STATE OF MICHIGAN

DEPARTMENT OF NATURAL RESOURCES

LANSING

JENNIFER M. GRANHOLM
GOVERNOR

REBECCA A. HUMPHRIES
DIRECTOR

January 28, 2008

Mr. Jonathon C. Cherry, P.E.
Kennecott Eagle Minerals Company
1004 Harbor Hill Drive, Suite 1003
Marquette, Michigan, 49855

Dear Mr. Cherry:

SUBJECT: Surface Use Lease and Mining and Reclamation Plan for the Eagle Project

Thank you for meeting with Department of Natural Resources (DNR) and Department of Environmental Quality (DEQ) staff on January 11 and January 18, 2008, to discuss Kennecott Eagle Mineral's (Kennecott) Eagle Project proposed Surface Use Lease and proposed Mining and Reclamation Plan. As a result of the meetings and additional written information you provided on January 22, 2008, the items brought up in our December 7, 2007 letter have been resolved as described more fully below:

SURFACE USE LEASE

Kennecott provided the Topsoil Management Plan regarding removal, storage, and monitoring of topsoil from excavated areas. The DNR staff believes it will be difficult to obtain restoration of topsoil over a large area commensurate with the pre-mining thickness.

> Surface Use Lease Exhibit C has been modified to require additional topsoil of similar character to be brought in from an outside source if Kennecott is unable to restore topsoil on the Premises to a thickness present at pre-mining conditions. The DNR also modifies the Mining and Reclamation Plan to incorporate the topsoil handling practices and procedures identified in the Topsoil Management Plan.

Kennecott provided further analysis of the alternate locations (Kennecott Analysis of Surface Location A-D) it considered for the portal and surface facility. The DNR concurs that the proposed location for the portal and surface facility is a preferred location. Since approximately one-half of the ore body lies on state-owned minerals, the State of Michigan has an interest in having its minerals developed from a preferred location.

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www.michigan.gov/dnr • (517) 373-2329

MINING AND RECLAMATION PLAN AMENDMENTS

Kennecott provided the enclosed Subsidence Monitoring Station Map depicting the monumented sites to be used for surface and subsurface monitoring. One surface and one subsurface monitoring site will be placed directly over the ore body. Kennecott proposed monthly monitoring which exceeds the quarterly monitoring requirement contained in the DEQ Mining Permit. The DNR was concerned that the one-half inch monthly, and two-inch cumulative standards proposed to determine that subsidence occurred might not be fully protective of the resources. The standard of deflection allowed under the DEQ Mining Permit is essentially zero movement (not counting possible movement due to gravitational effects) at a one-centimeter level of accuracy.

> The DNR modifies the Mining and Reclamation Plan to reflect Kennecott's frequency of monthly monitoring, at the array of monitoring sites identified in the attached map. Any net displacement of one centimeter or more from pre-mining conditions will be considered subsidence and will cause corrective action under the DEQ Mining Permit condition E8.

Kennecott provided the TDRSA Leak Detection System and Response Action Plan. However, Kennecott indicated a leak is indicated if both the sulfate level exceeds 500 mg/L and a flow rate greater than 25 gallon acres/day (1500 gallons) is observed. DEQ Mining Permit condition F22 states that either condition indicates a leak and is cause for corrective action.

> The DNR modifies the Mining and Reclamation Plan to reflect the TDRSA Leak Detection System and Response Action Plan. For clarification, DEQ Mining Permit Condition F22 shall be the basis to determine if a leak is present in the TDRSA.

The DNR was concerned that the DEQ Mining Permit did not appear to have an upper limit on the volume of water produced from the mine and asked Kennecott to provide an action plan to address high water production rates. Kennecott's response might allow high rates of water production for an extended time prior to taking corrective action. Further consultation with the DEQ and Kennecott found the parameters affecting maximum allowed water flow are interdependent on factors such as the maximum capacity of the wastewater treatment facility, discharge rate of surface contact water, and the modeled ability of the mine to produce water without affecting surface and ground water. Importantly, the DEQ Mining Permit relies on actual data from wetland and ground water monitoring to confirm there are no impacts to the surface and ground water resources.

> For clarification, the monitoring requirements in Section L of the DEQ Mining Permit shall be the basis to determine maximum allowed flow rate from the mine.

Kennecott provided an Impermeable Surface Inspection and Surface Repair Plan to address the discovery and repair of cracks in the impermeable surfaces. Through

further discussion with Kennecott, they informed the DNR they will use automatic sump pumps to keep impermeable collection areas pumped down to a minimum volume.

> The DNR modifies the Mining and Reclamation Plan to incorporate the Impermeable Surface Inspection and Surface Repair Plan. In addition, all collection sumps will utilize automatic sump pumps to keep collected volumes at a minimum.

Kennecott provided the Portal Abandonment Plan to prevent access to the portal plug.

> The DNR modifies the Mining and Reclamation Plan to incorporate the Portal Abandonment Plan to address abandonment of the portal near the surface.

Based on the above stated clarifications and amendments to the Mining and Reclamation Plan and Surface Use Lease, staff will recommend the Director approve both the Surface Use Lease and Mining and Reclamation Plan at the February 7, 2008, Natural Resources Commission meeting.

Please contact me at the number below if you have any questions.

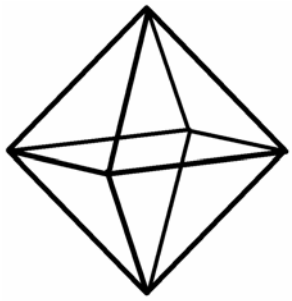
Sincerely,

Thomas Wellman

Thomas Wellman, Manager
Minerals and Land Management Section
Forest, Mineral and Fire Management Division
517-373-7666

cc: Mr. Jim Sygo, DEQ
Mr. Harold Fitch, DEQ
Mr. Joe Maki, DEQ
Ms. Arminda Koch, DNR
Ms. Lynne M. Boyd, DNR
Ms. Debbie Begalle, DNR
Mr. Milt Gere, DNR
Mr. William Brondyke, DNR

Plan



Kennecott
Eagle Minerals

Eagle Project

Topsoil Management Plan

Project I.D.: 04W018

Kennecott Eagle Minerals Company
Marquette, Michigan

December 2007

Eagle Project
Topsoil Management Plan

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Figure 1 Site Development Plan and Topographical Map

1. Introduction

1.1 Purpose

This Topsoil Management Plan has been prepared to address the potential effects of long-term storage of topsoil in stockpiles, and Kennecott Eagle Minerals Company (KEMC) methods to segregate and re-spread the topsoil during mine site reclamation. Additionally, this plan presents KEMC's plan to achieve a topsoil thickness and fertility commensurate with pre-construction activities.

2. Topsoil Management

2.1 Topsoil Stripping and Stockpiling

As discussed in the Mine Permit Application (Foth, 2006), average topsoil thickness at the site is approximately 3 inches. The quantity of topsoil to be stripped from the site during project construction is estimated at approximately 28,600 cubic yards (yd^3). Approximately 11,400 yd^3 of topsoil will be used on-site during construction to revegetate the disturbed areas, resulting in approximately 17,200 yd^3 to be stockpiled in the on-site topsoil stockpile area (Figure 1).

The topsoil stripping and stockpiling will be completed using conventional earth-moving equipment such as bulldozers, scrapers, graders and off-road trucks. In areas where the topsoil is relatively thin, the contractor will remove the topsoil using smaller equipment to minimize mixing of topsoil and subsoils.

Topsoil will be stockpiled in a controlled manner in the topsoil stockpile area. The stockpile will be surrounded by silt fencing or similar erosion control devices to prevent soil erosion until permanent erosion control measures are installed. Permanent measures include establishment of vegetation. Topsoil stockpiles will be seeded with a Michigan Department of Transportation (MDOT), 2003 Standard Specification for Construction (MDOT, 2003) Temporary Seed Mixture 24+ (TSM 24+). TSM 24+ includes a 50/50 mixture of Perennial Ryegrass and Spring Oats. The rye and oats will quickly establish vegetation on the stockpile and mitigate soil erosion and dust emissions.

2.2 Potential Long-Term Effects of Topsoil Stockpiling

During long-term stockpiling of soils, changes can occur below depth for sandy textured soils such as those present at the site. Potential changes could be a reduction in the content of available nutrients, pH and organic matter levels.

2.3 Topsoil Management Plan

To minimize the detrimental effects of long-term storage of topsoil in stockpiles, KEMC will implement the following procedures.

- Following stockpiling, KEMC will collect up to four samples (1 sample/5,000 yd^3 of topsoil stockpiled) of the topsoil for analysis, and test for pH, nitrogen, and organic content to establish an initial nutrient composition of the topsoil.

- As a temporary soil erosion and control measure, silt fences or similar erosion control devices will be installed surrounding the stockpiles to prevent soil erosion. For permanent soil erosion control, topsoil stockpiles will be seeded. In accordance with the facilities soil erosion sedimentation and control plan (Foth, 2007) to establish a vegetative cover and minimize erosion and dust emissions.

- Prior to use of the topsoil for reclamation, KEMC will collect samples of the topsoil for analysis, including pH, nitrogen, and organic content and compare these results to the initial condition. If required, soil amendment will be performed before re-spreading the topsoil to mitigate any deficiencies in the topsoil so that the topsoil is productive and a topsoil thickness and fertility commensurate with pre-construction activities is achieved.

Fertilizer application rates will be established upon evaluation of the soil nutrient content. If needed, additional similar quality topsoil will be purchased to meet reclamation needs.

- KEMC will re-spread topsoil in those areas requiring reclamation, to approximate pre-development thicknesses of approximately 3 inches using scrapers and bulldozers, as required.

- Vegetation establishment will proceed in accordance with the Mine Reclamation Plan and Mine Permit requirements.

3. References

Foth Infrastructure & Environment, LLC. *Eagle Project Part 91 Soil Erosion and Sedimentation Control Permit Application Main Facility*. July 2007

Foth & Van Dyke and Associates, 2006. *Eagle Project Mining Permit Application* (submitted to Michigan Department of Environmental Quality in February 2006).

Michigan Department of Environmental Quality. *General Permit Conditions Non Ferrous Metallic Mineral Mining Permit No. MP 01 2007.* Anticipated Issuance Date of December 14, 2007.

Michigan Department of Transportation, 2003. *Standard Specification for Construction.*

Figures

NOTES:

1. TOPOGRAPHIC AND PLANIMETRIC DATA SUPPLIED BY AERO-METRIC ENGINEERING, SHEBOYGAN, WISCONSIN. DATE OF PHOTOGRAPHY: JUNE 2, 2004.
2. MINE PLAN DATA AREA ADAPTED FROM MCINTOSH ENGINEERING, INC., TEMPE, ARIZONA.
3. SURFACE PROPERTY BOUNDARY AS OF NOVEMBER 18, 2004 SUPPLIED BY KENNECOTT VIA GOLDER & ASSOCIATES INC., AUGUST, 2005.
4. CONTOUR INTERVAL BASED ON NORTH AMERICAN VERTICAL DATUM OF 1988. HORIZONTAL DATUM BASED ON NAD 83/94. HORIZONTAL COORDINATES BASED ON UTM ZONE 16.
5. ORE BODY, WETLAND BOUNDARY (WETLAND AND COASTAL RESOURCES) SUPPLIED BY GOLDER & ASSOCIATES, INC. AUGUST, 2005.
6. SITE LOCATION: PROJECT SITE WITHIN SECTIONS 11 & 12, T50N, R29W, TOWN OF MICHIGAMME, MARQUETTE COUNTY, MICHIGAN.

LEGEND

- EXISTING ELEV. CONTOUR IN METERS MSL (1 METER INTERVAL)
- UNPAVED ROAD
- TREE
- TREE LINE
- WCR MAPPED WETLAND BOUNDARY PROVIDED BY GOLDER & ASSOCIATES, INC. APRIL 7, 2005.
- KENNECOTT PROPERTY BOUNDARY
- TREATED WATER INFILTRATION SYSTEM
- PLANIMETRIC WETLAND NOTATION
- PERIMETER FENCE
- APPROXIMATE MINE DECLINE AND ACCESS RAMP
- ORE BODY
- CULVERT
- EROSION MAT OR RIPRAP
- DRAINAGE DITCH AND FLOW DIRECTION
- EXCESS SOIL BERM (FINAL LOCATION AND SIZE BASED UPON ACTUAL EXCAVATED SOIL QUANTITIES)
- NON-CONTACT AREA
- MAIN OPERATIONS AREA
- BITUMINOUS LINED OPERATIONS AREA
- WETLANDS ADAPTED FROM US FISH AND WILDLIFE WETLAND INVENTORY MAP
- CONSTRUCTION STAGING AREA AND SOIL STOCKPILE AREA

Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

CHECKED BY:	JOSI	DATE: DEC. '07
APPROVED BY:	SVDI	DATE: DEC. '07
APPROVED BY:		DATE:

Kennecott Eagle Minerals

FIGURE 1
SITE DEVELOPMENT PLAN AND TOPOGRAPHIC MAP

Scale: 0 60M 120M

Date: DECEMBER, 2007

Prepared By: JOW

Project No. 04W018

L:\04W018\Top_soil_mgmt_plan\topsoil_site_dev_plan.dgn
12/13/2007 blw1

Jonathan C. Cherry, P.E.
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1004 Harbor Hill Drive
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Kennecott
Eagle Minerals

January 21, 2008

Ms. Lynn Boyd , Division Chief
Forest Mineral and Fire Management Division
Michigan Department of Natural Resources
Steven T. Mason Building
Post Office Box 30028
Lansing, Michigan 48909

Re: **Requested Clarifications on Kennecott Eagle Minerals Company Mining and Reclamation Plan (MRP)**

Dear Ms. Boyd:

Kennecott Eagle Minerals Company ("Kennecott") provides this letter in response to the Michigan Department of Natural Resources ("MDNR") request for clarification of certain items in Kennecott's MRP, as set forth in Mr. Thomas Wellman's December 11, 2007 correspondence to me and in subsequent discussions between the MDNR and Kennecott. Specifically, this letter encloses Kennecott's alternatives analysis of various locations for the mine portal and surface facilities. Based on our discussions, we understand (and with this letter confirm) that the MDNR has determined that the other clarifications requested in Mr. Wellman's December 11 letter are no longer necessary and will be deferred to the Department of Environmental Quality's ("MDEQ") regulation of the mine under Part 632 and other NREPA authorities.

