Application

Kennecott
Eagle Minerals

Humboldt Mill

Mining Permit Application

Volume II

Environmental Impact Assessment

(Report Text, Tables, Figures and Appendix A)

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Kennecott Eagle Minerals Company
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Volume II
Environmental Impact Assessment

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Appendix I Supplemental Hydrological and Biological Data Report

Note: The appendices listed above are contained in the following volumes:

Volume II: Report Text, Tables, Figures and Appendix A
Volume IIA: Appendix B-1 (1 of 5)
Volume IIB: Appendix B-1 continued (2 of 5)
Volume IIC: Appendix B-1 continued (3 of 5)
Volume IID: Appendix B-1 continued (4 of 5)
Volume IIE: Appendix B-1 continued (5 of 5)
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Volume IIG: Appendix I (1 of 4)
Volume IIH: Appendix I continued (2 of 4)
Volume II I: Appendix I continued (3 of 4)
Volume IIJ: Appendix I continued (4 of 4)

List of Abbreviations, Acronyms, and Symbols

AEM	Advanced Ecological Management, LLC
APE	Area of Potential Effect
ARD	Acid Rock Drainage
Callahan	Callahan Mining Corporation
CFR	Code of Federal Regulations
CHMM	Certified Hazardous Materials Manager
CO	carbon monoxide
COSA	Coarse ore storage area
CR	County Road
dBA	decibels
EIA	Environmental Impact Assessment
ft	feet
FEMA	Federal Emergency Management Agency
Foth	Foth Infrastructure & Environment, LLC
GLEAS	Great Lakes and Environmental Assessment Section
HAP	hazardous air pollutant
HTDF	Humboldt Tailings Disposal Facility
IRSL	Initial Risk Screening Level
ITSL	Initial Threshold Screening Level
KEMC	Kennecott Eagle Minerals Company
KME	King & MacGregor Environmental, Inc.
kV	kilovolt
MAERS	Michigan Air Emissions Reporting System
MEND	Mine Environmental Neutral Drainage
MCL	Michigan Compiled Laws
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
MDOT	Michigan Department of Transportation
mg/kg	milligrams per kilogram
MIBC	methyl isobutyl carbinol
MISHPO	Michigan State Historic Preservation Office
MIRIS	Michigan Resource Information System
MNFI	Michigan Natural Features Inventory
MPC	Minerals Processing Corporation
MSDS	Material Safety Data Sheets
MSHA	Mining Safety and Health Administration
MSL	Mean Sea Level
MVA	mega volt-amps
NAAQS	National Ambient Air Quality Standards
NO_x	Nitrous oxides
NPDES	National Pollutant Discharge Elimination System

NRCan	Natural Resources Canada
NREPA	Natural Resources and Environmental Protection Act
NRHP	National Register of Historic Places
NWI	National Wetland Inventory
OSHA	Occupational Safety and Health Administration
%	percent
P.E.	Professional Engineer
P.G.	Professional Geologist
P.H.	Professional Hydrologist
pH	- Log [H+]
Ph.D.	Doctor of Philosophy
PIPP	Pollution Incident Prevention Plan
PM	particulate matter
PM -2.5	Particulate matter less than 2.5 microns
R	Rule
ROP	Renewable Operating Permit
RPA	Registered Professional Archaeologist
SESC	Soil Erosion Sedimentation and Control Plan
SPCC	Spill Prevention Countermeasure and Control Plan
sp.	species
SO_2	sulfur dioxide
SRSL	Secondary Risk Screening Level
SSURGO	Soil Survey Geographic Database
TACs	Toxic Air Contaminants
tpy	tons per year
ug/m^3	micrograms per cubic meter
U.P.	Upper Peninsula
URS	URS Corporation
USC	United States Code
USEPA	United States Environmental Protection Agency
USFS	U.S. Forest Service
USGS	U.S. Geological Service
VOC	Volatile Organic Compounds
WWTP	Wastewater Treatment Plant
WSRA	Wild and Scenic Rivers Act

1. Introduction

Kennecott Eagle Minerals Company (KEMC) is proposing to develop the existing Humboldt Mill facilities to process nickel and copper ore. The Humboldt Mill is located at 4547 County Road (CR) 601, Humboldt, Michigan as shown on Figure 1-1. As part of the permitting process for this project KEMC needs to apply for a Mining Permit in accordance with Part 632 of Michigan's Natural Resources and Environmental Protection Act (NREPA) (MCL §324.63201 et. seq.). The milling operation is considered a mining activity. Therefore, this activity is permitted under Part 632 of NREPA and associated rules promulgated under R 425.101 et. seq.

This volume (Volume II) of the *Mining Permit Application* contains the *Environmental Impact Assessment* (EIA) for the Humboldt Mill. Appendices associated with this EIA are contained in Volume IIA through Volume IIJ. This EIA has been prepared on the basis of historical data and engineering and other environmental studies prepared for refurbishing, operating, and reclamation of the Humboldt Mill facilities.

1.1 Checklist

The EIA addresses specific conditions, features, and issues as outlined in R 425.202. These requirements are summarized in abbreviated notation in the EIA Requirements Checklist included in Appendix A. EIA sections addressing rule requirements are referenced. As appropriate, the rule reference appears in parenthesis directly in each section heading in this document.

