, repeat flushing. Get medical attention.

SKIN CONTACT :
Immediately wash with plenty of soap and water. Get medical attention.

INGESTION :
Do not induce vomiting without medical advice. If conscious, washout mouth and give water to drink. If reflexive vomiting occurs, rinse mouth and repeat administration of water. Get medical attention. If unconsious, do not give anything by mouth, place in the recovery position, check breathing and pulse. If necessary give artifical respiration.

INHALATION :
Remove to fresh air, treat symptomatically. Get medical attention.

NOTE TO PHYSICIAN :
Based on the individual reactions of the patient, the physician's judgement should be used to control symptoms and clinical condition.

5. FIRE FIGHTING MEASURES

FLASH POINT : None

EXTINGUISHING MEDIA :
Foam, Dry powder, Carbon dioxide, Other extinguishing agent suitable for Class B fires
Use extinguishing media appropriate for surrounding fire. Not expected to burn.

UNSUITABLE EXTINGUISHING MEDIA :
Water spray, Do not use water jets.

FIRE AND EXPLOSION HAZARD :
May form explosive dust-air mixtures. Handling operations may generate combustible dust in the finely divided and suspended state. To reduce the potential for dust explosions and/or fire, do not permit dust to accumulate. Empty product containers may contain product residue. Do not pressurize, cut, heat, weld, or expose containers to flame or other sources of ignition. May evolve oxides of carbon (COx) under fire conditions. May evolve oxides of nitrogen (NOx) under fire conditions.

SPECIAL PROTECTIVE EQUIPMENT FOR FIRE FIGHTING :
In case of fire, wear a full face positive-pressure self contained breathing apparatus and protective suit.

6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS :
Restrict access to area as appropriate until clean-up operations are complete. Ensure adequate ventilation. Remove sources of ignition. Ensure clean-up is conducted by trained personnel only. Use personal protective equipment recommended in Section 8 (Exposure Controls/Personal Protection). Notify appropriate government, occupational health and safety and environmental authorities. Spill may be slippery.

METHODS FOR CLEANING UP :
For powder: Remove as much as possible with broom, scoop or vacuum, as the addition of water causes slippery floor conditions. Reclaim into recovery or salvage drums. Dispose of material in compliance with regulations indicated in Section 13 (Disposal Considerations).

ENVIRONMENTAL PRECAUTIONS :
Do not contaminate surface water.

7. HANDLING AND STORAGE

HANDLING :
Do not get in eyes, on skin, on clothing. Do not take internally. Use with adequate ventilation. Avoid generating dusts. Keep the containers closed when not in use. Ensure all containers are labeled. Use personal protective equipment recommended in Section 8 (Exposure Controls/Personal Protection). Empty product containers may contain product residue. Do not pressurize, cut, heat, weld, or expose containers to flame or other sources of ignition. Do not use, store, spill or pour near heat, sparks or open flame. Maintain good housekeeping practices.

STORAGE CONDITIONS :
Store in a cool well ventilated area away from direct sunlight. Store separately from oxidizers. Keep in dry place. Store away from heat and sources of ignition. Connections must be grounded to avoid electrical charges.

SUITABLE CONSTRUCTION MATERIAL :
Compatibility with Plastic Materials can vary; we therefore recommend that compatibility is tested prior to use.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

OCCUPATIONAL EXPOSURE LIMITS :
Exposure guidelines have not been established for this product. Available exposure limits for the substance(s) are shown below.

Substance(s)	Category:	ppm	mg/m3	Non-Standard Unit
Inhalable (Total Dust) Nuisance Particulates (Inhalable particles.)	ACGIH/TWA		10	
Inhalable (Total Dust) Nuisance Particulates (Respirable particles.)	ACGIH/TWA		3	
Inhalable (Total Dust) Nuisance Particulates (Respirable fraction.)	OSHA Z1/PEL		5	
Inhalable (Total Dust) Nuisance Particulates (Total dust.)	OSHA Z1/PEL		15	
Inhalable (Total Dust) Nuisance Particulates (Respirable fraction.)	Z3/TWA			15 MPPCF
Inhalable (Total Dust) Nuisance Particulates (Total dust.)	Z3/TWA			50 MPPCF
Inhalable (Total Dust) Nuisance Particulates (Respirable fraction.)	Z3/TWA		5	
Inhalable (Total Dust) Nuisance Particulates (Total dust.)	Z3/TWA		15	

ENGINEERING MEASURES :
Use general ventilation with local exhaust ventilation. Local exhaust ventilation may be necessary when dusts or mists are generated.

RESPIRATORY PROTECTION :
Due to its low toxicity, the hazard potential associated with this material is relatively low. If dusts are generated, use an approved air-purifying respirator. A particulate cartridge may be used.

HAND PROTECTION :
When handling this product, the use of chemical gloves is recommended. The choice of work glove depends on work conditions and what chemicals are handled. Please contact the PPE manufacturer for advice on what type of glove material may be suitable. Gloves should be replaced immediately if signs of degradation are observed.

SKIN PROTECTION :
Wear chemical resistant apron, chemical splash goggles, impervious gloves and boots.

EYE PROTECTION :
Wear chemical splash goggles.

HYGIENE RECOMMENDATIONS :
Use good work and personal hygiene practices to avoid exposure. Keep a safety shower available. Keep an eye wash fountain available. Always wash thoroughly after handling chemicals. When handling this product never eat, drink or smoke. If clothing is contaminated, remove clothing and thoroughly wash the affected area. Launder contaminated clothing before reuse.

HUMAN EXPOSURE CHARACTERIZATION :
Based on our recommended product application and personal protective equipment, the potential human exposure is:
High

9. PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE	Powder
APPEARANCE	White
ODOR	Slight
SOLUBILITY IN WATER	Insoluble
pH (1 %)	5.5 - 7.5
VOC CONTENT	0 % Calculated

Note: These physical properties are typical values for this product and are subject to change.