For a detailed narrative summary and tabular illustration of the various location alternatives considered and a description of the criteria that Kennecott used to guide its analysis, see the enclosures. The basic rationale Kennecott used to select the proposed location embodied in Kennecott's issued permits is as follows:

- **The mine portal and surface facilities should be located in close proximity to each other and in one watershed if possible**. The selected alternative (and all of the other alternatives considered) is premised on the principle that keeping the portal and surface facilities in close proximity to each other and in one watershed is preferable to moving surface facilities to a location removed from the mine site or splitting facilities at the mine site across watersheds. This decreases the

footprint of the project from an environmental and reclamation perspective and reduces truck traffic on public roads. While it might be technically feasible to transport ore to surface facilities on private land some miles away from the mine, such a plan will substantially expand and complicate the environmental impact analysis needed to support the mining permit and result in a much broader and more significant environmental impact.

- **The currently proposed alternative is the most environmentally protective alternative, particularly with respect to management of treated wastewater associated with mine operations.** As you know, mine operations will entail the discharge of treated wastewater associated with the mine to groundwater under a Part 22 groundwater discharge permit issued by MDEQ. This discharge is required by this permit to meet drinking water standards prior to discharge. The selected surface facility location offers an optimal location for the discharge of this wastewater due to an 80-100 foot zone of unsaturated soils in the area of the discharge. This is a substantially thicker unsaturated zone (up to twice as thick) than is present at alternative locations for the surface facilities. This geologic feature will help prevent mounding of the treated discharge and localized modification to natural groundwater flow contours in the area. In addition, the discharge area in the selected alternative is located farther away from surface waters (6,800 feet), than other alternative locations, providing years of transit time for any theoretical migration and "venting" of discharge constituents to surface waters from groundwater, thereby ensuring that all applicable discharge criteria will be met at the venting location. In short, the selected location for the surface facilities will help ensure that the groundwater discharge associated with the mine will have no discernable impact on groundwater in the area of the discharge or on surface water.

- **The selected portal location involves no disturbance to the facing of the outcrop, minimal disturbance of surface and less blasting for portal construction**. As to portal location, Kennecott's first priority is the structural integrity of the decline and safely accessing the ore body. All of the location alternatives meet this objective, but certain locations will require substantially more surface disturbance and blasting to do so. The selected location involves a minimal disturbance of the surface, no disturbance of the outcrop and less blasting for portal construction than the other alternatives. This, in turn, means less environmental and aesthetic impacts because of lower erosion risks associated with a higher volume of staged soils, less waste rock, leaving more existing vegetation intact, and minimizing visual impacts. Minimization of surface soil/vegetation disturbance also leaves a much smaller "footprint" in the portal area that will have to be reclaimed.

- **The selected surface facility location is located in an area that was recently clear cut and is screened from the closest public road**. Despite the fact that the entire area has been recently clearcut, the selected location for the surface facility is the only alternative that is screened from the Triple A road by the outcrop and trees on the outcrop, rendering the selected location a superior location from an aesthetic standpoint.

I hope this summary of Kennecott's selection rationale and the enclosed alternatives analysis provides the clarification requested in Mr. Wellman's December 11th letter and subsequent discussions. If you are in need of any additional clarification or wish to discuss the alternatives analysis any further, please do not hesitate to contact me.

Sincerely,

Ka
Cc: Mindy Koch
Tom Wellman
Jim Sygo
Hal Fitch

1499525

KENNECOTT EAGLE MINERALS COMPANY'S
FACILITY LOCATION ALTERNATIVES ANALYSIS

The location of the surface facilities for the proposed Eagle Mine is based on two overriding considerations. First and foremost, the location of the mine portal must enable Kennecott to safely access the underground resource. Second, the portal and surface facilities must be located to minimize potential environmental impacts associated with mine operations. In addition to these primary objectives, Kennecott considered several other factors in evaluating alternative locations for the portal and surface facilities, including minimization of aesthetic impacts and impact of locations on future reclamation activities.

With these considerations in mind, Kennecott carefully reviewed and rejected the alternative of locating the portal and surface facilities on Kennecott property directly above or in close proximity to the ore body itself, since this would require the filling and/or substantial alteration of wetlands above the ore body and adjacent to the Salmon Trout River Main Branch. Kennecott also, after careful consideration, rejected the alternative of locating surface facilities on land some distance from the portal and mining area since this would markedly increase the environmental footprint of the overall operation, require duplicate engineered systems for managing water treatment and ore storage, and increase transportation requirements on public roads. Kennecott's alternatives analysis therefore focused on locating surface facility features close to various mine portal options. This analysis is illustrated in tabular form in the attached matrix, and the six locations considered are depicted in Figure 1. The following provides a narrative description of the mine portal options and paired alternatives for surface facility locations. The criteria used to evaluate the portal and related facility options are also described.

Portal options.

1. **Outcrop west face, underground entry:** For this option, the entry into the steep west portal rock face is below current grade. A steel arch originates approximately 37 meters west of the outcrop rock and begins a 15% decline such that the portal rock face entry is below current grade. The surface disturbance from portal construction is minimal for this configuration. Reclamation of this option would leave no visible evidence on the outcrop above the natural restored grade. This portal option is associated with Facility Location Alternatives 1 and 4.

2. **Outcrop west face, aboveground entry**: The entry into the steep west portal rock face would be at the current grade. A relatively short (5 to 10 meter) steel arch would enter the portal rock face near grade with the decline beginning under the outcrop. The surface disturbance from the portal construction would be minimal. However, disturbance to the outcrop itself (above grade) would be significant. Reclamation would mitigate the disturbance to the outcrop, but evidence of restoration would be visible at the portal rock face entry. This portal option is associated with Facility Location Alternative 2.

3. **Outcrop east face, underground entry:** The portal entry below ground into the gently sloped east outcrop face would require a steel arch longer than the arch proposed in the

outcrop west face associated with Facility Location Alternatives 1 and 4. The shallow entry angle with the outcrop rock would require more support than the steeper entry angle available on the west face. Additionally, more near surface blasting (thus more disturbance) would be required to install the portal. Reclamation of this option would leave no visible evidence on the outcrop above the natural restored grade. This portal option is associated with Alternatives 3 and 5.

4. **Vertical Shaft:** A vertical shaft would have to be located in close proximity to the ore body. The shaft would be equipped with hoists and elevators to enable material and personnel transport. To address water entry into the shaft from saturated alluvium, isolation methods would have to be employed to keep the shaft dry. Surface disturbance from this option is minimal, but the shaft would intersect an aquifer and move traffic and other activities associated with surface operations (such as staging and transfer of ore) much closer to wetlands and the Salmon Trout River Main Branch. Reclamation of this option would leave no visible evidence of disturbance. This portal option is associated with Facility Location Alternative 6.

Surface facility options.

Location of surface facility options paired with portal options are set forth as Alternatives 1 through 6 on Figure 1. As noted above, these alternative pairings were developed based on the basic design goal of keeping the portal and surface facilities within reasonably close proximity to each other and thereby minimizing the footprint of mine operations. The alternative combinations of surface facility and portal locations were evaluated based on several different criteria, the most important of which were:

Portal Safety. As noted above, this is the primary overarching criterion driving selection of portal location. As delineated in the attached table, all portal locations would enable Kennecott to access the ore body safely, but the design and construction methods differ significantly for certain options. These differences, in turn, have a substantial impact on other criteria considered.

Groundwater Protection: Available Unsaturated Zone for Groundwater Discharge. The Eagle Project proposes a groundwater discharge of treated water generated from planned mining activities. Treated water will be discharged within the main facility in a Treated Water Infiltration System (TWIS). The maximum design discharge rate is 504,000 gallons per day (MDEQ Groundwater Discharge Permit No. GW1810162). This discharge requires an adequate thickness of unsaturated soils so that discharge into that layer in all expected conditions would never produce mounding that intersects the ground surface. Although each Alternative provides adequate TWIS discharge media, locations with thicker unsaturated soils will further reduce mounding risk.

Surface Water Protection – Distance of Discharge to Closest Surface Water Downgradient of Facility. The Eagle Project has been designed to operate in a manner protective of the environment by incorporation of many engineering design and controls and operational practices in routine and atypical scenarios. Nevertheless, in an atypical situation, the distance from the facility to the closest surface water (in this case, the Salmon Trout River Main Branch) influences the risk to that surface water. Each alternative will provide a high degree of environmental protection. However, a longer distance between the facility and the nearest downgradient surface water substantially decreases any environmental risk associated with an atypical scenario.

Watershed Location. The immediate area of the Eagle ore body is in close proximity to a sub watershed divide between the Salmon Trout River Watershed and the Yellow Dog River Watershed. Locating the surface facilities and portal within one watershed, is, in Kennecott's view, preferable to splitting the facility between two watersheds.

Aesthetics. Aesthetic considerations include the visibility of the project and noise exposure to surrounding publicly accessible locations. The ability to manage negative aesthetics is evaluated for each alternative. Triple A Road is the public road adjacent to the project (Figure 1), therefore proximity to it influences the ability to manage aesthetics. The presence of the outcrop between the facility operations and Triple A Road also influences the resulting visual and noise aesthetics.

Prior Disturbance of location. The area surrounding the Eagle ore body has been clear cut fairly recently. The quantity of tree removal and level of modification to current habitat has been addressed in this criterion. Figure 1 is a high-resolution photograph background upon which a high-level visual evaluation can be made of each alternative location. Further details of the flora and fauna in this area are described in the EIA.

Ownership of Surface and Mineral Rights. The ability to legally use and access the surface and subsurface locations considered is addressed in this criterion. Although Kennecott does not own the surface of five of the six alternatives locations considered, it owns or leases the mineral rights under each location. Under the terms of its mineral leases with the state under these areas, Kennecott has the right to construct and operate surface facilities so long as the facilities and the leased minerals being extracted comprise "a common mining operation" area. Although Kennecott and the DNR do not agree as to whether the Eagle project operation comprises a common mining operation area as defined in the pertinent leases, Kennecott does not believe, based on discussions with MDNR, that this disagreement will prevent Kennecott from building and operating surface facilities at the location alternatives considered. Nonetheless, it was one of the criterion Kennecott used in its evaluation.

Foth

Client: Kennecott Eagle Minerals Company Scope ID.: 04W018
Project: Eagle Project
Prepared by: AKM Date: 01/17/08
Checked by: SVD1 Date: 01/17/08

	Criteria								
Alternative	**Surface Owner**	**Underlying Metallic Mineral Rights**	**Surface Disturbance from Portal Construction**	**Portal Construction Engineering**	**Available Unstaturated Zone for Groundwater Discharge**	**Distance to Closest Surface Water Downgradient (in feet)**	**Located in This Watershed**	**Aesthetics (Visual and Noise) and Public Safety**	**Current Site Condition**
1 Current Location, portal entry on *west* side of outcrop, *underground* entry.	State	State (KEMC Metallic Minerals Lease No. M-00603*)	Minimal disturbance, reclamation ***not*** visible.	enter bedrock at perpendicular face, less blasting required	Unsaturated zone at TWIS 80-100 ft.	6,800 feet	Salmon Trout River	Located away from Triple A, screened by outcrop and trees.	Recently clear cut, minimal tree removal required.
2 Current Location , portal entry on *west* side of outcrop, *aboveground* entry.	State	State (KEMC Metallic Minerals Lease No. M-00603*)	Minimal disturbance, reclamation ***is*** visible.	enter bedrock at perpendicular face, less blasting required	Unsaturated zone at TWIS 80-100 ft.	6,800 feet	Salmon Trout River	Located away from Triple A, screened by outcrop and trees.	Recently clear cut, minimal tree removal required.
3 Current Location, portal entry on *east* side of outcrop, *underground* entry.	State	State (KEMC Metallic Minerals Lease No. M-00603*)	Moderate disturbance, reclamation **not** visible.	enter bedrock at shallow angle, more support required, more blasting required	Unsaturated zone at TWIS 80-100 ft.	6,800 feet	Salmon Trout River	Located away from Triple A, screened by outcrop and trees.	Recently clear cut, minimal tree removal required.
4 Location *west* of current location, portal entry on *west* side of outcrop, *underground* entry.	KEMC	State (KEMC Metallic Minerals Lease No. M-00603*) AND KEMC	Minimal disturbance, reclamation **not** visible.	enter bedrock at perpendicular face, less blasting required	Unsaturated zone at TWIS 40-60 ft.	6,700 feet	Salmon Trout River	Close to Triple A, unscreened.	Recently clear cut, minimal tree removal required.
5 Location *southeast* of current location, portal entry on *east* side of outcrop, *belowground* *entry*.	KEMC/STATE	State (KEMC Metallic Minerals Lease No. M-00603*) AND KEMC	Moderate disturbance, reclamation **not** visible.	enter bedrock at shallow angle, more support required, more blasting required	Unsaturated zone at TWIS 60 ft.	6,700 feet	Salmon Trout River and Yellow Dog River	Close to Triple A, unscreened, close to wetland.	Recently clear cut, minimal tree removal required.
6 Location *west* of current location, on *KEMC land,* vertical *shaft* access.	KEMC	KEMC	Minimal disturbance, reclamation **not** visible.	must grout, freeze or otherwise isolate saturated alluvium to enter bedrock	Unsaturated zone at TWIS 40-50 ft.	3,900 feet	Salmon Trout River	Close to Triple A, unscreened, close to wetland.	Recently clear cut, minimal tree removal required.