1.2 Professional Qualifications *(R 425.202(1)(d))*

This EIA was prepared by Foth Infrastructure & Environment, LLC (Foth) under contract to KEMC. This document also incorporates information prepared by other qualified professionals working under contract to KEMC and/or Foth. Table 1-1 summarizes the organizations and individuals who have contributed to the preparation of this EIA.

1.3 EIA Methodologies *(R 425.202(1)(e))*

The supporting documents and studies contained in the Appendices of this EIA rely on data collection methods, analysis, and interpretation appropriate to the specific study topic. The technical reports contained in the Appendices to this EIA describe the methods of investigation as well as the quality assurance for the work performed.

1.4 Information Sources *(R 425.202(1)(f))*

The following is a list of sources of information used in preparation of the EIA.

Advanced Ecological Management. 2007a. *Humboldt Mill Aquatic Survey Report 2006*. (Appendix D-2).

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Foth Infrastructure & Environment, LLC. 2007f. Technical Memorandum RE: *Well Inventory and Wellhead Protection Survey.* (Appendix B-4).

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Foth Infrastructure & Environment, LLC. 2007h. Technical Memorandum RE: *Humboldt Mill Baseline Noise and Light Survey.* (Appendix H)

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1.5 Public Input *(R 425.202(4))*

Public input to this project will be provided as part of the public comment process administered through the Michigan Department of Environmental Quality's (MDEQ) review of the *Mining Permit Application*. KEMC will be holding community advisory group meetings to inform the public, answer questions and receive input about project operations and status of the site throughout the life of the project and post closure.

2. Description of Facility Area and Proposed Action

The Humboldt Mill property is located approximately 24 miles west of Marquette Michigan as shown on Figure 1-1. The property is located in Sections 2 and 11 in Township 47 North, Range 29 West, Humboldt Township, Marquette County, Michigan. The region surrounding the project is shown on Figure 2-1. Zoning appears in Figure 2-2. Property ownership is shown on Figure 2-3.

This property is considered a brownfield site by the United States Environmental Protection Agency (USEPA) as defined in 2002 under Public Law 107-118; H.R. 2869 to include mine-scarred lands. Mine-scarred lands are defined as lands, associated waters, and surrounding watersheds where extraction, beneficiation, or processing of ores and minerals has occurred (USEPA, 2004). Although this property is eligible for benefits under the USEPA's Brownfields Program, KEMC is pursuing the environmental improvement and use of this property without federal assistance.

Currently, surface facilities present include a mill housed within a building, an office/maintenance building, two crusher buildings, an electrical substation, and water tower. Figure 2-4 shows the property and buildings as well as the surrounding area. Mining activities in this area began over 50 years ago and a variety of iron ore tailings basins and waste rock piles are shown on Figure 2-4. Figure 2-5 shows surface sources of mining related residuals associated with past mining activities. Residual conditions of the soil, groundwater, and surface water are detailed in the *Humboldt Mill Hydrogeological Report* (Foth, 2007a) (Appendix B-1) and the *Humboldt Facility Investigation Report* (Foth, 2007b) (Appendix B-2).

The proposed project is described in detail in Volume I of the *Mining Permit Application*. Figure 2-6 shows the proposed site development plan. A summary of the project actions related to the potential environmental impacts are:

- Installation of a gate house at the mill facility entrance.
- Constructing storage areas and conveying systems to accept and crush ore. This includes the coarse ore storage area (COSA), primary, secondary, and tertiary crushing systems, and conveying systems to the mill.
- Refurbishing the current mill including using current equipment, upgrading current equipment, and installing new equipment as needed for the milling process.
- Constructing a concentrate load-out building serviced by a conveyor from the mill building. Rail cars will enter the building to be loaded in a secure environment protected from precipitation.
- Installing a rail spur for shipment of concentrate produced in the mill. This will be done on the former rail spur bed.
- Installing accessory equipment, buildings, and storage silos to support the operations.

- Recommissioning the existing Humboldt Tailings Disposal Facility (HTDF), installing a tailings slurry pipeline and a wastewater treatment plant (WWTP) to address discharge of treated HTDF water to surface waters.

Other aspects of the proposed project are:

- Electric power will be supplied by an existing 34 kV power line and transformer.

- The facility will require space heating for buildings but no process-related heat sources will be needed. Heating requirements will be supported by electric and/or propane heat.

- The concentrate will be loaded to rail cars for transport off-site for further processing. All ore and concentrate processing and handling activities will take place indoors and in controlled conditions such that there will be no exposure to precipitation. Particulate emissions will be controlled through air pollution control equipment such as the building enclosure, baghouses and wet spray bars.

- Facility non-contact stormwater runoff will be routed to a new sedimentation basin southwest of the mill (Figure 2-6) and will either infiltrate into groundwater or be routed to a wetland southwest of the facility that drains to the West Branch of the Black River.

- A water supply well will be refurbished south of the mill or a new water supply well will be installed. The well will supply potable water for the office/mill. Process make up water will be drawn from the HTDF and the supply well.