10. STABILITY AND REACTIVITY

STABILITY :
Stable under normal conditions.

HAZARDOUS POLYMERIZATION :
Hazardous polymerization will not occur.

CONDITIONS TO AVOID :
Avoid extremes of temperature. Moisture Heat and sources of ignition including static discharges. Avoid generating dusts.

MATERIALS TO AVOID :
Contact with strong oxidizers (e.g. chlorine, peroxides, chromates, nitric acid, perchlorate, concentrated oxygen, permanganate) may generate heat, fires, explosions and/or toxic vapors.

HAZARDOUS DECOMPOSITION PRODUCTS :
Under fire conditions: Oxides of carbon, Oxides of nitrogen

11. TOXICOLOGICAL INFORMATION

No toxicity studies have been conducted on this product.

SENSITIZATION :
This product is not expected to be a sensitizer.

CARCINOGENICITY :
None of the substances in this product are listed as carcinogens by the International Agency for Research on Cancer (IARC), the National Toxicology Program (NTP) or the American Conference of Governmental Industrial Hygienists (ACGIH).

HUMAN HAZARD CHARACTERIZATION :
Based on our hazard characterization, the potential human hazard is: Low

12. ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL EFFECTS :

No toxicity studies have been conducted on this product.

MOBILITY :
The environmental fate was estimated using a level III fugacity model embedded in the EPI (estimation program interface) Suite TM, provided by the US EPA. The model assumes a steady state condition between the total input and output. The level III model does not require equilibrium between the defined media. The information provided is intended to give the user a general estimate of the environmental fate of this product under the defined conditions of the models.
If released into the environment this material is expected to distribute to the air, water and soil/sediment in the approximate respective percentages;

Air	Water	Soil/Sediment
<5%	< 5%	> 90%

The portion in water is expected to be soluble or dispersible.

BIOACCUMULATION POTENTIAL
This preparation or material is not expected to bioaccumulate.

ENVIRONMENTAL HAZARD AND EXPOSURE CHARACTERIZATION
Based on our hazard characterization, the potential environmental hazard is: Low
Based on our recommended product application and the product's characteristics, the potential environmental exposure is: Moderate

If released into the environment, see CERCLA/SUPERFUND in Section 15.

13. DISPOSAL CONSIDERATIONS

If this product becomes a waste, it is not a hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA) 40 CFR 261, since it does not have the characteristics of Subpart C, nor is it listed under Subpart D.

As a non-hazardous waste, it is not subject to federal regulation. Consult state or local regulation for any additional handling, treatment or disposal requirements. For disposal, contact a properly licensed waste treatment, storage, disposal or recycling facility. Dispose of wastes in an approved incinerator or waste treatment/disposal site, in accordance with all applicable regulations. Do not dispose of wastes in local sewer or with normal garbage.

14. TRANSPORT INFORMATION

The information in this section is for reference only and should not take the place of a shipping paper (bill of lading) specific to an order. Please note that the proper Shipping Name / Hazard Class may vary by packaging, properties, and mode of transportation. Typical Proper Shipping Names for this product are as follows.

LAND TRANSPORT :

Proper Shipping Name : PRODUCT IS NOT REGULATED DURING TRANSPORTATION

AIR TRANSPORT (ICAO/IATA) :

Proper Shipping Name : PRODUCT IS NOT REGULATED DURING TRANSPORTATION

MARINE TRANSPORT (IMDG/IMO) :

Proper Shipping Name : PRODUCT IS NOT REGULATED DURING TRANSPORTATION

15. REGULATORY INFORMATION

This section contains additional information that may have relevance to regulatory compliance. The information in this section is for reference only. It is not exhaustive, and should not be relied upon to take the place of an individualized compliance or hazard assessment. Nalco accepts no liability for the use of this information.

NATIONAL REGULATIONS, USA :

OSHA HAZARD COMMUNICATION RULE, 29 CFR 1910.1200 :
Based on our hazard evaluation, none of the substances in this product are hazardous.

CERCLA/SUPERFUND, 40 CFR 117, 302 :
Notification of spills of this product is not required.

SARA/SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT OF 1986 (TITLE III) - SECTIONS 302, 311, 312, AND 313 :

SECTION 302 - EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355) :
This product does not contain substances listed in Appendix A and B as an Extremely Hazardous Substance.

SECTIONS 311 AND 312 - MATERIAL SAFETY DATA SHEET REQUIREMENTS (40 CFR 370) :
Our hazard evaluation has found that this product is not hazardous under 29 CFR 1910.1200.

Under SARA 311 and 312, the EPA has established threshold quantities for the reporting of hazardous chemicals. The current thresholds are: 500 pounds or the threshold planning quantity (TPQ), whichever is lower, for extremely hazardous substances and 10,000 pounds for all other hazardous chemicals.

SECTION 313 - LIST OF TOXIC CHEMICALS (40 CFR 372) :
This product does not contain substances on the List of Toxic Chemicals.

TOXIC SUBSTANCES CONTROL ACT (TSCA) :
The substances in this preparation are included on or exempted from the TSCA 8(b) Inventory (40 CFR 710)

FOOD AND DRUG ADMINISTRATION (FDA) Federal Food, Drug and Cosmetic Act :
When use situations necessitate compliance with FDA regulations, this product is acceptable under : 21 CFR 176.170 Components of paper and paperboard in contact with aqueous and fatty foods and 21 CFR 176.180 Components of paper and paperboard in contact with dry foods.

FEDERAL WATER POLLUTION CONTROL ACT, CLEAN WATER ACT, 40 CFR 401.15 / formerly Sec. 307, 40 CFR 116.4 / formerly Sec. 311 :
Substances listed under this regulation are not intentionally added or expected to be present in this product. Listed components may be present at trace levels.

CLEAN AIR ACT, Sec. 112 (40 CFR 61, Hazardous Air Pollutants), Sec. 602 (40 CFR 82, Class I and II Ozone Depleting Substances) :
Substances listed under this regulation are not intentionally added or expected to be present in this product. Listed components may be present at trace levels.