*MDNR Metallic Minerals Lease No. M-00603 grants the lease holder the right to develop surface facilities related to the mineral lease.

Shaded areas indicate optimum levels of that criteria.

431000
432000
433000
5178000
5177000

State of Michigan
Plum Creek
SALMON TROUT RIVER WATERSHED
YELLOW DOG RIVER WATERSHED
State of Michigan
Shaft
6
1,2,3
4
5
SALMON TROUT RIVER MAIN BRANCH
Backfill Facility
11
12
Outcrop
State of Michigan
SALMON TROUT RIVER MAIN BRANCH GROUNDWATER DIVIDE
SALMON TROUT RIVER EAST BRANCH GROUNDWATER DIVIDE
Triple A Road
State of Michigan
Longyear

NOTES

1. Surface Rights Boundary, Ore Body and Orthophotography supplied by Kennecott via Golder Associates Inc., August, 2005.
2. Horizontal datum based on NAD 83/94. Horizontal coordinates based on UTM Zone 16.
3. Property Ownership supplied from Kennecott and Coleman Engineering
4. Site Location - Project Site within Sections 11 &12, T50N, R29W, Michigamme Township, Marquette County, Michigan.

LEGEND

- Eagle Ore Body
- Kennecott Surface Ownership
- Other Surface Ownership
- Section Lines
- State Leased Area
- Subwatershed Divide
- Groundwater Divide
- Alternative #1, #2, #3
- Alternative #4
- Alternative #5
- Alternative #6

N

Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

CHECKED BY:	AKM	DATE: JAN. '08	
APPROVED BY:	SVD1	DATE: JAN. '08	
APPROVED BY:		DATE:	

Kennecott Eagle Minerals

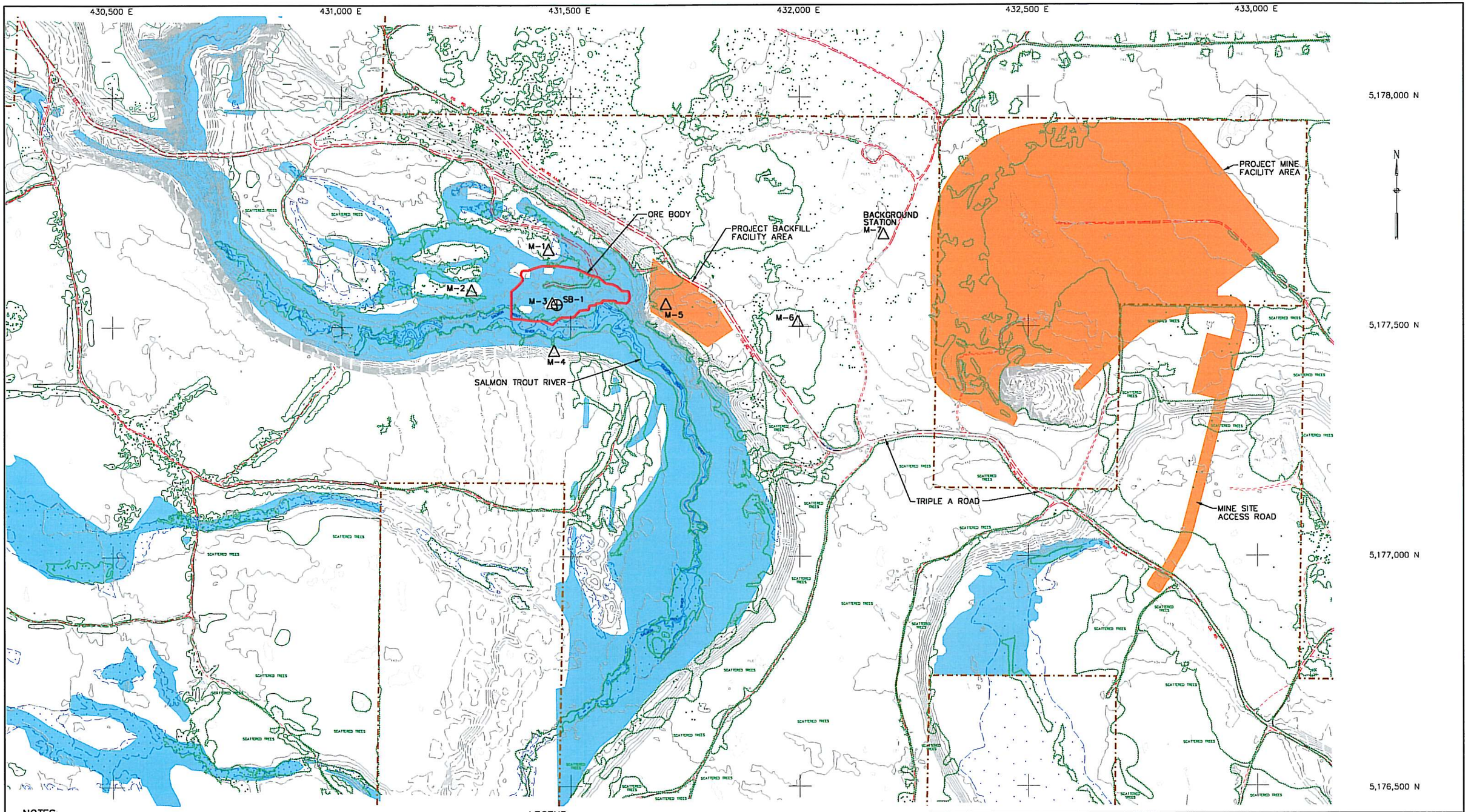
FIGURE 1

PROJECT SURFACE OWNERSHIP AND LOCATION ALTERNATIVES

Scale: 0 300 600 Feet | Date: JANUARY, 2008

Prepared by: DAT | Project No: 04W018

M:\kmceagle\mxd\MNDR_location1_memo_11x17.mxd January 22, 2008



NOTES:

1. TOPOGRAPHIC AND PLANIMETRIC DATA SUPPLIED BY AERO-METRIC ENGINEERING, SHEBOYGAN, WISCONSIN. DATE OF PHOTOGRAPHY: JUNE 2, 2004.
2. MINE PLAN DATA ADAPTED FROM MCINTOSH ENGINEERING, INC., TEMPE, ARIZONA.
3. SURFACE PROPERTY BOUNDARY AS OF NOVEMBER 18, 2004 SUPPLIED BY KENNECOTT VIA GOLDER & ASSOCIATES INC., APRIL 7, 2005.
4. CONTOUR INTERVAL BASED ON NORTH AMERICAN VERTICAL DATUM OF 1988. HORIZONTAL DATUM BASED ON NAD 83/94. HORIZONTAL COORDINATES BASED ON UTM ZONE 16.
5. ORE BODY, GROUNDWATER DISCHARGE AREA, WETLAND BOUNDARY (WETLAND AND COASTAL RESOURCES) SUPPLIED BY GOLDER & ASSOCIATES, INC. APRIL 7, 2005.

LEGEND

- EXISTING CONTOUR
- UNPAVED ROAD
- TREE
- TREE LINE
- WCR MAPPED WETLAND BOUNDARY PROVIDED BY GOLDER & ASSOCIATES, INC. APRIL 7, 2005.
- ORE BODY
- ROAD EASEMENT PROVIDE BY MCINTOSH ENGINEERING, INC., APRIL, 2005
- GROUNDWATER DISCHARGE INVESTIGATION AREA
- PLANIMETRIC WETLAND NOTATION
- PROPERTY LINE
- PROJECT FACILITY AREA
- SB-1 ⊕ SUBSIDENCE BORING NUMBER AND LOCATION
- M-1 △ SUBSIDENCE SURVEY MONUMENT NUMBER AND LOCATION

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CHECKED BY: JOS1			DATE: DEC. '07
APPROVED BY: SVD1			DATE: DEC. '07
APPROVED BY:			DATE:

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FIGURE 1

SUBSIDENCE MONITORING PLAN

Scale: 0 100M 200M
Date: DECEMBER, 2007
Prepared By: JOW
Project No. 04W018

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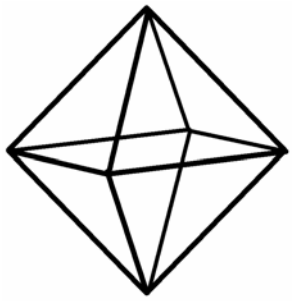
Plan



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Eagle Project

TDRSA Leak Detection System and Response Action Plan

Project I.D.: 04W018

Kennecott Eagle Minerals Company
Marquette, Michigan

December 2007

Eagle Project
TDRSA Leak Detection System and Response Action Plan

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Appendix A TDRSA CQA Plan
Appendix B Leak Detection System Inspection Forms

1. Introduction

1.1 Purpose

This TDRSA Leak Detection System and Response Action Plan ("the Plan") has been prepared for the Kennecott Eagle Minerals Company (KEMC) Eagle Project to describe how the collection of liquid in the Temporary Development Rock Storage Area (TDRSA) Leak Detection System (LDS) will be managed during construction and operations of the TDRSA. The LDS parameters assist in identifying the source of liquid collected and what action, if any, should be taken.

During construction and operation of the TDRSA, leak potential will likely originate from specific sources depending on the activities taking place. This plan evaluates the most likely leak sources over the TDRSA life to focus prevention, inspection, and action on the highest risk scenarios. Overall, the most likely opportunity for liner leaks stems from the construction process and during the placement of the first several feet of development rock on the TDRSA base. Recognizing this, a comprehensive construction and installation procedure overseen by assigned Construction Quality Assurance personnel is planned. Rigorous installation inspections are part of the program that minimizes leak risk from quality-control sources. Once the TDRSA liner system is installed and the bottom layer of development rock is placed, leak risk is reduced to a minimum as additional development rock is placed.

Water can enter or be present in the TDRSA from several sources: precipitation that leaks through the top cover, precipitation from the active face, infiltration through a liner breach, and water captured during the development rock placement. Water present in the LDS may originate from a liner breach, however, water can also be present from construction activities. This plan has been prepared to allow evaluation of liquid in the LDS and to assess its source. In addition, if the liquid is identified as a liner breach, actions are provided to mitigate the breach(es) and to protect groundwater.

2. Design and Construction

2.1 Design

The TDRSA is an engineered aboveground storage area used to temporarily store rock generated during mine development from the decline, drifts, levels, raises, and other underground workings needed to access the ore body. The rock, called development rock, will be transported from the development face by truck and placed on the lined TDRSA. The quantity of development rock that will be stored in the TDRSA is 247,900 yd^3. Once ore mining begins, all development rock stored in the TDRSA will be returned to backfill the mined areas.

The TDRSA will have a perimeter berm/access road, perimeter drainage ditch, contact water collection system sump and leak detection sump on the south end. A double liner system will be installed as shown in Figure 1. The TDRSA will first be filled over the entire floor area with a layer of development rock to protect the liner system.

The sump and LDS are shown in Figure 2. The LDS will consist of a 40 mil textured HDPE secondary liner and geocomposite drainage layer underlying the primary liner system. The leak detection liner and geocomposite drainage layer will allow collection and monitoring of liquid that may flow into the system as a result of construction water, a breach in the primary liner system, and/or surface or ground water infiltration. The LDS will be installed across the entire subbase and will be connected with the LDS sump.

2.2 Construction Quality Assurance

During construction of the TDRSA liner system, construction quality assurance (CQA) personnel will be on-site to observe that construction procedures and methods are performed in accordance with project and regulatory requirements. A TDRSA CQA Plan appears in Appendix A detailing the inspection and quality controls on liner installation. CQA personnel will follow specific observation protocol to document construction of the TDRSA liner system components including the subgrade, GCL, geomembrane liners (primary and LDS), geocomposite, contact water collection system, and drainage layer soil.

3. System Monitoring

3.1 Inspections and Monitoring of the Leak Detection Sump

Once development rock is being actively placed, the LDS sump will be monitored monthly for the presence of liquid. Inspections will be documented using the inspection forms provided in Appendix B. Liquid in the sump will be detected with a pressure transducer located in the LDS sump (Figure 2). If present, liquid in the sump will be pumped out and the volume recorded. If the volume exceeds 25 gallon per acre per day(gad), (USEPA, 1987), or in this case, 150 gallons for the approximate 6 acre TDRSA, the LDS sump will be checked for presence of liquid the following day. If present, the liquid will be pumped out, volume recorded, and analyzed for the parameters listed in Table 3-1:

Table 3-1
Leak Detection System Sump
Water Quality Parameters List

Parameter	Analytical Method	Threshold Limit	Units
Sulfate	EPA-375.4/9038	500	mg/L
pH	Field Measurement	--	standard pH units

Prepared by: MJP1
Checked by: JOS1

Sulfate levels of 500 milligrams/liter (mg/L) and greater than 25 gad (150 gal) indicates a breach of the TDRSA primary liner and the Response Action Plan will be implemented. Sulfate concentration less than 500 mg/L indicates the water present is from sources such as construction and no action is needed.