- Silos will be installed to store and feed bulk granular products to the mill operation. Silos for hydrated lime and sodium sulfite will be indoors and will be equipped with bin vents and pneumatic conveyors. Other mill reagents will be off-loaded and handled indoors.

- Tailings from the milling process will be slurried and pumped to the bottom of the HTDF and placed in a controlled manner as described in Volume I of the *Mining Permit Application*.

- The HTDF will have a low-permeabilility cut-off wall installed at the north end that will prevent migration of HTDF water to the Quaternary aquifer. The WWTP will treat, as needed, HTDF effluent before discharging to a wetland identified as Wetland EE on the north side of the HTDF. Wetland EE drains to the Middle Branch Escanaba River.

- Reclamation of the site after operations are complete will restore the property to a condition consistent with an industrial site.

- Operational and post-closure monitoring will be completed to document protection of water resources.

- Financial assurance documented in Volume I of the *Mining Permit Application* will be provided by KEMC per R 425.401. The financial assurance covers anticipated reclamation costs, environmental monitoring costs, administrative oversight and estimated environmental contingencies.

3. Environmental Assessment

For each resource topic included in this assessment, existing conditions are described per R 425.202(1)(a)(i). Proposed mining activities that may affect each resource are presented and the potential impact from the activity is described as required in R 425.202(1)(a)(ii)-(iii). Measures that will be completed in accordance with the plans described in Volume I of this *Mining Permit Application* to reduce and mitigate potential impacts are presented per R 425.202(1)(a)(iv). Cumulative impacts that may occur are presented throughout this section per the requirement of R 425.202(1)(b).

The environmental studies that were completed for this EIA comply with the requirements of R 425.202. Resource topics that are evaluated for this EIA include the following:

- Topography,
- Soil,
- Geology of the bedrock and unconsolidated materials overlying the bedrock,
- Groundwater and aquifers,
- Surface water systems,
- Regional hydrology,
- Groundwater and surface water quality,
- Private and public water supplies including irrigation wells,
- Designated wellhead protection areas,
- Wetlands and flood plains,
- Natural rivers,
- Wild and scenic rivers,
- Residential dwellings, schools, and other public and private structures,
- Existing and proposed infrastructure,
- Natural areas,
- State wilderness areas,
- Federal wilderness areas,
- Wild areas,
- Research natural areas,
- Land use,
- Aquatic and terrestrial flora and fauna,
- Fish and wildlife habitat and ecological systems
- Threatened and endangered species and species of special concern,
- Non-native and invasive species,
- Archaeological resources,
- Air quality and meteorology,
- Visual resources, and
- Noise, light and seismicity.

All these topics are addressed in Section 3. Section 4 addresses prudent and feasible alternatives to various aspects of the Eagle Project.

Extensive effort was put forth by KEMC in conducting the baseline environmental studies documented in this EIA and determining the areas subject to potential affects from milling activities. The studies performed for this EIA varied in scope depending on the resource issue.

For water resource related topics of groundwater and surface water, the study area included portions of the Black River watershed and the Middle Branch Escanaba River watershed (see Figure 2-1). For aquatic resources, the study area included what is referred to in this document as the West Branch of the Black River, Middle Branch Escanaba River, Lake Lory, and the HTDF. For wetlands, threatened species, endangered species, species of special concern, terrestrial flora and fauna, and habitat, the study area encompassed approximately 3,169 acres, which includes the Humboldt Mill. Similarly, approximately 99 acres around the mill facilities were included in the archaeological study area. For hydrologic related impacts, the area of potential impact is the Quaternary aquifer and surface water system immediately north of the HTDF and the West Branch of the Black River. It should be noted that the area potentially affected by mining operations does not equate to an unacceptable impact. The purpose of this EIA is to disclose potential impacts and changes to the local environment due to the mining operations that are regulated under the environmental permits that KEMC is applying for. As such, the EIA is correctly viewed as a disclosure document.

In all cases, the study area was beyond the area of potential impact. The area of potential impact is constrained by construction activities at the mill and HTDF. The study areas for other topics such as natural rivers, infrastructure, places of business, and aesthetics are defined by their occurrence within several miles of the project site. Section 1.4 provides a summary of the data sources and baseline studies used in preparing this EIA. These KEMC commissioned studies and historical studies are described in the following sections as appropriate with specific reports appearing in Appendices B through I of this EIA.

3.1 Topography and Drainage *(R 425.202(2)(a))*

3.1.1 Description of Existing Topography and Drainage Patterns

The subject site is located in the Town of Humboldt, in western Marquette County (Figure 1-1). The area is characterized by rugged bedrock ridges, separated by sand plains, wetlands and lakes. The highest elevation in the vicinity of the mill can be found on the ridge in the north half of Section 11, T47N, R29W, approximately 1760 ft above mean sea level (MSL) (Figure 2-6). The lowest elevation, 1540 ft MSL occurs at the northern outlet of the HTDF. The land in the vicinity of the mill has been raised up to the existing grade from previous activities resulting in it being generally flat with a slight south slope at an elevation of approximately 1600 ft MSL (Figure 2-6).