CALIFORNIA PROPOSITION 65 :
Substances listed under California Proposition 65 are not intentionally added or expected to be present in this product.

MICHIGAN CRITICAL MATERIALS :
Substances listed under this regulation are not intentionally added or expected to be present in this product. Listed components may be present at trace levels.

STATE RIGHT TO KNOW LAWS :
Substances listed under this regulation are not intentionally added or expected to be present in this product. Listed components may be present at trace levels.

NATIONAL REGULATIONS, CANADA :

WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHMIS) :
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

WHMIS CLASSIFICATION :
Not considered a WHMIS controlled product.

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA) :
The substance(s) in this preparation are included in or exempted from the Domestic Substance List (DSL).

AUSTRALIA
All substances in this product comply with the National Industrial Chemicals Notification & Assessment Scheme (NICNAS).

CHINA
All substances in this product comply with the Provisions on the Environmental Administration of New Chemical Substances and are listed on the Inventory of Existing Chemical Substances China (IECSC).

EUROPE
The substances in this preparation have been reviewed for compliance with the EINECS or ELINCS inventories.

JAPAN
All substances in this product comply with the Law Regulating the Manufacture and Importation Of Chemical Substances and are listed on the Existing and New Chemical Substances list (ENCS).

KOREA
All substances in this product comply with the Toxic Chemical Control Law (TCCL) and are listed on the Existing Chemicals List (ECL)

PHILIPPINES
All substances in this product comply with the Republic Act 6969 (RA 6969) and are listed on the Philippines Inventory of Chemicals & Chemical Substances (PICCS).

16. OTHER INFORMATION

Due to our commitment to Product Stewardship, we have evaluated the human and environmental hazards and exposures of this product. Based on our recommended use of this product, we have characterized the product's general risk. This information should provide assistance for your own risk management practices. We have evaluated our product's risk as follows:

* The human risk is: Low

* The environmental risk is: Low

Any use inconsistent with our recommendations may affect the risk characterization. Our sales representative will assist you to determine if your product application is consistent with our recommendations. Together we can implement an appropriate risk management process.

This product material safety data sheet provides health and safety information. The product is to be used in applications consistent with our product literature. Individuals handling this product should be informed of the recommended safety precautions and should have access to this information. For any other uses, exposures should be evaluated so that appropriate handling practices and training programs can be established to insure safe workplace operations. Please consult your local sales representative for any further information.

REFERENCES

Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, American Conference of Governmental Industrial Hygienists, OH., (Ariel Insight CD-ROM Version), Ariel Research Corp., Bethesda, MD.

Hazardous Substances Data Bank, National Library of Medicine, Bethesda, Maryland (TOMES CPS CD-ROM Version), Micromedex, Inc., Englewood, CO.

IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man, Geneva: World Health Organization, International Agency for Research on Cancer.

Integrated Risk Information System, U.S. Environmental Protection Agency, Washington, D.C. (TOMES CPS CD-ROM Version), Micromedex, Inc., Englewood, CO.

Annual Report on Carcinogens, National Toxicology Program, U.S. Department of Health and Human Services, Public Health Service.

Title 29 Code of Federal Regulations, Part 1910, Subpart Z, Toxic and Hazardous Substances, Occupational Safety and Health Administration (OSHA), (Ariel Insight CD-ROM Version), Ariel Research Corp., Bethesda, MD.

Registry of Toxic Effects of Chemical Substances, National Institute for Occupational Safety and Health, Cincinnati, OH, (TOMES CPS CD-ROM Version), Micromedex, Inc., Englewood, CO.

Ariel Insight (An integrated guide to industrial chemicals covered under major regulatory and advisory programs), North American Module, Western European Module, Chemical Inventories Module and the Generics Module (Ariel Insight CD-ROM Version), Ariel Research Corp., Bethesda, MD.

The Teratogen Information System, University of Washington, Seattle, WA (TOMES CPS CD-ROM Version), Micromedex, Inc., Englewood, CO.

Prepared By : Product Safety Department
Date issued : 08/28/2009
Version Number : 1.10

OPTIMER® 9877 PULV

FLOCCULANT

An Ecolab Company

LOT NO.	DENSITY	NET WEIGHT

FDA: 21 CFR 176.170 Components of paper and paperboard in contact with aqueous and fatty foods and 21 CFR 176.180 Components of paper and paperboard in contact with dry foods.

CAUTION! May cause irritation with prolonged contact. Do not get in eyes, on skin, on clothing. Do not take internally. Avoid generating dusts. Do not breathe dust. Use with adequate ventilation. In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. After contact with skin, wash immediately with plenty of water. Wear suitable protective clothing.

ATTENTION: For more information refer to the material safety data sheet. Empty containers may contain residual product. DO NOT reuse containers unless properly reconditioned.

NFPA		HMIS
	0	0
0	0	0
		0
		^

Degree of Hazard
4 = Extreme
3 = High
2 = Moderate
1 = Low
0 = Insignificant
* = Chronic Health Hazard
^ = See MSDS
UNLESS OTHERWISE INDICATED

EMERGENCY TELEPHONE NUMBER(S): (800) 424-9300 (24 Hours) CHEMTREC

Nalco Global Eqt Soln, Door 29
6233 West 65th Street, CHICAGO, IL, USA 60638
630-305-CHEM

Material: 9877 PULV.02 Generated: 1/22/2015

U.S. DOT Shipping Name: PRODUCT IS NOT REGULATED DURING TRANSPORTATION
MARINE TRANSPORT (IMDG/IMO): PRODUCT IS NOT REGULATED DURING TRANSPORTATION

CHARLES TENNANT & Company/Compagnie
CHARLES TENNANT & CO/CIE,
div of CHARLES TENNANT & CO (CANADA) LTD
34 CLAYSON RD., TORONTO, ONTARIO
M9M 2G8
CACD

PRODUCT: TENNAPRESS PE26

Section 01: CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MANUFACTURERS.....	SUPPLIED BY: PROSPEC CHEMICALS P.O. BOX 3478 FORT SASKATCHEWAN ALBERTA, CANADA T8L 2T4 (780) 992-1522
PRODUCT NAME	TENNAPRESS PE26
CHEMICAL NAME:.....	SODIUM CARBOXYMETHYL CELLULOSE (CAS NO. 9004-32-4).
MATERIAL USE:.....	MINING CHEMICALS.
CHEMICAL FAMILY:.....	CARBOHYDRATE.
CHEMICAL FORMULA:.....	NOT AVAILABLE.
MOLECULAR WEIGHT:.....	NOT AVAILABLE.