3.2 Response Action Plan

A Response Action Plan (RAP) is a site-specific plan that establishes procedures in the event that liquids are measured in the LDS sump exceeding 25 gad and a sulfate concentration of 500 mg/L or more in accordance with Special Permit Condition F.22 of the Nonferrous Metallic Mineral Mining Permit No. MP 01 2007 (MDEQ, 2007).

To implement the RAP, KEMC will proceed as follows:

- Notify MDEQ and MDNR in writing of the exceedance within 7 days of its discovery.
- Continue daily assessment of liquid quantity and sample testing. If the 25 gad rate continues to be exceeded, KEMC will install a permanent pump in the LDS sump for continuous liquid removal to minimize liquid head on the LDS liner.
- Within 30 days after notification of the exceedance, KEMC will submit to MDEQ and MDNR a report discussing the determination of the nature/source of the liquid and actions taken.

The best option to mitigate a leak will depend on a number of factors including the amount and rate of development rock placed, chemistry of the liquid in the LDS sump, and the effectiveness of the secondary liner system to contain the leakage. Therefore, no single action can be pre-selected. Continuing monitoring of the LDS sump will be key in determining RAP success. Potential actions to be evaluated include:

- Installation of an additional liner over the existing in-place development rock. This will prevent precipitation from infiltrating in-place development rock, thus eliminating the source of the liquid transmitted through a liner breach. A permanent pump can be installed in the LDS collection sump to collect the remaining liquid infiltrating through the in-place development rock. Installation of the additional liner could be staged such that development rock would be temporarily placed over the existing rock until the first stage of additional liner is completed. This rock could then be relocated to the additional lined area as the second stage of additional liner is completed. During these construction events, the area could be graded to direct runoff into a temporary, lined pond area created within the TDRSA and the runoff pumped to the CWBs.

- Interim cover to prevent precipitation from infiltrating in-place development rock. The cover could be graded to direct runoff into a temporary, lined pond area created within the TDRSA and the runoff pumped to the CWBs.

- Establish a low threshold for pump activation in the contact water collection system sump such that minimal quantity of liquid and head would be maintained.

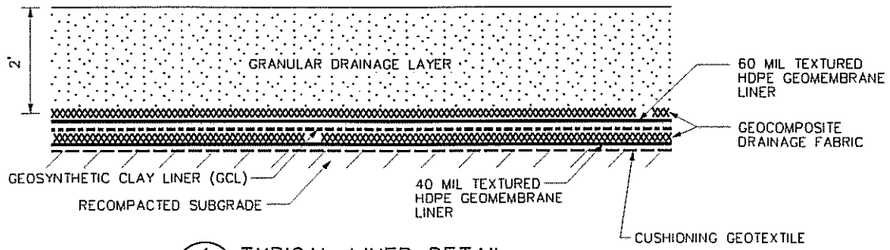
4. References

ASTM D 7007-03 *Standard Practices for Electrical Methods for Locating Leaks in Geomembranes Covered with Water or Earth Materials*

Michigan Department of Environmental Quality. *General Permit Conditions Nonferrous Metallic Mineral Mining Permit No. MP 01 2007.* Anticipated Issuance Date of December 14, 2007.

USEPA. *Background Document of Bottom Liner Performance in Double-Lined Landfills and Surface Impoundments, EPA/530-SW-87-013* (1987).

Figures



1/1 TYPICAL LINER DETAIL

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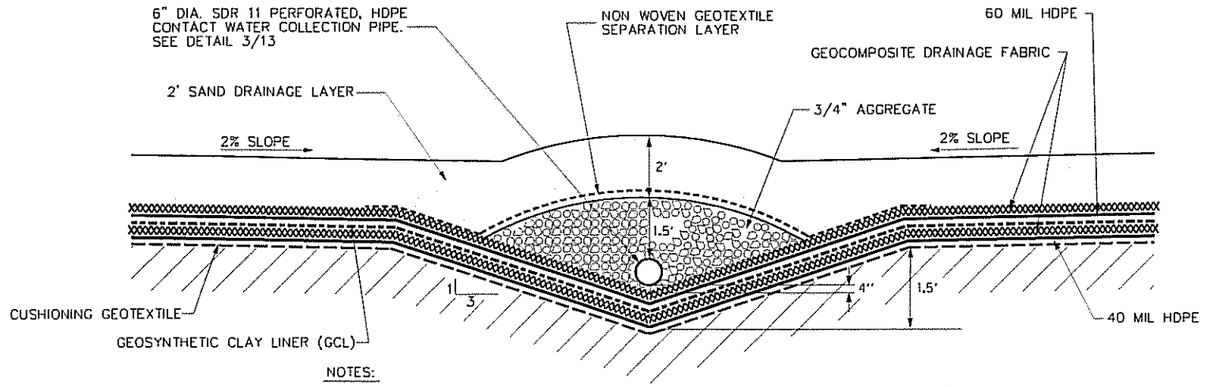

NOTES:

1. DRAINAGE LAYER WILL HAVE A MINIMUM HYDRAULIC CONDUCTIVITY OF 1 X 10^{-3} CM/SEC. (2' THICK).
2. GEOCOMPOSITE (GEONET) WILL HAVE A TRANSMISSIVITY OF NOT LESS THAN 1 X 10^{-3} M^2/SEC.
3. DRAINAGE AGGEGATE WILL BE WASHED, ROUNDED, NON-CARBONATE 3/4" COARSE AGGREGATE, HAVING A MINIMUM HYDRAULIC CONDUCTIVITY OF 1 X 10^{-1} CM/SEC.

2/1 TYPICAL CONTACT WATER COLLECTION TRENCH

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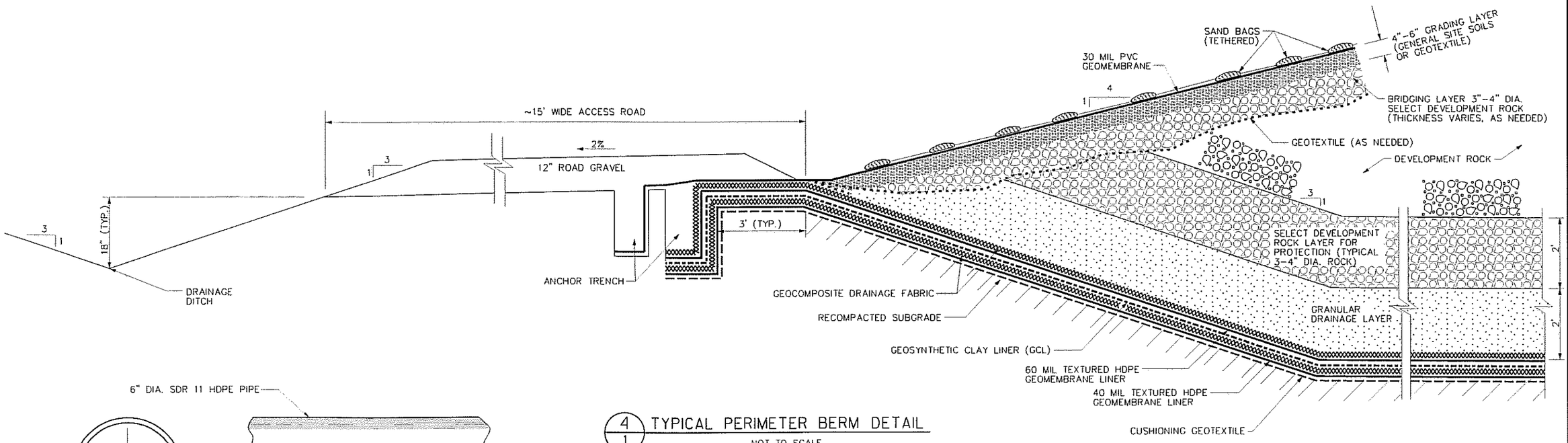

4/1 TYPICAL PERIMETER BERM DETAIL

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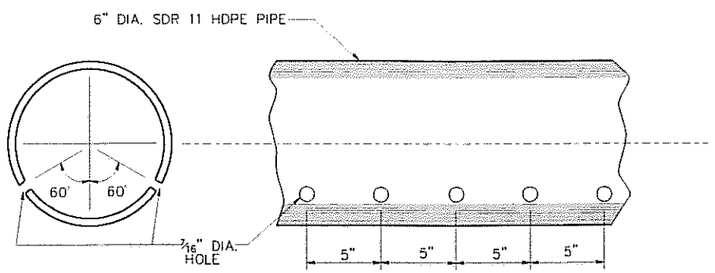

3/1 TYPICAL PIPE PERFORATION DETAIL

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APPROVED BY: SVDI			DATE: DEC. '07
APPROVED BY:			DATE:

Kennecott Eagle Minerals

FIGURE 1

TDRSA LINER SYSTEM AND TEMPORARY COVER

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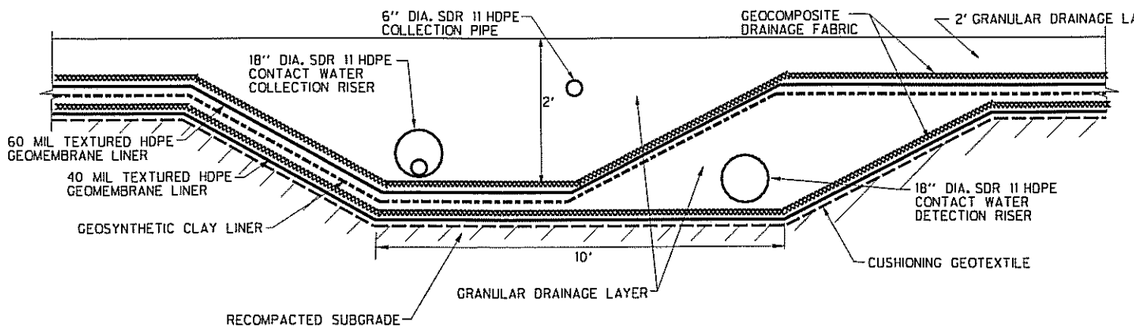

SECTION A-A

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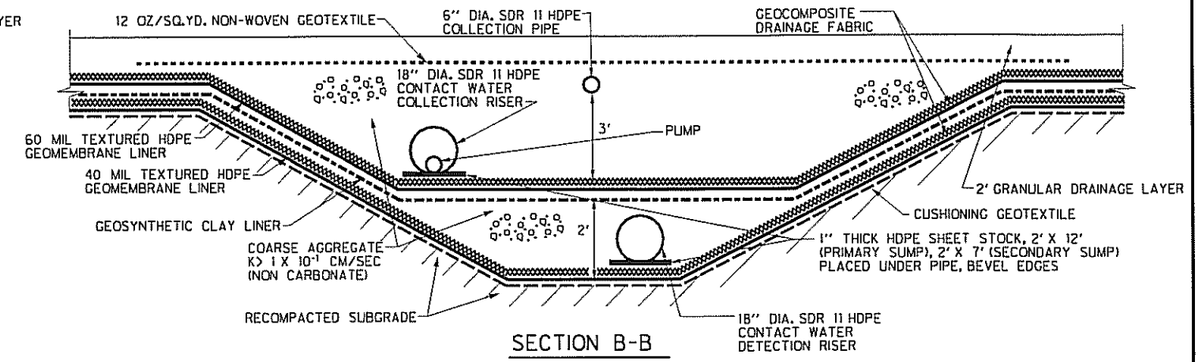

SECTION B-B

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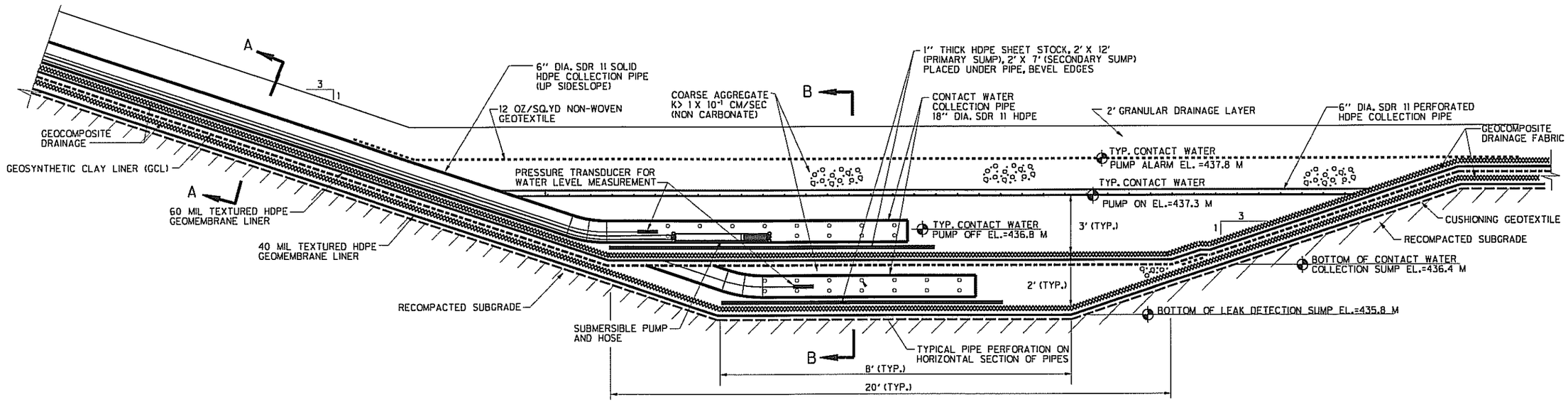

1/2 TYPICAL CONTACT WATER COLLECTION SUMP DETAIL

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APPROVED BY:			DATE:	

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FIGURE 2

TDRSA CONTACT WATER COLLECTION SUMP AND LEAK DETECTION SYSTEM

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Prepared By: JOW	Project No. 04W018

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Appendix A

TDRSA CQA Plan

Report

TDRSA CQA Plan

Eagle Project

Project I.D.: 04W018

Kennecott Eagle Minerals Company
Marquette, Michigan

February, 2006

(Revised July 2006)

(Revised December 2007)

Eagle Project

TDRSA CQA Plan

Project ID: 04W018

Prepared for

Kennecott Eagle Minerals Company

ISO 14001:2004 Registered System

Prepared by

Foth & Van Dyke and Associates, Inc.