To the northwest of the mill is the HTDF, an approximate 67 acre water-filled pit containing tailings. The pit was created as a result of iron mining in the 1950s and 1960s. After mining ceased, the pit was allowed to fill with water. Subsequently, the pit was used for the placement of sulfide tailings generated from the milling of ore from the Ropes Gold Mine. On the south end of the HTDF, there is an angular depression that contains water intermittently depending on the season. This depression was a small iron ore deposit extracted shortly before the Humboldt Mine closed.

Lean iron ore and development rock (waste rock) taken from the Humboldt Mine are stored in two separate areas, forming flat-topped hills that rise up to 150 ft above the existing terrain. One area is located adjacent to the northwest edge of the HTDF and the other is located southwest of the HTDF, just to the west of the mill complex (Figure 2-6). Tailings produced from ore processing during iron mine operations have been deposited in topographic depressions (tailings

basins) to the southeast and southwest of the mill (Figure 2-6). The tailings basin southeast of the mill is surrounded by man-made stone berms constructed between isolated upland areas. The iron ore tailings basin southwest of the mill facility was formerly a natural lake (McKinnon Lake) and it continues to be the source of water for the West Branch of the Black River.

Surface drainage patterns in the vicinity of the subject site are controlled primarily by the high bedrock ridge in the north half of Section 11. Prior to the start of iron mining in 1954, this ridge formed the surface water and groundwater drainage divide between the Middle Branch Escanaba River to the north and the Black River to the south. After mining ended in this location and water filled the pit, the surface water divide shifted to the southern perimeter of the pit. Surface water drainage at the mill is primarily to the southwest towards the West Branch of the Black River. Surface drainage in the watershed of the HTDF is to the north through an earthen berm into Wetland EE.

The facility area (total facility footprint) is defined as the fenced-in area as shown on Figure 2-6. The fenced area includes the mill facility which lies in the Black River Watershed and the HTDF which lies in the Middle Branch Escanaba River Watershed. Disturbed areas from previous mining activities currently exist well beyond the mill facility and HTDF.

Regionally, the project lies on the surface drainage border of the Black River Watershed and the Middle Branch Escanaba River Watershed (Figure 2-1). The Black River Watershed covers approximately 34.5 mi^2; the Middle Branch Escanaba River Watershed covers approximately 182 mi^2.

The Black River Watershed, where the mill facility is located, encompasses the Black River, Lake Lory, Iron Ore Tailings Basin West (formerly McKinnon Lake), Iron Ore Tailings Basin North, and Iron Ore Tailings Basin South (Figure 2-6). The Black River flows generally southwest from the project area for several miles before turning generally southeast. The Black River joins the Escanaba River approximately seven miles south-southwest of Ishpeming (Figure 2-1). The Black River drains into the Middle Branch Escanaba River southeast of the site. Both of these watersheds are part of the regional Escanaba River watershed that drains into Lake Michigan.

The Middle Branch Escanaba River Watershed, where the HTDF is located, encompasses the Middle Branch Escanaba River which flows in a easterly direction about ¾ mile directly north of the facility. The river meanders southeast into Greenwood Reservoir. The reservoir has two outlets that join downstream before the confluence with the Black River.

3.1.2 Proposed Mining Activities Affecting Topography and Drainage

Physical changes to the land in construction and operation of this project that could affect the topography and drainage of the area are listed below:

- Construction/refurbishment of surface facilities,
- Management of stormwater runoff,
- Recommissioning and placement of tailings into the HTDF,
- Reclamation of the surface facilities at closure.

3.1.3 Potential Impacts and Mitigations of Impacts on Topography and Drainage

During project construction, earth moving equipment will re-grade the area, excavate limited areas for building foundations, and excavate the sedimentation basin in accordance with the stormwater management plan described in Volume I of the *Mining Permit Application*. As a brownfield site with useable structures in place, the mill site encompasses a large, disturbed area which will not be expanded. Once the mill project is constructed, stormwater will be routed in a controlled manner to the sedimentation basin and on to the riparian wetland prior to entering the West Branch of the Black River. The controlled routing and treatment achieved by the sedimentation basin will improve the current stormwater impact to the environment in the vicinity of this site.

Recommissioning of the HTDF through the construction of a cut-off wall and berm on the north side of the HTDF (see Volume I of the *Mining Permit Application*) will cut off subsurface seepage of water out of the facility into the Quaternary aquifer on the north side of the HTDF as described in Volume I and Appendix D of Volume IA of the *Mining Permit Application*. During operations, this seepage will be directed to the WWTP prior to surface discharge to Wetland EE on the north side of the HTDF. Wetland EE drains into the Middle Branch Escanaba River.

After operations are terminated and stable water quality conditions are achieved in the epilimnion of the HTDF (see Appendix D of Volume IA) the berm installed at construction will be removed. The subsurface cut-off wall will remain in place. This will allow natural surface drainage from the surface of the HTDF into the wetland complex on the north side of the HTDF. Thus during operations and after reclamation, surface drainage out of the HTDF will increase, but will be controlled and subsurface drainage into the local aquifer will be cut off. As documented in Appendix B-3 this will be a *de minimus* impact on the water levels and drainage in the wetland (Wetland EE) on the north side of the HTDF.