Section 02: HAZARDS IDENTIFICATION

ROUTE OF ENTRY:

SKIN CONTACT:.....	NOT CONSIDERED TOXIC BY SKIN CONTACT.
SKIN ABSORPTION:.....	NOT AVAILABLE.
EYE	MAY CAUSE SLIGHT IRRITATION.
INHALATION	SLIGHT IRRITANT.
INHALATION CHRONIC:.....	NOT AVAILABLE.
INGESTION:.....	NOT AVAILABLE.
EFFECTS OF ACUTE EXPOSURE:.....	NOT AVAILABLE.
EFFECTS OF CHRONIC EXPOSURE:.....	NOT AVAILABLE.

Section 03: COMPOSITION/INFORMATION ON INGREDIENTS

Hazardous Ingredients	%	Exposure Limit	C.A.S.#	LD/50, Route,Species	LC/50 Route,Species
SODIUM CARBOXYMETHYL CELLULOSE	60-100	NOT AVAILABLE	9004-32-4	ORAL RAT 27000 MG/KG	NOT AVAILABLE

Section 04: FIRST AID MEASURES

SKIN:.....	NO EMERGENCY CARE ANTICIPATED.
EYE:.....	REMOVE CONTACT LENSES, IF WORN. FLUSH CONTINUOUSLY WITH WATER FOR 15 MINUTES. FORCIBLY HOLD EYELIDS APART TO ENSURE IRRIGATION OF ALL EYE TISSUE. IF IRRITATION PERSISTS GET MEDICAL ATTENTION.
INHALATION:.....	REMOVE PERSON TO FRESH AIR. SEEK MEDICAL ATTENTION IF SYMPTOMS DEVELOP.
INGESTION:.....	NO EMERGENCY CARE ANTICIPATED.
NOTES TO PHYSICIAN:.....	NO SPECIAL FIRST-AID NEEDED.
GENERAL ADVICE:.....	NO SPECIAL FIRST-AID NEEDED.

Section 05: FIRE FIGHTING MEASURES

FLAMMABLE LIMITS IN AIR.....	NOT AVAILABLE.
IF YES, UNDER WHICH CONDITIONS?.....	DUSTY CONDITIONS.
MEANS OF EXTINCTION:.....	WATER. CARBON DIOXIDE. FOAM. DRY POWDER EXTINGUISHER.
SPECIAL PROCEDURES:.....	SELF-CONTAINED, POSITIVE PRESSURE BREATHING APPARATUS AND PROPER PROTECTIVE CLOTHING SHOULD BE WORN IN FIGHTING FIRES INVOLVING ANY CHEMICAL SUBSTANCE.
FLASH POINT, F, COC.....	NOT APPLICABLE.
AUTO IGNITION TEMPERATURE °C:.....	APPROX. 370 (UNDER DUSTY CONDITIONS, WHEN THE CONCENTRATION OF DUST IN AIR IS 0.150 KG/M3).
T.D.G. FLAMMABLE CLASS:.....	NON REGULATED.
UPPER EXPLOSION LIMIT:.....	NOT AVAILABLE.
LOWER EXPLOSION LIMIT:.....	NOT AVAILABLE.
HAZARDOUS COMBUSTION PRODUCTS..	OXIDES OF CARBON (CO,CO2).
EXPLOSION DATA:	
SENSITIVITY TO STATIC DISCHARGE:.....	POSSIBILITY OF EXPLOSION UNDER DUSTY CONDITIONS.
SENSITIVITY TO IMPACT:.....	NOT AVAILABLE.
RATE OF BURNING:.....	NOT AVAILABLE.
EXPLOSIVE POWER:.....	NOT AVAILABLE.

PRODUCT: TENNAPRESS PE26

Section 06: ACCIDENTAL RELEASE MEASURES

CLEAN-UP PROCEDURES, LEAK/SPILL:...	AVOID OPEN FLAMES, SMOKING, FRICTION SPARKS, STATIC SPARKS, WELDING AND CUTTING TOOLS IN DUSTY SURROUNDINGS.

Section 07: HANDLING AND STORAGE

STORAGE NEEDS:.....	STORE IN A COOL AND DRY PLACE, FOR PRODUCT INTEGRITY.
HANDLING PROCEDURES AND EQUIPMENT:	AVOID CREATING DUSTY CONDITIONS.
SPECIAL SHIPPING INSTRUCTIONS.....	PROTECT AGAINST PHYSICAL DAMAGE. USE PRECAUTION WHEN HANDLING OR SHIPPING ANY CHEMICAL SUBSTANCE.

Section 08: EXPOSURE CONTROLS/PERSONAL PROTECTION

PROTECTIVE EQUIPMENT:	
GLOVES/TYPE:.....	RUBBER.
RESPIRATOR/TYPE:.....	AN APPROVED DUST MASK IS RECOMMENDED UNDER DUSTY CONDITIONS.
EYE/TYPE:.....	SAFETY GLASSES.
FOOTWEAR/TYPE:.....	NOT REQUIRED.
CLOTHING/TYPE:.....	WEAR ADEQUATE PROTECTIVE CLOTHES.
OTHER/TYPE:.....	AN EYE WASH STATION AND SAFETY SHOWER SHOULD BE NEAR THE WORK AREA.
ENGINEERING CONTROLS:.....	GOOD GENERAL VENTILATION IS NORMALLY ADEQUATE.