February 2006

(Revised July 2006)

(Revised December 2007)

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Eagle Project
TDRSA CQA Plan

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1 Introduction

1.1 Purpose and Scope

The purpose of the Construction Quality Assurance (CQA) Plan is to provide minimum requirements for construction observation, testing, and documentation activities performed during construction. This plan is followed during construction to monitor and confirm that the construction features are constructed in accordance with the design and regulatory requirements.

The plan outlines the various sampling and testing programs to be carried out during the construction.

2 Construction Observation - Record Keeping

2.1 Construction Observation Report

The CQA monitor(s) are responsible to collect all samples and perform all Quality Control (QC) testing required by the CQA Plan. A daily report will be prepared by each inspector for each day of activity. The report will contain, at a minimum, the following information:

- Date
- Type of inspection
- Summary of weather conditions
- Summary of any meetings held and attendees
- Equipment and personnel on the project
- Summary of construction activities and locations
- Description of off-site materials received
- Calibration and recalibration of test equipment
- Description of procedures used
- Test locations, procedures, results and test data sheets
- Summary of samples collected
- Personnel involved in inspection and sampling activities
- Signature of the inspector
- Description of delays in construction activities
- Detailed description of any problems or non-conforming construction
- Progress of work in terms of approximate quantities

2.2 Daily Summary Report

The CQA officer or the CQA monitors, under the direct supervision of the CQA officer, will prepare a daily summary report containing, at a minimum, the following:

- Date
- Summary of weather conditions
- Summary of location where construction is occurring
- Contractors, equipment and personnel on the project
- Summary of any meetings held and attendees
- Description of all materials used and references or results of testing and documentation
- Calibration and recalibration of test equipment
- Daily inspection reports from each CQA monitor
- Description of any construction not meeting the project requirements and how it was corrected

2.3 Photographs

Photographs shall be obtained for all items of construction. A sufficient number of photographs shall be obtained to document the construction of each construction item (e.g., each manhole, each type of pipeline, each method of anchoring geomembranes, etc.). Each photograph shall be a 35 mm or digital photograph. A photo log containing the following information will be maintained:

- Date, time, location and orientation of photograph
- Name and signature of photographer
- Location and description of the work

Construction problems and non-conforming work shall be documented with photographs taken before and after the problem or when the non-conforming work has been corrected.

2.4 Test Data Sheets

CQA monitor will record all test data results on the test data sheets. Independent consultants engaged by the CQA shall submit their test results or data on forms acceptable to and approved by the CQA monitor.

2.5 Document Control and Record Storage

2.5.1 Daily Records

The daily records maintained during construction activities include, but are not limited to the following daily records:

- Daily inspection reports.
- Daily summary reports.
- Test data sheets from each CQA monitor.
- Test data or documentation data sheets from independent consultants (if any).
- Field book maintained by each CQA monitor.
- Field notes from all record surveys.

2.5.2 Storage of Records

All document originals listed in Section 2.5.1 above will be stored in 3-ring binders at the construction site. Copies of all documents will be on file at the CQA officer's office.

3 Construction Observation - Testing and Verification

This section outlines minimum requirements for the testing and verification of the components of construction.

3.1 Survey Verification

At a minimum, the record surveys shall document the following:

Composite Liner System

- Subbase of liner on 50-ft grid.
- Contact water collection system trench elevations every 25 ft (every 50 ft if a total station or laser is used).
- Geomembrane location information for panels, repairs, destructive tests, and anchor trench.

Contact Water Collection and Extraction System

- Collection pipe locations and invert elevations every 25 ft (every 50 ft if a total station or laser is used).
- Locations and pertinent elevations of manholes, cleanouts, leak detection sump, and collection sump.

3.1.1 Tolerances

Tolerances for each survey are listed in Table 3-1. Areas which do not meet the tolerances listed in Table 3-1 will be regraded or removed and replaced until the tolerances are met and resurveyed.

Table 3-1
Summary of Survey Tolerances

	Item	Frequency	Tolerance
1	Composite Liner		
	a) Subbase grade	50 ft grid	- 0.2 ft
2.	Contact Water Collection System		
	a) Collection piping	every 25 ft	± 0.05 ft/100 ft [(1)]
	b) Leak detection sump and collection sump	Bottom/top of sump. Grade breaks/corners	- 0.2 ft

[(1)]Positive drainage to be maintained at each location

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Checked by: JOS1

3.2 Thickness Verification

The CQA monitor shall verify the thickness of the gravel drainage layer as indicated in Table 3-2. The method of verification may include survey, hand augers, hand shoveling, or other approved method.

Table 3-2
Summary of Minimum Thicknesses

Item	Frequency	Minimum Thickness	Tolerance
1. Gravel Drainage Layer	200 ft grid	min. 1.0 ft	+0.1 ft

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Checked by: JOS1

4 Construction Observation - Soil Components

4.1 Scope, Sampling Requirements and Acceptance Criteria

The following elements of the design shall be constructed and sampled according to the CQA program in this section:

- Compacted subgrade
- Granular drainage layer

4.2 Compacted Subgrade

All fill materials placed for liner support construction (i.e., subgrade, berms, etc.) shall be tested in accordance with the following schedule:

Test	Minimum Frequency	Acceptable Test Values
Compaction characteristics: modified Proctor (ASTM D 1557) or standard Proctor (ASTM D 698)	Minimum of 1 test, then an additional 1 test/5,000 cy (in-place)/each soil type,	NA
In-Place Density and Percent Compaction: (ASTM D 2922 or ASTM D 1556)	100-ft grid/1-ft lift	90% of modified Proctor or 95% of standard Proctor maximum dry density

4.2.1 CQA Officer Inspection of Subgrade and Foundation

The CQA officer or CQA monitor(s) shall perform the following functions during subgrade preparation:

- Verify that all trees, stumps, roots, boulders and debris are removed.
- Verify that placement of frozen soil or soil onto frozen ground does not occur.
- Verify that the foundation is constructed and graded to provide a smooth, workable surface on which to construct the liner.

4.3 Granular Drainage Layer

All granular drainage layer construction for the contact water collection system shall be tested in accordance with the following schedule:

	Test Description	Test Method	Minimum Frequency	Specification
a.	Grain Size	ASTM D 422	1/1,000 cy	< 5% passing No 200 sieve, uniformity coefficient of less than 4 (gravel soils) or less than 6 (sandy soils)
b.	Hydraulic Conductivity	ASTM D 2434	1/2,500 cy	> 1 X 10^{-3} cm/sec

Prepared by: MJP1
Checked by: JOS

All gravel filter and coarse aggregate material for the leak detection sump and collection system shall be tested in accordance with the following schedule:

	Test Description	Test Method	Minimum Frequency
a.	Grain Size	ASTM D 422	1/1,000 lin ft of trench 1 per sump
b.	Hydraulic Conductivity	ASTM D 2434	Minimum of one sample

In addition, the CQA officer shall inspect the granular drainage layer, gravel filter, and coarse aggregate materials for undesirable objects.

5 Geotextile Cushioning Layer

5.1 On-Site Quality Assurance

5.1.1 Geotextile Cushioning Layer Rolls and Panels

Construction quality assurance monitoring for geotextile cushioning material rolls and panels includes:

1. Monitoring and documenting the unloading of trucks delivering geotextile rolls to the site.

2. Monitoring and documenting the handling and on-site storage procedures and location of the geotextile rolls.

3. Review of manufacturer's QA testing for conformance with project specifications.

5.1.2 Geotextile Cushioning Layer Panel Placement

Quality assurance monitoring for geotextile panel placement includes:

1. Monitoring and documenting sewing of adjacent geotextile panels for conformance to the project specifications.

6 Construction Observation – GCL

6.1 On-Site Quality Assurance

6.1.1 GCL Rolls and Panels

Construction quality assurance monitoring for the rolls and panels include:

1. Monitoring and documenting the unloading of trucks delivering GCL rolls to the site.

2. Monitoring and documenting the handling and on-site storage procedures and location of GCL rolls.

3. Recording the manufacturing roll and batch number of GCL rolls delivered to the site, date of fabrication and physical dimensions.

4. Review of manufacturer's QA testing for conformance with specifications, including:

   a. Name of the manufacturer and fabricator

   b. Copies of quality control certificates that are issued by the producer of the GCL materials.

5. Selecting samples from GCL rolls delivered to the site for off-site conformance testing. Conformance testing will be performed as outlined below. Samples shall be sent to a geosynthetics testing laboratory for the following material properties:

Test Description	Test Method	Minimum Frequency	Specification
Mass of GCL/unit area	ASTM D 5993	40,000 sf	0.82 lb/ft^2
Tensile strength	ASTM D 6768	100, 000 sf	23 lb/in
Peel strength	ASTM D 6496	100,000 sf	2.1 lb/in
Free swell of bentonite	ASTM D 5890	100,000 sf	24 ml/2g
Cap Fabric mass/unit area	ASTM D 5261	100,000 sf	5.8 oz/yd^2

6. Fixing a code number to samples and recording the manufacturing numbers of the rolls from which samples are taken.

7. Labeling, packaging and shipping samples to an off-site laboratory for conformance testing.

8. Interpreting laboratory test results in accordance with the specifications and accepting or rejecting delivered rolls based on results of off-site testing.

9. Visual review and marking of GCL as it is unrolled and deployed at the job site for uniformity, damage, and imperfections, including holes, thin spots, tears, punctures, and foreign matter.

6.1.2 Panel Placement

Quality assurance monitoring for panel placement includes:

1. Obtaining a written acceptance of the subgrade by the GCL installer.

2. Evaluating and documenting weather conditions (e.g., temperature, wind) for GCL placement and informing the construction manager if requirements for weather conditions are not met, so the construction manager can decide to stop GCL placement.

3. Monitoring and documenting GCL placement as well as conditions of panels as placed.

    a. Noting panel defects, tears or other deformities.
    b. Measuring in-place panel dimensions.
    c. Recording panel numbers.

4. Documenting that the panels have been installed in accordance with the project and manufacturer's specifications.

6.2 Documentation and Reporting

Documenting and reporting methods will be implemented to systematically record results of on-site monitoring. Reporting forms will be used for roll and panel placement.

A GCL installer's certificate of acceptance of the subgrade will be obtained prior to placement of GCL panels.

A photo log will be created containing photos of all phases of the GCL installation.

Copies of test results for all off-site laboratory testing will be forwarded to the on-site supervisor and will be made available to the construction manager. The laboratory test result documents will be maintained in a job file and submitted with the final documentation report.

7 Construction Observation - Geomembrane

The following section summarizes the quality assurance plan for testing and monitoring of the geomembrane liner installation.

7.1 On-Site Quality Assurance

7.1.1 HDPE Geomembrane

7.1.1.1 Geomembrane Rolls and Panels

Construction quality assurance monitoring for the rolls and panels include:

1. Monitoring and documenting the unloading of trucks delivering geomembrane rolls to the site.

2. Monitoring and documenting the handling and on-site storage procedures and location of geomembrane rolls.

3. Recording the manufacturing roll and batch number of geomembrane rolls delivered to the site, date of fabrication and physical dimensions.

4. Review of manufacturer's QA testing for conformance with specifications, including:

    a. Name of the manufacturer and fabricator

    b. Name and type of liner

    c. Thickness of liner

    d. Origin and identification of the raw materials

    e. Copies of quality control certificates that are issued by the producer of the raw materials.

    f. Reports of tests that are conducted to verify the quality of the raw materials, such as specific gravity, melt flow index, and percent carbon black.

5. Selecting samples from geomembrane rolls delivered to the site for off-site conformance testing. Conformance testing will be performed as outlined in Table 7-1. Samples shall be sent to a geosynthetics testing laboratory for material properties.

6. Fixing a code number to samples and recording the manufacturing numbers of the rolls from which samples are taken.

7. Labeling, packaging and shipping samples to an off-site laboratory for conformance testing.

8. Interpreting laboratory test results in accordance with the specifications and accepting or rejecting delivered rolls based on results of off-site testing.

9. Visual review and marking of the geomembrane as it is unrolled and deployed at the job site for uniformity, damage, and imperfections, including holes, cracks, thin spots, tears, punctures, blisters, and foreign matter.