Reclamation activities are described in Volume I of the *Mining Permit Application* and will mitigate the short-term operations phase impact to topography. Areas as appropriate will be seeded with a mixture of natural vegetation. As a result, the topography and drainage at the site will retain the improved stormwater conditions accorded this site. The reclamation plan will support the stormwater system improvements put in place during construction.

3.2 Soils *(R 425.202(2)(b))*

3.2.1 Existing Soils

The Humboldt Mill region is comprised of bedrock overlain by a complex sequence of unconsolidated glacial and post glacial sedimentary material that is thin over the Lower Proterozoic rocks and thicker over the Archean rocks (Figure 3-1). Exposed bedrock is common in outcrops north and northeast of the mill buildings (Figure 3-2). The unconsolidated deposits are more than 50 ft deep in areas around the mill. A soil and geologic investigation has been performed and is documented in Appendix B-1. A soils map covering the mill, HTDF and surrounding area is presented in Figure 3-3.

The area soils are predominantly sand, gravel and rock fill, and iron ore tailings, with lesser amounts of native sand and gravel and weathered bedrock. The geology of the unconsolidated

parent soil material consists of a complex assemblage of glacial till and outwash; fill consisting of fine to coarse sand, gravel, cobbles and boulders; peat, and iron ore tailings.

The Humboldt Mill Project site has been the location of over 50 years of mining activity. Prior to mill construction in 1954, this area was a wooded wetland divided by isolated upland areas and low bedrock exposures (Figure 3-4). The soils in the mill area now reflect extensive disturbance, with backfilled areas that support the buildings and a variety of waste rock and tailings piles from past activities (Figures 2-6, 3-2 and 3-3). Structural fill was placed over much of the area south of the mill buildings in previously low-lying wetland areas. The backfill consists of fine to coarse sand, gravel and rock from previously existing deposits on the property that were leveled and transported to fill low-lying areas; and waste rock extracted from the Humboldt Mine. In many areas, it is difficult to distinguish sand gravel and rock that has been used as fill from similar material that is found naturally in place.

In the iron ore tailings basins east of the mill, a wedge of iron ore tailings was identified more than fifty feet thick overlying *in-situ* peat, sand and gravel outwash and till. The tailings are contained primarily by a constructed berm stretching between previously existing hills of sand, gravel and bedrock and occur as a wedge, or delta, with a thickness ranging from at least fifty feet in the northern area, to approximately twenty feet thick in the southernmost area tested.

As part of the baseline studies completed for this EIA, extensive testing was conducted around the mill documenting the occurrence of mining residuals in unconsolidated soil deposits at the site. This information is extensively documented in Appendix B-1.

The HTDF, formerly the Humboldt Mine, was excavated with very steep sides (see Appendix B-1). The soils surrounding the HTDF are comprised of natural soils, waste rock, or a mixture of both (Figures 2-6 and 3-2). The native soils in the HTDF vicinity are comprised of a variety of forms: boulders, coarse to fine gravel, coarse to fine sand, silt and clay. Undisturbed soils surrounding the vicinity of the project are identified on Figure 3-3.

3.2.2 Proposed Activities and Potential Impacts Affecting Soils

With the project being constructed on previously disturbed areas, soil disturbance will be minor during the 12 year period of mill refurbishment, operation, and reclamation.

Impacts to soils outside the project area due to deposition of airborne particulates originating from the mill are expected to be minimal as described in Section 3.18. The few sources of particulate matter from the planned activities are derived from vehicular traffic, material handling, and stack emissions from dust collection systems that will total 5.8 tons per year. The entire mill site will have low emissions as presented in *Michigan Air Use Permit - Permit to Install Application* (Foth, 2008) and summarized later in this EIA. Impacts to soils outside of the mill site due to erosion events will be insignificant relative to current conditions since stormwater runoff will be managed, treated, and discharged in a controlled fashion which is an improvement over current conditions. Off-site erosional impacts will also be reduced relative to current conditions due to clean up and installation improvements of stormwater controls around the mill.

Given the low particulate emissions from the facility (Section 3.18) in the vicinity of a historic area, impacts on soils from particulate emissions are considered negligible.

3.3 Geology *(R 425.202(2)(c))*

The geologic conditions at the mill site and HTDF and methods of investigation and historical documentation are documented in Appendix B-1.

3.3.1 Existing Geologic Conditions

The geology of the Humboldt Mine area was mapped in detail by the United States Geological Service (USGS) (Cannon, 1975). The geology was also investigated by the Callahan Mining Corporation (Callahan) as documented in the report entitled *Humboldt Pit Hydrogeological Report*, prepared by Traverse Engineering Services, P.C. (1984). The Traverse Engineering Report is included in Appendix B-1. The USGS map was part of the Traverse Engineering Services report and excerpted portions of the immediate Humboldt Mine and Mill sites are shown in Figure 3-5. The dominant geological formation is silicate-rich iron-formation with lesser quantities of Goodrich Quartzite, metadiabase, and lenses of basal conglomerate. Figure 3-5 shows the outline of the Humboldt Mine Pit.