Section 09: PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE:.....	SOLID (POWDER).
ODOUR/APPEARANCE:.....	WHITE TO TAN.
ODOUR THRESHOLD:.....	NOT AVAILABLE.
VAPOUR PRESSURE:.....	NOT APPLICABLE.
REL. VAPOUR DENSITY.....	NOT APPLICABLE.
% VOLATILE:	
BY VOLUME.....	NOT AVAILABLE.
BY WEIGHT.....	NOT AVAILABLE.
EVAPORATION RATE:.....	NOT AVAILABLE.
BROWNING TEMPERATURE oC:.....	227 (440 F).
BOILING POINT °C:.....	NOT AVAILABLE.
FREEZING POINT °C:.....	NOT AVAILABLE.
pH:.....	6-12.
SPECIFIC GRAVITY:.....	0.6-0.9.
SOLUBILITY IN WATER (20 °C):.....	COMPLETE.
COEFFICIENT WATER/OIL DIST.:.....	NOT AVAILABLE.

Section 10: STABILITY AND REACTIVITY

CHEMICAL STABILITY:	
YES.....	YES UNDER NORMAL CONDITIONS OF LIGHT, PRESSURE AND TEMPERATURE.
NO, WHICH CONDITIONS?	
COMPATIBILITY WITH OTHER SUBSTANCES:	
YES.....	NOT AVAILABLE.
NO, WHICH ONES?	
REACTS VIOLENTLY WITH.....	NOT AVAILABLE.
DECOMPOSITION:.....	NOT AVAILABLE.

Section 11: TOXICOLOGICAL INFORMATION

ACUTE ORAL TOXICITY.....	NOT AVAILABLE.
LC 50 OF MATERIAL, SPECIES & ROUTE:.	NOT AVAILABLE.
EXPOSURE LIMIT OF MATERIAL:.....	NOT AVAILABLE.
IRRITANCY OF MATERIAL:.....	SLIGHT.
SENSITIZING CAPABILITY OF MATERIAL:	NOT AVAILABLE.
CARCINOGENICITY OF MATERIAL:.....	NOT LISTED BY NTP. NOT REGULATED BY OSHA. NOT EVALUATED BY IARC.
REPRODUCTIVE EFFECTS:.....	NOT AVAILABLE.
REPRODUCTIVE TOXICITY:.....	NOT AVAILABLE.
MUTAGENICITY:.....	NOT AVAILABLE.
TERATOGENICITY & EMBRYOTOXICITY:..	NOT AVAILABLE.
SYNERGISTIC MATERIALS:.....	NONE KNOWN.
MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE:	A SINGLE CASE OF ALLERGIC CONTACT DERMATITIS REPORTED AFTER REPEATED LONG-TERM (8 YEARS) SKIN CONTACT WITH PURIFIED SODIUM CMC. EMPHYSEMA, OTHER LUNG DISEASES, AND ASTHMA.

PRODUCT: TENNAPRESS PE26

Section 12: ECOLOGICAL INFORMATION

BIODEGRADABILITY.....	NOT AVAILABLE.
ENVIRONMENTAL.....	NOT AVAILABLE.

Section 13: DISPOSAL CONSIDERATIONS

WASTE DISPOSAL, METHOD AND EQUIPMENT:	ALL WASTE FROM THIS PRODUCT INCLUDING ALL EMPTY CONTAINERS MUST BE DISPOSED OF IN ACCORDANCE WITH MUNICIPAL, PROVINCIAL AND FEDERAL REGULATIONS.

Section 14: TRANSPORT INFORMATION

T.D.G. CLASSIFICATION:.....	NON REGULATED.
T.D.G. SHIPPING NAME:.....	NOT APPLICABLE.
T.D.G. SHIPPING INFORMATION:.....	NOT APPLICABLE.

Section 15: REGULATORY INFORMATION

WHMIS CLASSIFICATION:.....	NOT A CONTROLLED PRODUCT. THIS MSDS IS PROVIDED AS A CUSTOMER SERVICE.
CPR COMPLIANCE.....	THIS PRODUCT HAS BEEN CLASSIFIED IN ACCORDANCE WITH THE HAZARD CRITERIA OF THE CPR AND THE MSDS CONTAINS ALL OF THE INFORMATION REQUIRED BY THE CPR.

Section 16: OTHER INFORMATION

MANUFACTURERS MSDS DATE:.....	OCTOBER 2001.
MSDS REVISION DATE:.....	JUNE 20, 2014.
NOTE:.....	The information on this Material Safety Data Sheet has been obtained from the manufacturer, and where applicable, from other reliable sources such as CCOHS and RTECS. However, CHARLES TENNANT & (COMPANY) CANADA LIMITED makes no warranties, expressed or implied, as to the accuracy, completeness or adequacy of the information contained herein, and shall not be held liable (regardless of fault) to anyone directly or indirectly for damages or injuries in the use of this product arising out of or in connection with the accuracy, completeness or adequacy of such information.
PREPARED BY	Regulatory Affairs
PREPARATION DATE	Jun20/14

Carboxymethylcellulose sodium salt

Harmful to aquatic life

Avoid release to the environment. - IF INHALED: Call a POISON CENTER or doctor/physician 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. - Dispose of contents/container in accordance with municipal, provincial and federal regulations.

Sigma Chemical Company

Please refer to the original SDS for more information

GRAYMONT

SAFETY DATA SHEET

HIGH CALCIUM HYDRATED LIME

Section 1. Identification

GHS product identifier : HIGH CALCIUM HYDRATED LIME

Other means of identification : Hydrated Lime, Calcitic Hydrated Lime, Lime, Slaked lime, Lime Putty, Lime Slurry, Milk of Lime, Calcium Hydroxide.