Table 7-1
Material Properties, Textured HDPE Geomembrane

Property	Test Method	Units	Minimum Frequency	40 mil Acceptance Criteria	60 mil Acceptance Criteria
A. Sheet Properties					
1. Thickness (min. avg.)	ASTM D5199/ ASTM D5994	Mil	5 places per roll	38	57
a. Lowest Ind. for 8 Out of 10 Values		Mil		36	54
b. Lowest Ind. for Any of 10 Values		Mil		34	51
2. Asperity Height (min. avg.)	GRI Procedure GM12	Mil	1/100,000 ft^2 min. 1 per resin batch	15	15
3. Tensile Properties (each direction)	ASTM D638 Type IV				
a. Yield Strength		lb/in.	1/100,000 ft^2 min. 1 per resin batch	63 min.	126 min.
b. Break Strength		lb/in.	1/100,000 ft^2 min. 1 per resin batch	45 min.	90 min.
c. Elongation at Yield		%	1/100,000 ft^2 min. 1 per resin batch.	12 min.	12 min.
d. Elongation at Break		%	1/100,000 ft^2 min. 1 per resin batch	100 min.	100 min.
B. Resin Properties					
1. Melt Flow Index	ASTM D1238	g/10 min.	1/100,000 ft^2 min. 1 per resin batch	1.0 max.	1.0 max.
2. Resin Density	ASTM D1505	g/cm^3	1/100,000 ft^2 min. 1 per resin batch	0.93 min.	0.93 min.
C. Seam Properties					
1. Peel Strength (fusion)	ASTM D6392	lb/in.	1 per 500 lin ft	50 min.	90 min.
2. Peel Strength (extrusion)	ASTM D6392	lb/in.	1 per 500 lin ft	44 min.	78 min.
3. Shear Strength	ASTM D6392	lb/in.	1 per 500 lin ft	60 min.	120 min.

Property	Test Method	Units	Minimum Frequency	40 mil Acceptance Criteria	60 mil Acceptance Criteria
4. Peel Strength	ASTM D6392	%	1 per 500 lin ft	< 25%	< 25%
D. Environmental Properties					
1. Stress Cracking	ASTM D5397	hrs.	1 per each resin batch	200	200

Prepared by: MJP1
Checked by: JOS1

7.1.1.2 Panel Placement

Quality assurance monitoring for panel placement includes:

1. Obtaining a written acceptance of the subgrade by the geomembrane installer.

2. Evaluating and documenting weather conditions (e.g., temperature, wind) for geomembrane placement and informing the construction manager when weather conditions do not meet specifications, so the construction manager can decide to stop geomembrane placement.

3. Monitoring and documenting geomembrane placement as well as conditions of panels as placed.

    a. Noting panel defects, tears or other deformities.

    b. Measuring panel thicknesses at a minimum of five locations along the length of each roll.

    c. Measuring in-place panel dimensions.

    d. Recording panel numbers.

4. Recording the locations of installed panels and checking that the panels have been installed in accordance with the design plan.

    a. Assigning each panel a unique panel number and identifying that panel with the manufacturer's roll number.

    b. Recording panel numbers and locations on a panel layout diagram.

7.1.1.3 Trial Seam Testing

Items included in quality assurance monitoring of field seams include the following:

1. Monitoring trial fusion welded seams constructed prior to each seaming sequence to evaluate the seaming crew and equipment.

a. Record machine temperature, ambient temperature, machine speed, seamer identification, machine number, date and time for all trial seams.

b. Trial seams will be made at the beginning of each seaming period and at least once every four hours, for each seaming apparatus used that day. Each seamer will make at least one (1) trial seam each day. Two specimens, 1 inch wide, will be cut from each end of the trial seam (i.e., four samples total). These samples are to be field-tested for shear and peel. Two (2) peel tests will be performed on the inside and outside tracks of the weld and two (2) shear tests will be performed. Alternate shear and peel tests so both tests are performed for each end of the trial seam.

2. Evaluating and documenting trial seam test results in accordance with the specifications and accepting or rejecting seaming crews and/or equipment.

3. Evaluating and documenting the suitability of weather conditions (e.g., temperature, wind, humidity) for seaming and informing the construction manager when weather conditions do not meet the specifications so the construction manager can decide to stop geomembrane seaming.

4. Observing and documenting seaming procedures and progress.

5. Assigning a seam number to each seam and recording seam construction data, including seaming crew identification, date and time of seam construction, ambient temperature.

   a. Record the location of all seams on a seam layout diagram.

6. Confirming that the installer's field tensiometer has current calibration documentation. At a minimum, the field tensiometer shall have been calibrated within 3 months prior to start of project.

7.1.1.4 Seam Testing and Repair

Items included in the quality assurance for monitoring seam testing and repair include the following:

1. Monitoring and documenting non-destructive testing done to evaluate continuity of all field and factory-fabricated seams.

   a. Observe seam pressure tests and vacuum box tests.
   b. Mark apparent failed seams for repair.
   c. Document seam repair and retesting.

2. Selecting locations where geomembrane samples will be taken to conduct destructive testing.

   a. A minimum of one destructive test sample will be collected for every 500 lineal feet of field seam.

b. Locations of destructive test samples will be noted on a repair and sample location diagram.

3. Monitoring the cutting of samples by the geomembrane installer.

4. Assigning a unique number to each sample and recording sample locations and other pertinent observations made during sampling.

5. Monitoring the cutting of the sample in three parts: one for the geomembrane installer, one for archiving, and one for testing by the off-site laboratory.

6. Monitoring and documenting the field seam destructive tests performed by the geomembrane installer.

7. Labeling, packaging and shipping samples to the independent laboratory for destructive testing.

8. Interpreting test results and accepting or rejecting seams based on off-site laboratory testing results. Five (5) of five (5) tests per sample shall pass the minimum peel and shear requirements.

9. Monitoring and documenting patching of holes caused by sampling.

10. Monitoring and documenting the non-destructive testing of the seams associated with seam repair.

11. Monitoring and documenting the repair of the rejected seams and the non-destructive testing of the seam repairs.

    a. Document passing seam tests between all destructive test locations.
    b. Record all seam repair locations.

12. Monitoring and documenting destructive testing related to seam repair.

    a. Monitoring and documenting one destructive seam sample for every 500 lineal feet of repaired seam as described above.

7.1.1.5 Defect Repairs

The following quality assurance monitoring and testing will be implemented to monitor defect repairs:

1. Performing systematic visual observation of the entire surface of the geomembrane to locate and document defects and indicate for each defect the type of repair that is required.

2. Monitoring and recording the repair of defects and the non-destructive testing of all repairs.

3. Recording the location and the nature of all defect repairs.

7.1.1.6 Anchorage Testing

Quality assurance associated with monitoring and testing of anchor trenches shall include the following:

1. Anchor trench excavation shall be monitored for proper depth and location.

2. Geomembrane panels extending into the anchor trench shall be monitored for complete seaming within the anchor trench.

3. Anchor trench backfill operations will be observed and documented.

    a. The length of the open trench shall not exceed the amount of liner to be placed in one day.

    b. The depth of a typical anchor trench shall be documented to conform to approved project drawings.

    c. Backfill shall be placed in lifts not to exceed one foot in loose thickness.

4. Trench backfill shall consist of the soil excavated from the trench and compaction shall meet or exceed the density of the adjacent material.

7.1.2 PVC Geomembrane

7.1.2.1 PVC Panels

Construction quality assurance monitoring for the 30-mil PVC (or other approved thicknesses) for temporary cover includes:

1. Monitoring and documenting the unloading of trucks delivering geomembrane panels to the site. Factory fabricated PVC panels are typically packaged accordion folded on a sturdy wooden pallet designed for fork lift access.

2. Monitoring and documenting the handling and on-site storage procedures and location of geomembrane panels.

3. Recording the manufacturing data of geomembrane panels delivered to the site, date of fabrication and physical dimensions.

4. Review of manufacturer's QA testing for conformance with specifications, including:

    a. Name of the manufacturer and fabricator

b. Name and type of liner

c. Thickness of liner

d. Origin and identification of the raw materials

e. Copies of quality control certificates that are issued by the producer of the raw materials.

f. Reports of tests that are conducted to verify the quality of the raw materials, such as surface uniformity, nominal gauge thickness, and minimum tensile properties.

5. Selecting samples from geomembrane panels delivered to the site for off-site conformance testing. Conformance testing will be performed as outlined in Table 7-2. Samples shall be sent to a geosynthetics testing laboratory for material properties.

6. Fixing a code number to samples and recording the manufacturing (serial) numbers of the panels from which samples are taken.

7. Labeling, packaging and shipping samples to an off-site laboratory for conformance testing.

8. Interpreting laboratory test results in accordance with the specifications and accepting or rejecting delivered panels based on results of off-site testing.

9. Visual review and marking of the geomembrane as it is unrolled and deployed at the job site for uniformity, damage, and imperfections, including holes, cracks, thin spots, tears, punctures, blisters, and foreign matter.

Table 7-2
Material Properties, 30 mil PVC Geomembrane

Property	Test Method	Minimum Frequency	Specification
A. Sheet Properties			
1. Thickness (gauge, nominal)	ASTM D1593 (micrometer)	5 places per panel	30 mils min
2. Tensile Properties (each direction)	ASTM D 882		
a. Breaking Factor (lbs/inch width)		1/100,000 ft^2 min. 1 per resin batch	73 lbs/in min
b. Elongation at Break (percent)		1/100,000 ft^2 min. 1 per resin batch	380% min
c. Modulus (force) at 100% Elongation (lbs/inch width)		1/100,000 ft^2 min. 1 per resin batch.	32 lbs/in min

Property	Test Method	Minimum Frequency	Specification
B. Seam Properties			
1. PVC Peel Adhesion	ASTM D 413	1 per 3,000 lin ft (factory seams)	15 lbs/in min
		1 per 500 lin ft (field seams)	15 lbs/in min
2. PVC Bonded Seam Strength	ASTM D 882 (as modified by PGI)	1 per 3,000 lin ft (factory seams)	78 lbs/in min
		1 per 500 lin ft (field seams)	78 lbs/in min

Prepared by: MJP1
Checked by: JOS1

7.1.2.2 Panel Placement

Quality assurance monitoring for panel placement includes:

1. Obtaining a written acceptance of the subgrade (grading layer) by the geomembrane installer.

2. Evaluating and documenting weather conditions (e.g., temperature, wind) for geomembrane placement and informing the construction manager when weather conditions do not meet specifications, so the construction manager can decide to stop geomembrane placement.

3. Monitoring and documenting geomembrane placement as well as conditions of panels as placed.

    a. Noting panel defects, tears or other deformities.

    b. Measuring panel thicknesses at a minimum of five locations along the length of each panel.

    c. Measuring in-place panel dimensions.

    d. Recording panel numbers.

4. Recording the locations of installed panels and checking that the panels have been installed in accordance with the design plan.

    a. Assigning each panel a unique panel number and identifying that panel with the manufacturer's identification number.

    b. Recording panel numbers and locations on a panel layout diagram.

7.1.2.3 Trial Seam Testing (Thermal Welded Seams)

Items included in quality assurance monitoring of thermal welded field seams include the following:

1. Monitoring trial thermal welded seams constructed prior to each seaming sequence to evaluate the seaming crew and equipment.

    a. Record machine temperature, ambient temperature, machine speed, seamer identification, machine number, date and time for all trial seams.

    b. Trial seams will be made at the beginning of each seaming period and at least once every four hours, for each seaming apparatus used that day. Each seamer will make at least one (1) trial seam each day. Two specimens, 1 inch wide, will be cut from each end of the trial seam (i.e., four samples total). These samples are to be field-tested for shear and peel. Two (2) peel tests will be performed on the inside and outside tracks of the weld and two (2) shear tests will be performed. Alternate shear and peel tests so both tests are performed for each end of the trial seam.

2. Evaluating and documenting trial seam test results in accordance with the specifications and accepting or rejecting seaming crews and/or equipment.

3. Evaluating and documenting the suitability of weather conditions (e.g., temperature, wind, humidity) for seaming and informing the construction manager when weather conditions do not meet the specifications so the construction manager can decide to stop geomembrane seaming.

4. Observing and documenting seaming procedures and progress.

5. Assigning a seam number to each seam and recording seam construction data, including seaming crew identification, date and time of seam construction, ambient temperature.

    a. Record the location of all seams on a seam layout diagram.

6. Confirming that the installer's field tensiometer has current calibration documentation. At a minimum, the field tensiometer shall have been calibrated within 3 months prior to start of project.

7.1.2.4 Seam Testing and Repair

Items included in the quality assurance for monitoring seam testing and repairs include the following:

1. Monitoring and documenting non-destructive testing done to evaluate continuity of all field and factory-fabricated seams.

    a. Observe seam air channel tests and air lance tests.

b. Mark apparent failed seams for repair.
c. Document seam repair and retesting.

2. Selecting locations where geomembrane samples will be taken to conduct destructive testing.

   a. A minimum of one destructive test sample will be collected for every 500 lineal feet of field seam.

   b. Locations of destructive test samples will be noted on a repair and sample location diagram.

3. Monitoring the cutting of samples by the geomembrane installer.

4. Assigning a unique number to each sample and recording sample locations and other pertinent observations made during sampling.

5. Monitoring the cutting of the sample in three parts: one for the geomembrane installer, one for archiving, and one for testing by the off-site laboratory.

6. Monitoring and documenting the field seam destructive tests performed by the geomembrane installer.

7. Labeling, packaging and shipping samples to the independent laboratory for destructive testing.

8. Interpreting test results and accepting or rejecting seams based on off-site laboratory testing results. Four (4) of five (5) tests per sample shall pass the minimum peel and shear requirements and the average of the five tests per sample must meet the minimum requirements.

9. Monitoring and documenting patching of holes caused by sampling.

10. Monitoring and documenting the non-destructive testing of the seams associated with seam repair.

11. Monitoring and documenting the repair of the rejected seams and the non-destructive testing of the seam repairs.

    a. Document passing seam tests between all destructive test locations.
    b. Record all seam repair locations.

12. Monitoring and documenting destructive testing related to seam repair.

    a. Monitoring and documenting one destructive seam sample for every 500 lineal feet of repaired seam as described above.

7.1.2.5 Defect Repairs

The following quality assurance monitoring and testing will be implemented to monitor defect repairs:

1. Performing systematic visual observation of the entire surface of the geomembrane to locate and document defects and indicate for each defect the type of repair that is required.