Bedrock in this area consists of Archean granitic gneiss in fault contact with younger, Lower Proterozoic sediments intruded by diabase dikes and sills that have been folded and metamorphosed. The metamorphosed sedimentary and intrusive rocks form the highest ridges. The rocks include quartzite, iron formation, minor slate and the intruded diabase, that are complexly folded, but generally form an anticline which plunges to the west and hosts the iron ore deposit that was mined from the Humboldt Mine (Traverse Engineering Services, 1984).

Structural fill was placed over much of the area south of the mill buildings in previously low-lying wetland areas. This material consists of coarse sand and gravel, cobbles, and boulders extracted from borrow pits on the east side of the mill; and broken rock (low-grade iron ore) and development rock from the Humboldt Mine. Detailed geologic cross-sections and discussion of the geology of the site appears in Appendix B-1.

3.3.2 Proposed Activities and Potential Impacts Affecting Geologic Conditions

None of the activities proposed for the mill are intrusive on existing geologic conditions. The mill refurbishment is entirely at the surface or several feet below grade.

A cut-off wall will be installed on the north side of the HTDF as described in Volume I of the *Mining Permit Application*. The wall will not structurally affect the geology of the site or surrounding area. As such, there are no impacts identified on geologic conditions from the proposed mill or HTDF construction, operation and reclamation.

3.4 Groundwater

The groundwater conditions at the mill site, HTDF and surrounding areas; and methods of investigation and historical documentation are provided in Appendix B-1 and Appendix I and satisfy the requirements of R 425.202(3).

3.4.1 Groundwater Hydrology *(R 425.202(2)(d))*

Groundwater in this area occurs in the unconsolidated deposits overlying the bedrock. Bedrock formations host much less groundwater, generally occurring in isolated fractures, joints and openings along bedding planes. Groundwater flow rates vary widely depending on the hydraulic conductivity of the hosting material and can occur under water table or artesian conditions. Although artesian conditions may occur locally in the unconsolidated formations, the upper surface of the groundwater in this area is generally unconfined and is subject to atmospheric pressure. Groundwater is recharged from direct precipitation and runoff from bedrock ridges, having a thin veneer of unconsolidated material, draining downward to glacial drift-filled valleys.

A groundwater elevation contour map is provided in Figure 3-6. Groundwater appears to flow and discharge predominantly to the west and southwest toward the West Branch of the Black River. Given the close proximity of Lake Lory to the south, one would expect the groundwater in the highly permeable iron tailings to drain in that direction. While there is a component of flow toward Lake Lory, the levee around the perimeter of the iron ore tailings basin appears to be restricting the flow of groundwater. This inference is based on the slope of the water table surface on the south and east sides of the tailings basin. This has resulted in an apparent mounding of the water table and redirection of groundwater flow to the southwest.

Groundwater flow across the main portion of the mill facility is to the west and southwest, where the bulk is captured by riparian wetlands in the area and the Black River. In the vicinity of the mill, there is a limited area where groundwater in the Quaternary system flows into the HTDF. Water exits the HTDF into downgradient wetlands to the north. The water that exits the HTDF does so through seepage into the Quaternary aquifer along the north side of the HTDF. This information is documented in Appendix B-1 and Appendix I. A detailed hydrologic balance of the HTDF under current and operational conditions is documented in Appendix D of Volume IA of the *Mining Permit Application*.

3.4.2 Groundwater Quality *(R 425.202(2)(g))*

Historical and existing groundwater quality at and around the mill and HTDF is documented in Appendix B-1 and Appendix I.

3.4.2.1 Contaminated Groundwater as Defined by Part 201 *(R 425.202(2)(h))*

A thorough investigation has been performed to identify contaminated groundwater quality at the Humboldt Mill Project site as defined by Part 201 of NREPA. This documentation is presented in Appendix B-1 and Appendix I.

3.4.3 Proposed activities Affecting Area Groundwater

Activities potentially affecting the groundwater fall in two categories: activities performed for project construction and treating the discharge of water from the HTDF.

3.4.4 Potential Impacts on Groundwater Quantity and Quality

Mill clean up activities will impact groundwater in a beneficial way through clean up and installation improvements of stormwater controls around the mill.

The project will change the groundwater flow out of the north end of the HTDF. Currently water exiting the HTDF is through subsurface seepage to the Quaternary aquifer at the north end of the HTDF. During construction, a cut-off wall will be constructed on the north side of the HTDF eliminating subsurface seepage. During operations excess water in the HTDF will be routed to a water treatment plant, for treatment, prior to surface discharge to Wetland EE on the north side of the HTDF. Wetland EE drains into the Middle Branch Escanaba River. The reduction in flow to the aquifer on the north end of the HTDF is inconsequential and will not affect groundwater levels or groundwater flow in areas north of the HTDF. Moreover as discussed in Section 3.6, there are no private or public wells immediately north of the HTDF and thus there will be no quantity or quality impacts to the public or private water well supplies.

Concerning groundwater quality, the cut-off wall will prevent potential seepage of water in the stratified HTDF into the Quaternary aquifer north of the HTDF. See Appendix B-1 and Appendix I of this EIA and Appendix D in Volume IA of the *Mining Permit Application* for a detailed discussion on the geology and hydrology of the HTDF which demonstrates that the plans for use of the HTDF will protect groundwater and surface water resources.