Product code : Not available.

Product type : Solid.

Identified uses

Neutralization, focculation, stabilization, absorption.

Supplier/Manufacturer : GRAYMONT
#200-10991 Shellbridge Way
Richmond, BC V6X 3C6
Canada
Phone: 1 604 207-4292
Toll free : 1 866 207-4292
Fax: 1 604 207-9014
Web Site: http://www.graymont.com/

Emergency telephone number (with hours of operation) : CANUTEC (613-996-6666)
CHEMTREC, US (800-424-9300
INTERNATIONAL: (703-527-3887)

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture : SKIN CORROSION/IRRITATION - Category 2
SERIOUS EYE DAMAGE/ EYE IRRITATION - Category 1
CARCINOGENICITY (inhalation) - Category 1A
SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Respiratory tract irritation) - Category 3
SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) - Category 1

GHS label elements

Hazard pictograms :

Signal word : Danger

Hazard statements : H318 - Causes serious eye damage.
H315 - Causes skin irritation.
H350 - May cause cancer if inhaled.
H335 - May cause respiratory irritation.
H372 - Causes damage to organs through prolonged or repeated exposure.

Precautionary statements

Section 2. Hazards identification

Prevention : P201 - Obtain special instructions before use.
P202 - Do not handle until all safety precautions have been read and understood.
P281 - Use personal protective equipment as required.
P280 - Wear protective gloves. Wear eye or face protection.
P271 - Use only outdoors or in a well-ventilated area.
P260 - Do not breathe dust.
P270 - Do not eat, drink or smoke when using this product.
P264 - Wash hands thoroughly after handling.

Response : P314 - Get medical attention if you feel unwell.
P308 + P313 - IF exposed or concerned: Get medical attention.
P304 + P340 + P312 - IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a POISON CENTER or physician if you feel unwell.
P302 + P352 + P362 + P363 - IF ON SKIN: Wash with plenty of soap and water. Take off contaminated clothing. Wash contaminated clothing before reuse.
P332 + P313 - If skin irritation occurs: Get medical attention.
P305 + P351 + P338 + P310 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER or physician.

Storage : P401 - Store to minimize dust generation.

Disposal : P501 - Dispose of contents and container in accordance with all local, regional, national and international regulations.

Hazards not otherwise classified (HNOC)

Physical hazards not otherwise classified (PHNOC) : None known.

Health hazards not otherwise classified (HHNOC) : None known.

Section 3. Composition/information on ingredients

Substance/mixture : Mixture

Other means of identification : Hydrated Lime, Calcitic Hydrated Lime, Lime, Slaked lime, Lime Putty, Lime Slurry, Milk of Lime, Calcium Hydroxide.

CAS number/other identifiers

CAS number : Not applicable.

Product code : Not available.

Ingredient name	%	CAS number
Calcium Hydroxide	90 - 100	1305-62-0
Crystalline silica, quartz	0.0001 - 1	14808-60-7

Crystalline silica has been found in some products at or above detection level 0.1%. Concentration is dependent upon limestone source.

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Get medical attention immediately. Call a poison center or physician. Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 20 minutes. Chemical burns must be treated promptly by a physician. Get medical attention immediately. Call a poison center or physician.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention. If necessary, call a poison center or physician. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Skin contact : Get medical attention immediately. Call a poison center or physician. Flush contaminated skin with plenty of water. Wash contaminated clothing thoroughly with water before removing it, or wear gloves. Continue to rinse for at least 20 minutes. Chemical burns must be treated promptly by a physician. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : Get medical attention immediately. Call a poison center or physician. Wash out mouth with water. Remove dentures if any. Remove victim to fresh air and keep at rest in a position comfortable for breathing. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Stop if the exposed person feels sick as vomiting may be dangerous. Do not induce vomiting unless directed to do so by medical personnel. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Chemical burns must be treated promptly by a physician. Never give anything by mouth to an unconscious person. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : Causes serious eye damage.

Inhalation : May cause respiratory irritation.

Skin contact : Causes skin irritation.

Ingestion : No known significant effects or critical hazards.

Over-exposure signs/symptoms

Eye contact : Adverse symptoms may include the following:
pain
watering
redness

Inhalation : Adverse symptoms may include the following:
respiratory tract irritation
coughing
burning sensation

Skin contact : Adverse symptoms may include the following:
pain or irritation
redness
blistering may occur

Ingestion : Adverse symptoms may include the following:
burning sensation
abdominal cramps and pain
vomiting

Section 4. First aid measures

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : No specific treatment.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Wash contaminated clothing thoroughly with water before removing it, or wear gloves.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media : Use an extinguishing agent suitable for the surrounding fire.

Unsuitable extinguishing media : None known.

Specific hazards arising from the chemical : No specific fire or explosion hazard.

Hazardous thermal decomposition products : None.

Special protective actions for fire-fighters : No special measures are required.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : No action shall be taken involving any personal risk or without suitable training. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders : If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Spill : Move containers from spill area. Approach release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Avoid dust generation. Do not dry sweep. Vacuum dust with equipment fitted with a HEPA filter and place in a closed, labeled waste container. Dispose of via a licensed waste disposal contractor. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Avoid exposure - obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Do not get in eyes or on skin or clothing. Do not ingest. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Empty containers retain product residue and can be hazardous.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Store to minimize dust generation. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination.