2. Monitoring and recording the repair of defects and the non-destructive testing of all repairs.

3. Recording the location and the nature of all defect repairs.

7.1.2.6 Anchorage Testing

Quality assurance associated with monitoring and testing of anchor trenches shall include the following:

1. Anchor trench excavation shall be monitored for proper depth and location.

2. Geomembrane panels extending into the anchor trench shall be monitored for complete seaming within the anchor trench.

3. Anchor trench backfill operations will be observed and documented.

    a. The length of the open trench shall not exceed the amount of geomembrane to be placed in one day.

    b. The depth of a typical anchor trench shall be documented to conform to approved project drawings.

    c. Backfill shall be placed in lifts not to exceed one foot in loose thickness.

a. Trench backfill shall consist of the soil excavated from the trench and compaction shall meet or exceed the density of the adjacent material.

7.2 Documentation and Reporting

Documenting and reporting methods will be implemented to systematically record results of on-site monitoring and on-site testing. Reporting forms will be used for roll and panel placement, trial seam testing, panel seaming, non-destructive seam testing and destructive seam testing. Unique identifying numbers will be assigned to each panel and seam and used to reference the panel and seam location and test results.

A geomembrane installer's certificate of acceptance of the subgrade will be obtained prior to placement of geomembrane panels.

Panel location and seam location diagrams will be kept showing the location of all panels and seams, repairs and destructive sample test locations. These location diagrams will be updated on a daily basis and will be available for review by the construction manager.

A photo log will be created containing photos of all phases of the geomembrane liner installation, including deployment, seaming, testing, and anchor trench construction.

Copies of test results for all off-site laboratory testing will be forwarded to the on-site supervisor and will be made available to the construction manager. The laboratory test result documents will be maintained in a job file and submitted with the final documentation report.

8 Construction Observation - Miscellaneous Items

8.1 Geocomposite Drainage Layer

8.1.1 Geocomposite Rolls and Panels

Construction quality assurance monitoring for the rolls and panels include:

1. Monitoring and documenting the unloading of trucks delivering geocomposite rolls to the site.

2. Monitoring and documenting the handling and on-site storage procedures and location of geocomposite rolls.

3. Review of manufacturer's QA testing for conformance with specifications. The geocomposite and its components shall meet the property requirements stated below:

Property	Test Method	Minimum Frequency	Specifications
GEONET			
Thickness, minimum average	ASTM D 5199	15,000 lbs	200 mil
Polymer Density, minimum	ASTM D 1505	200,000 lbs	0.940 g/cc
Carbon Black Content	ASTM D 4218	15,000 lbs	2 percent
Carbon Black Disperson	ASTM D 5596	45,000 lbs	See note[1]
GEOTEXTILE			
Mass/Unit Area, minimum	ASTM D 5261	20,000 sq. yards	10 oz/sq yards
Grab Strength, minimum	ASTM D 4632	20,000 sq yards	260 lbs
Permittivity, minimum	ASTM D 4491	1.0/sec	100,000 sq. yd
AOS (095), maximum	ASTM D 4751	80 sieve	100,000 sq. yd.
GEOCOMPOSITE			
Transmissivity, minimum, including attached geotextiles[2]	ASTM D 4716	100,000 sq. yards	1×10^{-3} m^2/sec
Geonet/Geotextile adhesion[3]	ASTM D 413	100,000 sq. yards	1.0 lbs/inch

[1] Carbon black dispersion for 10 different views: 8 of 10 in Category 1 or 2; and all 10 in Category 1, 2, or 3.
[2] Manufacturing quality control transmissivity tests shall be measured using water at 20 degrees C with a gradiant of 0.1 under a normal pressure of 10,000 psf. A minimum seating period of 15 minutes shall be used.
[3] Average of five equally spaced tests across the roll width.

4. Visual review and marking of the geocomposite as it is unrolled and deployed at the job site for uniformity, damage, and imperfections, including holes, tears, punctures, and foreign matter.

8.1.2 Panel Placement

Quality assurance monitoring for panel placement includes:

1. Monitoring and documenting geocomposite placement as well as conditions of panels as placed, including the following:

a. Noting panel defects, tears or other deformities.
b. Orientation of panels as placed
c. Anchorage procedures
d. Documentation that cover materials are placed in a manner that prevents damage to the geocomposite
e. Documentation that each component of the geocomposite is secured to like components of adjacent panels

8.2 Contact Water Collection and Extraction System

Survey documentation of the contact water collection and extraction system and other pipeline systems shall be completed as described in Section 3. Any aggregate material used as gravel drainage layer, and backfill or bedding in the trench or sumps shall be sampled and tested as described in Section 4.3

All materials and equipment shall be inspected prior to construction for conformance with the specifications and for any defects and/or flaws.

All non-perforated pipe sections shall be air pressure tested following construction and backfilling. Pumps and controls shall be fully tested to assure all operational functions are working properly.

8.2.1 Installation

The CQA officer shall inspect all prefabricated structures for conformity with design specifications and for conformity with design specifications and for defective manufacturing. Additionally, the following CQA activities will be performed during contact water collection and extraction system installation:

1. Full-time observation to ensure that the underlying liner components are not damaged by collection system installation
2. Documentation that the collection pipe location and invert elevations are in accordance with project specifications
3. Documentation that pipe joining procedures are in accordance with project specifications
4. Documentation that fill materials placed around the collection piping are in accordance with project specifications
5. Documentation that the collection sump and the underlying leak detection sump are constructed in accordance with project specifications
6. Documentation that the collection and leak detection sumps' sideslope risers, associated extraction pumping equipment, and controls are installed in accordance with project specifications
7. Documentation and testing of backfilling procedures during installation of the double encased forcemain to the contact water basin.
8. Documentation that the piping is not damaged during cover material placement
9. Documentation of extraction systems, field test demonstrating system, operational readiness, including pumps, pressure meter control, values, etc.

9 Construction Observation Report

9.1 Documentation

Upon completion of the construction of each major phase and prior to placing in service, the CQA officer shall submit a documentation report to the MDEQ. This report contains, at a minimum, the following information:

- Certification by a professional engineer, registered in the State of Michigan, that, based on his/her knowledge and review of the construction records, the construction has been performed in substantial conformance with the engineering plans and specifications.
- Detailed narrative describing the construction events in chronological order and results of the quality assurance testing.
- Daily field reports prepared by the on-site CQA technician.
- Field and laboratory test data relevant to subgrade preparation.
- Field and laboratory test data relevant to installation of geosynthetic components of the liner (GCL, geomembrane, geotextile)
- Field and laboratory test data relevant to installation of the contact water collection and extraction system
- Discussion of any construction material or equipment which deviated from the engineering plans and specifications, reasons for deviation, methods to bring the deviation into compliance, and approval of deviations by the MDEQ.
- Photographs documenting all aspects of construction.
- Record drawings, sealed by a licensed professional engineer, documenting the "as constructed" elevations of the various components of the construction (± 0.5 feet), locations of field testing performed, geomembrane panel layout, and cross sections of the construction.
- Information required by Part 115, Administrative Rule 299.4921.

Appendix B

Leak Detection System
Inspection and Monitoring Forms

Leak Detection System Inspection and Monitoring Form
Kennecott Eagle Minerals Company

Inspector: _____

Date: _____

Inspection Results

Liquid in LDS Sump: _____ yes _____ no

Gallons Pumped from LDS Sump: _____

Liquid Sampled: _____ yes _____ no

Date Sampled: _____

Field pH: _____

Laboratory Sulfate Result: _____

Is the volume pumped greater than 150 gallons and the sulfate result greater than 500 mg/L? If yes, this is a reportable condition: Yes _____ No _____

Recommended Actions

Follow-up of Previously Recommended Actions

Date of Next Inspection: _____

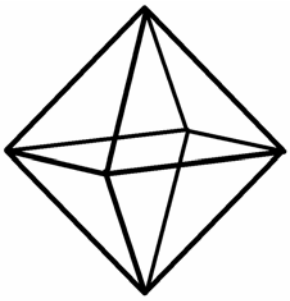
Archive Inspection Form Until: (5 yrs from date of inspection)

Leak Detection System Inspection and Monitoring Log

Kennecott Eagle Minerals Company

Date	Liquid Present in Sump (y/n)	Field pH	Laboratory Sulfate (mg/L)	Gallons of Liquid Pumped from LDS Sump	Recommended/Implemented Actions	Initials

Plan



Kennecott
Eagle Minerals

Eagle Project

Impermeable Surface Inspection and Surface Repair Plan

Project I.D.: 04W018

Kennecott Eagle Minerals Company
Michigamme Township, Michigan

December 2007

Eagle Project

Impermeable Surface Inspection and Surface Repair Plan

Project ID: 04W018

Prepared for

Kennecott Eagle Minerals Company

ISO 14001:2004 Registered System

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Eagle Project
Impermeable Surface Inspection and Surface Repair Plan

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Figures

Figure 1 Contact Area Impermeable Surface

Appendices

Appendix A Impermeable Surface Inspection Log

1. Impermeable Surface Inspection and Surface Repair Plan

1.1 Introduction

This Impermeable Surface Inspection and Surface Repair Plan has been prepared to address integrity monitoring of impermeable surfaces that will be exposed to contact storm water. The monitoring plan includes frequency of inspection and action plans for surface repair, along with a sample inspection log documenting the date of inspection, identification of the inspector, results, and required follow-up action. Inspection documents will be kept on site.

Figure 1 indicates impermeable surface areas with potential for exposure to contact water. Areas covered under this plan include:

- Coarse Ore Storage Area (COSA).
- Truck Wash Area.
- Bituminous Surfaced Areas.

Other areas with impermeable surfaces with potential for exposure to contact water include the temporary development rock storage area (TDRSA), the fuel storage area, and the contact water basins (CWB). These areas will be monitored under separate plans.

1.1.1 The COSA

The COSA will be constructed to contain mined ore awaiting processing. The COSA building will measure approximately 1,394 m^2 (15,000 ft^2) having a storage capacity of 3,000 m^3 (3,924 yd^3). This building will be enclosed on three sides and constructed of steel framing with steel siding. A clear plastic drop door will be installed across the open side to minimize precipitation contact with the ore and reduce particulate release. The floor of the COSA will be constructed of 12-in thick reinforced concrete sloping to a catch basin for collection of contact water. To minimize potential reinforcement steel corrosion, the reinforcement will be epoxy-coated. Any collected contact water will be pumped to the CWB for treatment. A vapor barrier will be installed below the concrete floor to provide additional moisture retention.

1.1.2 Truck Wash Area

Ore transport trucks leaving the main operations area will be required to go through a truck wash prior to leaving the facility. The truck wash, an approximately 4,000 square foot facility, will be an enclosed system that recycles the wash water. Solids will be removed from the wash water using a series of cyclone separators.

1.1.3 Bituminous Surfaced Areas

Bituminous surfaced areas will be constructed in the areas shown on Figure 1. These areas are generally located in the southern part of the main operations area and include the roadway from the mine portal to the COSA facility, the crusher and crushed ore bins area, laydown area, and the entrance to the truck wash. The bituminous areas will consist of 4-inches of bituminous concrete supported by 12-inches of road aggregate.

1.2 Site Inspections and Monitoring

1.2.1 COSA

KEMC personnel will provide monthly inspections of the COSA floor slab during time periods when ore is stored in the facility.

Areas of the COSA which do not contain ore will be inspected and repaired as necessary. Then, ore will be moved to these previously inspected/repaired areas and the exposed portion of the COSA floor inspected and repaired as necessary. Staging of inspections as described herein will be performed until the entire COSA floor area is evaluated.

To evaluate the catch basins in the COSA, any standing liquid will be removed and properly disposed of, and the catch basins inspected for any potential areas of leakage or cracking.

KEMC personnel will complete monthly inspection logs outlining dates of inspection, identification of the inspector, results, and required follow-up action. A sample inspection log is included in Appendix A.

1.2.2 Truck Wash Area

KEMC personnel will provide monthly inspections of the truck wash concrete pavement during mining operations. Catch basins will be evaluated by removing standing liquid and visually inspection the basin for leaks and cracks.

Monthly inspection logs (Appendix A) will be completed during the inspections.

1.2.3 Bituminous Surfaced Areas

Bituminous surfaced areas will be inspected on a monthly basis. KEMC personnel will observe the pavement for cracking and other pavement surface problems that may compromise its impermeability or develop into potholes, such as alligatored areas, which are interconnecting cracks forming a series of blocks resembling alligator skin.

KEMC personnel will complete monthly inspection logs outlining dates of inspection, identification of the inspector, results, and required follow-up action. Repairs will be performed in a timely manner.

1.3 Repair Methods

1.3.1 Concrete Areas

Once identified, cracks that have the potential to provide a conduit for contact water transmittal will be sealed by methods appropriate to their size. Based on the size of the crack, repairs will be conducted by one of two methods: routing and epoxy troweling, and epoxy grouting. Cracks that are less than 1/8-inch in width will be considered Class 1 cracks; cracks greater than 1/8-inch in width will be considered Class 2 cracks.

Class 1 cracks will be repaired by routing and epoxy troweling. Routing of the crack consists of routing the crack with a concrete saw or other hand or pneumatic tool, to open the crack sufficiently to receive the sealant. A minimum routed width of ¼ - inch is desirable since smaller

openings are difficult to fill. The surface of the routed crack will be cleaned and allowed to dry. Epoxy sealing will then be troweled into the crack. Separation of the floor slab from the perimeter wall/foundation of the COSA will generally be treated as Class 1 cracks and filled by epoxy troweling.