3.5 Surface Water

Surface water hydrology and surface water quality at the mill, HTDF and surrounding areas, methods of investigation and historical documentation are provided in Appendix B-1 and Appendix I and satisfy the requirements of R 425.202(3).

3.5.1 Baseline Surface Water Hydrology and Quality *(R 425.202(2)(e) and (g))*

Characterization of surface water hydrology, surface water quality and sediment quality has been completed through a combination of studies from prior owners and operators, MDEQ records and recent investigations. These data are presented in Appendix B-1 and Appendix I of this EIA. In addition, a detailed analysis of this data relating to the placement of mill tailings into the HTDF is provided in Appendix D of Volume IA of the *Mining Permit Application*. The studies and extensive database document seasonal flow variations, seasonal water chemistry changes and the influence on regional surface water from past mining activities. The proposed activities for the Humboldt Mill and HTDF will enhance environmental protection at the site as it relates to surface water protection.

3.5.2 Proposed Activities Affecting Surface Water

Activities affecting the surface water fall into three categories: stormwater management at the mill, modifying the effluent (water) from the HTDF, and particulate emissions.

3.5.3 Potential Impacts to Surface Water Quantity and Quality

Activities that could potentially impact surface water quantity and quality include the following:

- The HTDF will have an alteration of its discharge from current seepage to groundwater to surface water discharge of similar quantity during planned operations at the HTDF.

- During operations, water discharge from the HTDF will be routed through a water treatment plant prior to discharge into Wetland EE on the north side of the HTDF. This

discharge will be regulated by a National Pollutant Discharge Elimination System (NPDES) permit and thus will be protective of water resources.

- After closure of the HTDF, the water treatment plant will remain operational until water quality in the epilimnion of the HTDF returns to levels that meet water quality standards. At this time the containment berm on the north side of the HTDF will be altered to allow natural drainage of surficial water from the surface HTDF to Wetland EE. Appendix D of Volume IA of the *Mining Permit Application* provides the technical basis for this management approach and demonstrates that surface water quality will be protected.

- The few sources of particulate emissions from the planned activities are derived from vehicle traffic, material handling, and stack emissions that will total 5.8 tons per year. This emission level is not considered significant relative to potential water quality impacts.

The Contingency Plan in Volume I of the *Mining Permit Application*, describes additional options that are available for addressing water quality that have proven viable at the site for preservation of water quality discharging from the HTDF.

3.6 Water Supply Wells *(R425.202(2)(i), R425.202(2)(j), R425.202(2)(k) and R425.202(2)(l))*

3.6.1 Existing Public, Private and Irrigation Wells in Potentially Affected Area

Water well surveys using state databases were performed in July, 2007 to support this application. The survey results appear in Appendix B-4 and are based on the MDEQ scanned well logs database and the MDEQ Wellogic database. Databases will not reflect wells constructed after the July 2007 database survey or those installed without proper documentation and reporting.

The closest designated wellhead protection area is at Ishpeming-Negaunee and lies nine miles east of the project site. There are no identified irrigation wells in the area as documented in the well survey in Appendix B-4.

3.6.2 Proposed Activities Affecting Wells

The surface water discharge planned from the HTDF is identified as the only potential mining activity that could affect area wells.

3.6.3 Potential Impacts to Water Supply Wells

Potential impacts to water wells could theoretically occur due to a reduction in seepage of water from the HTDF to the aquifer on the north side. However, as discussed in Section 3.4, the reduction in subsurface seepage is not considered significant enough to change groundwater levels north of the HTDF. Moreover, based on the search criteria identified in Section 3.6.1, there are no documented private or public water supplies within approximately 1,300 ft of the HTDF that could be affected. As such, neither public nor private quantities of potable groundwater resources will be impacted. By the same logic, cutting off subsurface seepage from the HTDF through installation of a cut-off wall will be protective of groundwater quality in the

aquifer at the north end of the HTDF - the only aquifer that could potentially be affected by water quality impacts from the operations.

3.6.4 Mitigation of Impacts to Water Supply Wells

No negative impacts have been identified, therefore no mitigation is proposed.

3.7 Wetlands and Flood Plains *(R 425.202(2)(m))*

3.7.1 Existing Wetlands

Wetlands in the Humboldt Mill area have been investigated in surveys performed by King & MacGregor Environmental, Inc. (KME) in 2006, 2007 and 2008. The surveys are documented in Appendices C-1, C-2, and I of this document. The survey reports document a preliminary investigation of the 3,169 acre study area and site visits in June, August and September 2006, and June, 2007 documenting wetland boundaries within a 186 acre detailed study area around the mill and additional wetlands near the HTDF and Black River. In September 2008, an additional study was completed to identify and delineate eight small wetland areas north of the HTDF in the area of the proposed cut-off wall. The investigation was conducted in accordance with Michigan's rules, regulations, guidance documents, and general practices. The surveys and evaluations demonstrate that the project will not be sited within regulated wetlands and document vegetative communities and hydrology in wetlands that could potentially experience indirect impacts from the project due to changes in hydrology.