Section 8. Exposure controls/personal protection

Control parameters

United States

Occupational exposure limits

Ingredient name	Exposure limits
Calcium Hydroxide	**OSHA PEL (United States, 2/2013).** TWA: 5 mg/m³ 8 hours. Form: Respirable fraction TWA: 15 mg/m³ 8 hours. Form: Total dust **ACGIH TLV (United States, 4/2014).** TWA: 5 mg/m³ 8 hours. **NIOSH REL (United States, 10/2013).** TWA: 5 mg/m³ 10 hours. **MSHA PEL** TWA 8/40 hours: 5 mg/m³
Crystalline silica, quartz	**OSHA PEL Z3 (United States, 2/2013).** TWA: 10 mg/m³ 8 hours. Form: Respirable TWA: 250 mppcf 8 hours. Form: Respirable **NIOSH REL (United States, 10/2013).** TWA: 0.05 mg/m³ 10 hours. Form: Respirable dust **ACGIH TLV (United States, 4/2014).** TWA: 0.025 mg/m³ 8 hours. Form: Respirable fraction **MSHA PEL** TWA 8/40 hours: 30 mg/m³/(%SiO2)+2 mg/m³ Form: Total dust 10 mg/m³/(%SiO2)+2 mg/m³ Form: Respirable dust

Canada

Occupational exposure limits		TWA (8 hours)			STEL (15 mins)			Ceiling			
Ingredient	List name	ppm	mg/m³	Other	ppm	mg/m³	Other	ppm	mg/m³	Other	Notations
Calcium dihydroxide	US ACGIH 4/2014	-	5	-	-	-	-	-	-	-	
	AB 4/2009	-	5	-	-	-	-	-	-	-	[3]
	BC 7/2013	-	5	-	-	-	-	-	-	-	
	ON 1/2013	-	5	-	-	-	-	-	-	-	
	QC 1/2014	-	5	-	-	-	-	-	-	-	
Crystalline silica, quartz	US ACGIH 4/2014	-	0.025	-	-	-	-	-	-	-	[a]
	AB 4/2009	-	0.025	-	-	-	-	-	-	-	[b]
	BC 7/2013	-	0.025	-	-	-	-	-	-	-	[c]
	ON 1/2013	-	0.1	-	-	-	-	-	-	-	[a]
	QC 1/2014	-	0.1	-	-	-	-	-	-	-	[d]

Section 8. Exposure controls/personal protection

[3]Skin sensitization
Form: [a]Respirable fraction [b]Respirable particulate. [c]Respirable [d]Respirable dust

Appropriate engineering controls : Use only with adequate ventilation. If user operations generate dust, fumes, gas, vapor or mist, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. Engineering controls may be required to control the primary or secondary risks associated with this product.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: chemical splash goggles and/or face shield. If inhalation hazards exist, a full-face respirator may be required instead.

Skin protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : Use a properly fitted, particulate filter respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator. Wear an appropriate NIOSH approved respirator if concentration levels exceed the safe exposure limits.

Section 9. Physical and chemical properties

Appearance

Physical state : Solid. [Fine powder.]

Color : White.

Odor : Sweet, soil like odor.

Odor threshold : Not available.

pH : 12.45 [Sat. soln.] at 25°C

Melting point : Not available.

Section 9. Physical and chemical properties

Boiling point : Not available.

Flash point : Not applicable.

Evaporation rate : Not available.

Flammability (solid, gas) : Not applicable.

Lower and upper explosive (flammable) limits : Not applicable.

Vapor pressure : Not available.

Vapor density : Not available.

Relative density : 2.3 to 2.4

Solubility : Not available.

Solubility in water : 0.165 g/100 g at 20°C

Partition coefficient: n-octanol/water : Not available.

Auto-ignition temperature : Not applicable.

Decomposition temperature : 540°C (1004°F)

Viscosity : Not available.

Volatility : Not available.

VOC (w/w) : 0 % (w/w)

Section 10. Stability and reactivity

Reactivity : No specific test data related to reactivity available for this product or its ingredients.

Chemical stability : The product is stable.

Possibility of hazardous reactions : None.

Conditions to avoid : Do not allow quicklime to come into contact with incompatible materials. e.g. Water, acids, reactive fluoridated compounds, reactive brominated compounds. reactive powered metals, organic acid anhydrides, nitro-organic compounds, reactive phosphorous compounds, interhalogenated compounds.

Incompatible materials : Reactive or incompatible with the following materials: oxidizing materials and acids.

Hazardous decomposition products : None.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
Calcium Hydroxide	LD50 Oral	Rat	7340 mg/kg	-

Irritation/Corrosion

Product/ingredient name	Result	Species	Score	Exposure	Observation
Calcium Hydroxide	Eyes - Severe irritant	Rabbit	-	10 mg	-

Section 11. Toxicological information

Sensitization

There is no data available.

Carcinogenicity

Classification

Product/ingredient name	OSHA	IARC	NTP	ACGIH	EPA	NIOSH
Crystalline silica, quartz	-	1	Known to be a human carcinogen.	A2	-	+

Specific target organ toxicity (single exposure)

Name	Category	Route of exposure	Target organs
Calcium Hydroxide	Category 3	Not applicable.	Respiratory tract irritation

Specific target organ toxicity (repeated exposure)

Name	Category	Route of exposure	Target organs
Crystalline silica, quartz	Category 1	Inhalation	kidneys, respiratory tract and testes

Aspiration hazard

There is no data available.

Information on the likely routes of exposure : Dermal contact. Eye contact. Inhalation. Ingestion.

Potential acute health effects

Eye contact : Causes serious eye damage.

Inhalation : May cause respiratory irritation.

Skin contact : Causes skin irritation.

Ingestion : No known significant effects or critical hazards.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : Adverse symptoms may include the following:
pain
watering
redness

Inhalation : Adverse symptoms may include the following:
respiratory tract irritation
coughing
burning sensation

Skin contact : Adverse symptoms may include the following:
pain or irritation
redness
blistering may occur

Ingestion : Adverse symptoms may include the following:
burning sensation
abdominal cramps and pain
vomiting

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Section 11. Toxicological information

Potential immediate effects : No known significant effects or critical hazards.

Potential delayed effects : No known significant effects or critical hazards.

Long term exposure

Potential immediate effects : No known significant effects or critical hazards.

Potential delayed effects : No known significant effects or critical hazards.

Potential chronic health effects

General : Causes damage to organs through prolonged or repeated exposure.