Class 2 cracks will be repaired by epoxy injection. This method generally consists of drilling holes at close intervals in the crack and injecting epoxy under pressure. This fills the crack entirely to provide a good seal.

Larger areas where mechanical damage has occurred may require removal and replacement with new concrete. In these areas, the damaged area will be cut out and removed, new reinforcement bars drilled and grouted into the existing concrete, and a new section of concrete placed.

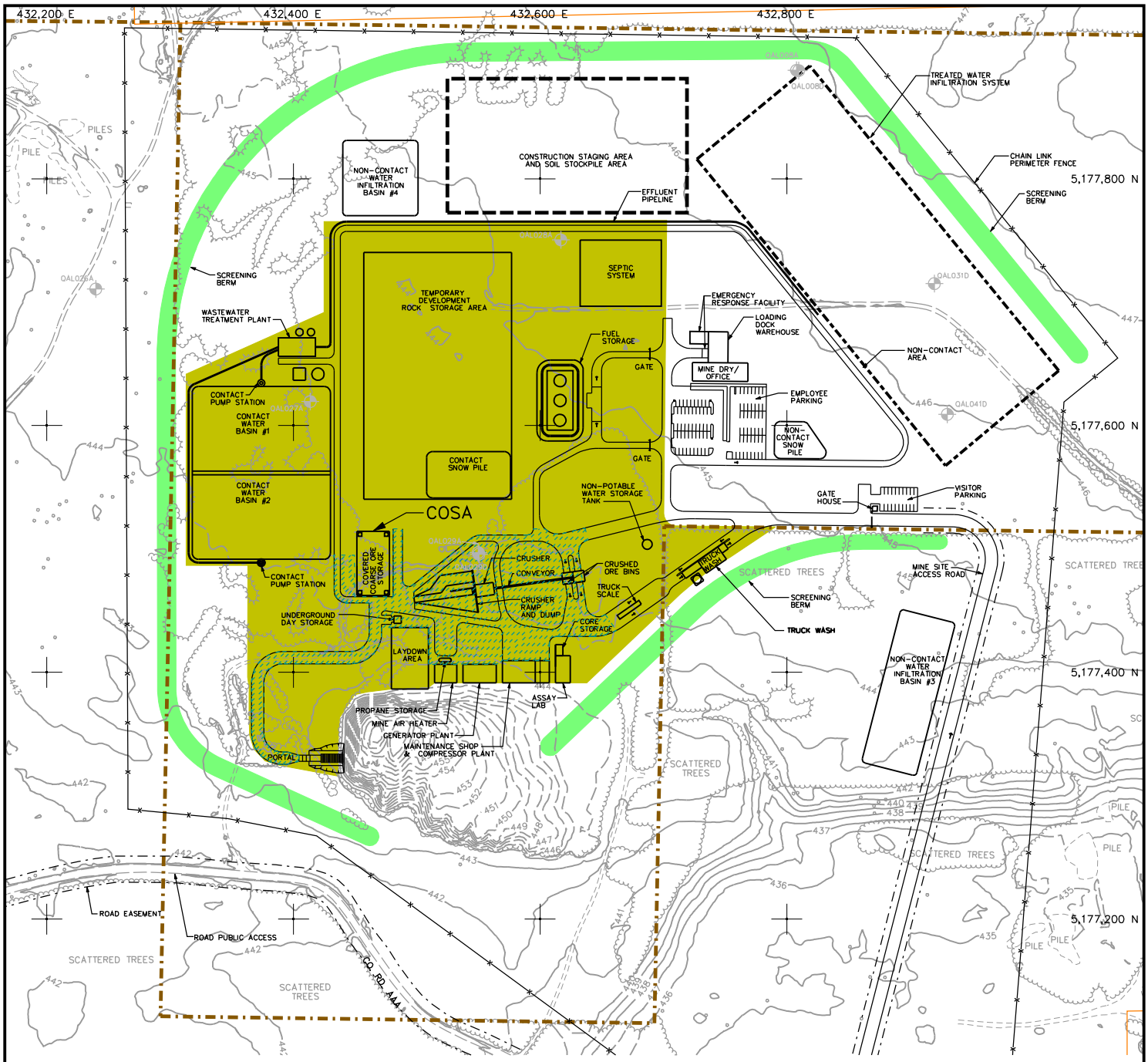
1.3.2 Bituminous Surfaced Areas

As with concrete pavement, repair methods for cracks in bituminous surfaced areas will vary with the size of the crack as described below:

- Minor Cracks: Minor cracks are less than ¼-inch wide and can generally be filled with an asphalt emulsion sealer.
- Structural Cracks: Structural cracks are cracks between ¼-inch and 1-inch wide. These will generally be sealed with a hot elastomeric-type crack sealant.
- Cracks wider than 1-inch: Cracks wider than 1-inch will be patched with hot mix asphalt.

Prior to repair, the cracks will be cleaned with compressed air, or other appropriate method, to remove deleterious material. Cracks between ¼-inch and ½-inch wide will be routed to a minimum of ½-inch by ½-inch in shape. The cleaned cracks will be sealed with the elastomeric sealant or hot mix asphalt, depending on size, and allowed to cure prior to exposure to traffic.

Figures



NOTES:

1. TOPOGRAPHIC AND PLANIMETRIC DATA SUPPLIED BY AERO-METRIC ENGINEERING, SHEBOYGAN, WISCONSIN. DATE OF PHOTOGRAPHY: JUNE 2, 2004.
2. MINE PLAN DATA ADAPTED FROM MCINTOSH ENGINEERING, INC., TEMPE, ARIZONA.
3. SURFACE PROPERTY BOUNDARY AS OF NOVEMBER 18, 2004 SUPPLIED BY KENNECOTT VIA GOLDER & ASSOCIATES INC., AUGUST, 2005.
4. CONTOUR INTERVAL BASED ON NORTH AMERICAN VERTICAL DATUM OF 1988. HORIZONTAL DATUM BASED ON NAD 83/94. HORIZONTAL COORDINATES BASED ON UTM ZONE 16.
5. SITE LOCATION: PROJECT SITE WITHIN SECTIONS 11 & 12, T50N, R29W, TOWN OF MICHIGAMME, MARQUETTE COUNTY, MICHIGAN.

LEGEND

- EXISTING ELEV. CONTOUR IN METERS MSL
- UNPAVED ROAD
- TREE
- TREE LINE
- KENNECOTT PROPERTY BOUNDARY
- ROAD EASEMENT PROVIDE BY MCINTOSH ENGINEERING, INC., AUGUST, 2005
- TREATED WATER INFILTRATION SYSTEM
- PLANIMETRIC WETLAND NOTATION
- PERIMETER FENCE
- MAIN OPERATIONS AREA
- BITUMINOUS LINED OPERATIONS AREA

N

Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION

CHECKED BY:	JOS1	DATE:	DEC. '07
APPROVED BY:	SVD1	DATE:	DEC. '07
APPROVED BY:		DATE:	

Kennecott Eagle Minerals

FIGURE 1

CONTACT AREA IMPERMEABLE SURFACES

Scale: 0 60M 120M

Date: DECEMBER, 2007

Prepared By: GJB

Project No. 04W018

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12/13/2007 jow

Appendix A

Impermeable Surface Inspection Log

Impermeable Surface Inspection Form
Kennecott Eagle Minerals Company

Inspector: _____	**Concrete Pavement**
Date: _____	Inspection Area: _____

Inspection Results

Recommended Actions

Follow-up of Previous Recommendations

Date of Next Inspection: _____

Archive Inspection Form Until: _____ (5 yrs from date of inspection)

Impermeable Surface Inspection Form
Kennecott Eagle Minerals Company

Inspector: _____	**Bituminous Pavement**
Date: _____	Inspection Area: _____

Inspection Results

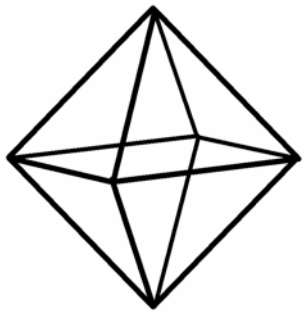
Recommended Actions

Follow-up of Previous Recommendations

Date of Next Inspection: _____

Archive Inspection Form Until: _____ (5 yrs from date of inspection)

Plan



Kennecott
Eagle Minerals

Eagle Project

Portal Abandonment Plan

Project No.: 04W018

Kennecott Eagle Minerals Company
Marquette, Michigan

December 2007

Eagle Project

Portal Abandonment Plan

Project ID: 04W018

Prepared for

Kennecott Eagle Minerals Company

ISO 14001:2004 Registered System

Prepared by

Foth Infrastructure & Environment, LLC

December 2007

2737 South Ridge Road, Suite 600 • P.O. Box 12326 • Green Bay, WI 54307-2326 • (920) 497-2500 • Fax: (920) 497-8516

Eagle Project
Portal Abandonment Plan

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1 Portal Abandonment Description 1

Figures

Figure 1 Portal Abandonment

1 Portal Abandonment Description

As part of the Mine Reclamation Plan, the mine portal abandonment will be performed in the following manner:

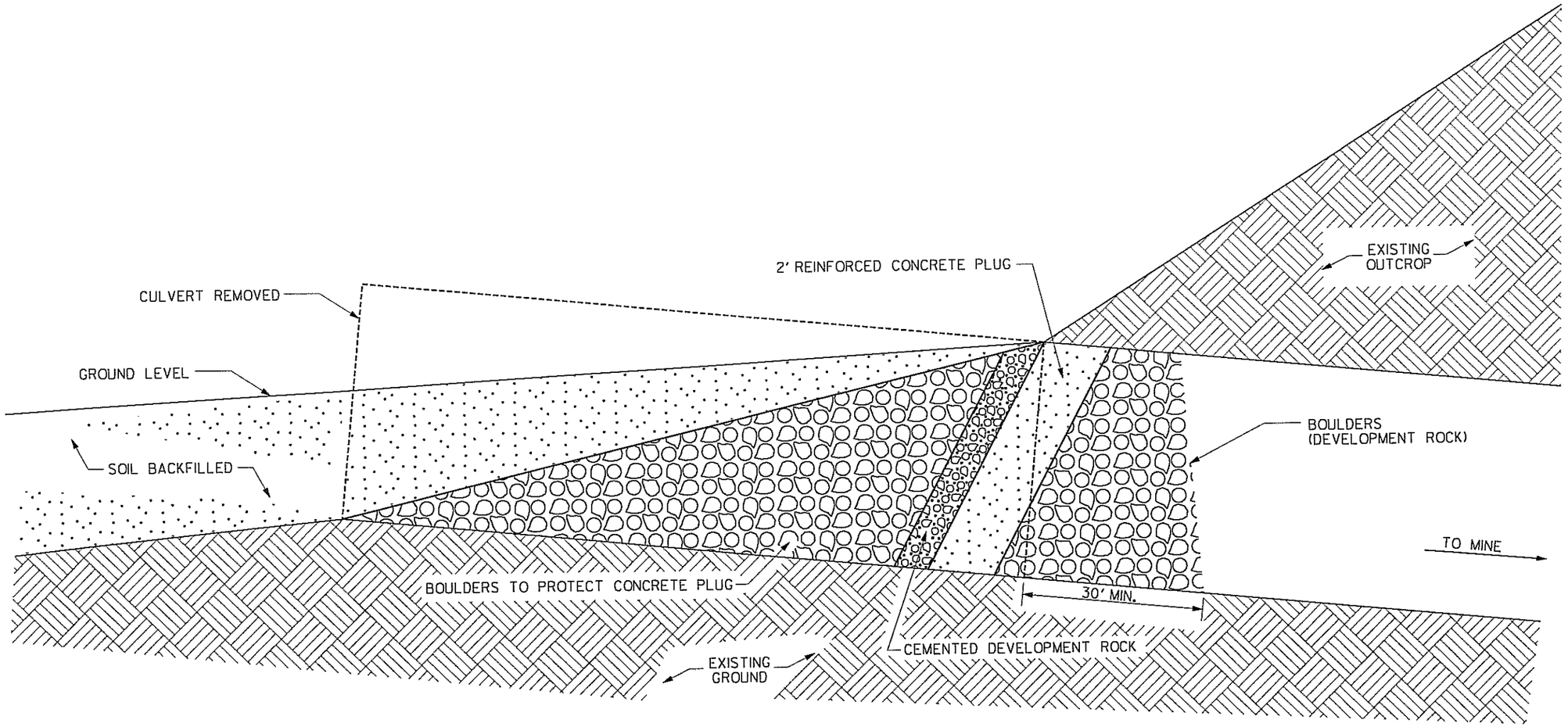
- The portal installed to provide access to the decline during mine operations will be removed.

- Boulders of development rock will be placed inside the portal a distance of approximately 30 feet from the portal entry (Figure 1).

- A two foot thick plug of concrete will be installed over the face of the development rock boulders. At the top where the installation joins with the natural outcrop at ground level, rock pieces from the outcrop will be embedded to a depth of two feet below grade level (Figure 1).

- Once the concrete is set and the portal plug is complete, backfilling with clean fill of the area up to the surrounding area grade level will be performed.

Figures



Foth Infrastructure & Environment, LLC				
REVISED	DATE	BY	DESCRIPTION	
CHECKED BY:	JOS1		DATE: DEC. '07	
APPROVED BY:	SVD1		DATE: DEC. '07	
APPROVED BY:			DATE:	

Kennecott
Eagle Minerals

FIGURE 1

PORTAL ABANDONMENT

Scale:	NOT TO SCALE	Date:	DECEMBER, 2007
Prepared By:	JOW	Project No.	04W018

L:\04W018\MRP\4w18_portal_closure_f1.dgn
12/17/2007 bjk