Carcinogenicity : May cause cancer if inhaled. Risk of cancer depends on duration and level of exposure.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

There is no data available.

Section 12. Ecological information

Toxicity

Product/ingredient name	Result	Species	Exposure
Calcium Hydroxide	Acute LC50 33884.4 µg/L Fresh water	Fish - Clarias gariepinus - Fingerling	96 hours

Persistence and degradability

There is no data available.

Bioaccumulative potential

There is no data available.

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Care should be taken when handling empty containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Avoid dispersal of

Section 13. Disposal considerations

spilled material and runoff and contact with soil, waterways, drains and sewers.

Section 14. Transport information

	DOT	TDG	IMDG	IATA
UN number	Not regulated.	Not regulated.	Not regulated.	Not regulated.
UN proper shipping name	-	-	-	-
Transport hazard class(es)	-	-	-	-
Packing group	-	-	-	-
Environmental hazards	No.	No.	No.	No.
Additional information	-	-	-	-

AERG : Not applicable.

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations :

TSCA 8(a) CDR Exempt/Partial exemption: Not determined

United States inventory (TSCA 8b): Calcium Hydroxide is subject to inventory update reporting (IUR).

RCRA classification: Calcium Hydroxide is not listed or classified.

CWA-311: Calcium Hydroxide has been withdrawn from the Clean Water Act (CWA) list of hazardous subtances. (11/13/79) (44FR65400).

CERCLA: Calcium Hyrdoxide is not listed.

FDA: Calcium Hydroxide has been determined as Generally Recognized As Safe (GRAS) by FDA. See 21CFR184.1205. (CFR Title 21 Part 184 - - Direct food substances affirmed as generally recognized as safe).

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Not listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

Section 15. Regulatory information

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

SARA 311/312

Classification : Immediate (acute) health hazard
Delayed (chronic) health hazard

Composition/information on ingredients

Name	%	Fire hazard	Sudden release of pressure	Reactive	Immediate (acute) health hazard	Delayed (chronic) health hazard
Calcium Hydroxide	90 - 100	No.	No.	No.	Yes.	No.
Crystalline silica, quartz	0.0001 - 1	No.	No.	No.	No.	Yes.

SARA 313

	Product name	CAS number	%
Form R - Reporting requirements	Not listed	-	-
Supplier notification	Not listed	-	-

SARA 313 notifications must not be detached from the SDS and any copying and redistribution of the SDS shall include copying and redistribution of the notice attached to copies of the SDS subsequently redistributed.

State regulations

Massachusetts : The following components are listed: Calcium Hydroxide; Crystalline silica, quartz

New York : None of the components are listed.

New Jersey : The following components are listed: Calcium Hydroxide; Crystalline silica, quartz

Pennsylvania : The following components are listed: Calcium Hydroxide; Crystalline silica, quartz

California Prop. 65

WARNING: This product contains a chemical known to the State of California to cause cancer.

Ingredient name	Cancer	Reproductive	No significant risk level	Maximum acceptable dosage level
Crystalline silica, quartz	Yes.	No.	No.	No.

Canada

Canadian lists

Canadian NPRI : None of the components are listed.

CEPA Toxic substances : None of the components are listed.

Canada inventory : All components are listed or exempted.

International lists

National inventory

Section 15. Regulatory information

Australia	:	All components are listed or exempted.
China	:	All components are listed or exempted.
Europe	:	All components are listed or exempted.
Japan	:	All components are listed or exempted.
Malaysia	:	Not determined.
New Zealand	:	All components are listed or exempted.
Philippines	:	All components are listed or exempted.
Republic of Korea	:	All components are listed or exempted.
Taiwan	:	Not determined.

Section 16. Other information

Hazardous Material Information System (U.S.A.)

Health : 3 * **Flammability :** 0 **Physical hazards :** 1

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks Although HMIS® ratings are not required on SDSs under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

National Fire Protection Association (U.S.A.)

Health : 3 **Flammability :** 0 **Instability :** 1

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History

Date of issue mm/dd/yyyy	:	04/15/2015
Version	:	1
Prepared by	:	KMK Regulatory Services Inc.
Key to abbreviations	:	ATE = Acute Toxicity Estimate BCF = Bioconcentration Factor GHS = Globally Harmonized System of Classification and Labelling of Chemicals IATA = International Air Transport Association IBC = Intermediate Bulk Container IMDG = International Maritime Dangerous Goods LogPow = logarithm of the octanol/water partition coefficient MARPOL 73/78 = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution) UN = United Nations

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

HIGH CALCIUM HYDRATED LIME

Danger

Causes skin irritation - Causes serious eye damage - May cause cancer (state route of exposure if it is conclusively proven that no other routes of exposure cause hazard) - May cause respiratory irritation; or; May cause drowsiness or dizziness

GRAYMONT

Obtain special instructions before use. - Do not handle until all safety precautions have been read and understood. - Do not breathe dust/fume/gas/mist/vapours/spray. - Wash hands thoroughly after handling. - Do not eat, drink or smoke when using this product. - Use only outdoors or in a well- ventilated area. - Wear protective gloves/protective clothing/eye protection/face protection. - Use personal protective equipment as required. - IF ON SKIN: Wash with plenty of soap and water. - IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. - IF exposed or concerned: Get medical advice/attention. - Immediately call a POISON CENTER or doctor/physician. - Call a POISON CENTER or doctor/physician if you feel unwell. - Get medical advice/attention if you feel unwell. - If skin irritation occurs: Get medical advice/attention. - Take off contaminated clothing and wash before reuse. - Wash contaminated clothing before reuse. - Store to minimize dust generation. - D

Please refer to the original SDS for more information

Appendix C

Industrial Stormwater Pollution Prevention Plan (SWPPP) Outline (Draft)

NorthMet Project Tailings Basin

Industrial Stormwater Pollution Prevention Plan (SWPPP) Outline

July 2016 Draft

Contents

List of Appendices