The initial survey in 2006 included a preliminary wetland evaluation based on a review of National Wetland Inventory (NWI) maps, the Soil Survey Geographic (SSURGO) database for Marquette County, and Michigan Department of Natural Resources (MDNR) 1998 aerial photography. From this survey, general wetland habitat within the 3,169 acre regional study area was identified. Figure 3-7 shows the NWI identified wetlands. Figure 3-3 shows the Marquette County soils for the study area resulting from the SSURGO survey. Based on these data sources, a preliminary wetland map was developed and is shown in Figure 3-8. The preliminary wetland map indicates approximately 1,000 acres of the 3,169 acre study area are classified as wetlands, with emergent wetland and forested wetland dominating, particularly in Section 14 (Figure 3-8).

Within the detailed study area where most proposed activities will take place, twenty-five individual wetlands were flagged in August and September, 2006. The flagged wetlands comprise approximately 16 acres of the 186 acre detailed study area. On August 23, 24 and September 11, 2007, the MDEQ Land and Water Management Division, Wetlands and Submerged Lands Unit performed a Level 3 wetland evaluation to confirm the presence and regulatory status of the flagged wetlands within the detailed study area. Figure 3-9 shows the confirmed wetland boundaries. The MDEQ Level 3 evaluation appears in Appendix C-3.

Wetland J (Figure 3-9) is the largest wetland within the mill site study area and lies adjacent to CR 601. The northern and western portions of this wetland complex have been impacted by previous mining related activities. An active beaver lodge is present within this wetland. Plant species identified within this wetland include blue-joint grass, reed canary grass, marsh-marigold, beggar-ticks (*Bidens tripartitus*), European swamp thistle, node pondweed (*Potamogeton nodosus*), wool grass, broad-leaved cattail (*Typha* sp.), bebb willow, sedge (*Carex*

sp.), spotted joe-pye weed, red maple and speckled alder (*Alnus incana* sp. *rugosa*). Approximately two acres of open water exist within the central portion of the wetland.

In 2007, two additional wetlands outside the detailed study area were characterized to compliment the 2006 survey: Wetland EE and the Black River wetland.

Wetland EE lies north of the HTDF and extends northeast to the Middle Branch Escanaba River (Figure 3-10). The portion of Wetland EE south of Highway 41 was flagged by KME and is shown on Figure 3-11. The flagged portion of Wetland EE is approximately 11.8 acres. This wetland is an emergent/scrub-shrub wetland and is part of a wetland complex extending offsite and consists of emergent, scrub-shrub, and forested components. The wetland complex is bisected by US Highway 41 and an old railroad bed (Figure 3-10). Although Figure 3-10 does not indicate the connection, Wetland EE is hydrologically connected to the Middle Branch Escanaba River through surface water drainage.

Vegetation identified in Wetland EE includes blue-joint (*Calamagrostits Canadensis*), aquatic sedge (*Carex aquatilis*), strict sedge (*Carex stricta*), European horsetail (*Equisetum sylvaticum*), soft rush (*Juncus effuses*), American water-horehound (*Lycopus americanus*), petioled willow (*Salix petiolaris*), balsam willow (*Salix pyrifolia*), wool-grass (*Scirpus cyperinus*), white meadow-sweet (*Sparea alba*), and broad-leaved cattail (*Typha latifolia*). The soils are described in the SSURGO database as Histosols and Aquents – ponded, a poorly drained soil type, and Kinross muck, another poorly drained soil type. The standing water present over the entire wetland during the onsite evaluation indicates the soil conditions are consistent with the SURRGO description.

Upland areas adjacent to Wetland EE have been disturbed by historical mining activities. A large lean ore and waste rock pile is directly west of wetland EE (Figure 3-11). Vegetation in upland areas include sugar maple (*Acer saccharum*), spotted knapweed (*Centaurea maculosa*), Queen Anne's lace (*Daucus carota*), Canada mayflower (*Maianthemum canadense*), white pine (*Pinus strobes*), quaking aspen (*Populus tremuloides*), black cherry (*Prunus serotina*), and bracken fern (*Pteridium aquilinum*). There was no evidence of standing water or saturated soils in the upland areas.

The Black River Wetland lies on the western border of the detailed study area (Figure 3-12). This wetland receives and will continue to receive stormwater discharge from the mill site. The boundary was not flagged during this survey since no construction is planned for this area, however, the vegetation and soils were characterized. This wetland is an emergent/scrub-shrub wetland complex contiguous to the West Branch of the Black River. The historic rail spur bed bisects the northern portion of the wetland. The headwaters to the West Branch of the Black River flow from what is currently named Iron Ore Tailings Basin West immediately west of the Black River Wetland. This pond was a natural lake that was used in the past to dispose of tailings.

The north side of the Black River Wetland is mostly scrub-shrub, then emergent moving south to the West Branch of the Black River. Scrub-shrub includes habitats described as Northern Shrub thicket, a fairly persistent shrub-dominated wetland dominated by speckled alder (*Alnus incana* sp. *rugosa*) with some whithe-rod (*Viburnum nudum*), highbush-cranberry (*V. trilobum*) and sweet gale (*Myrica gale*). Soils are described in the SSURGO database as Histosols and Aquents

– ponded, and Carbondale and Tawas soils, both very poorly drained soil types. Onsite observations were consistent with these soil descriptions.

In September 2008 eight small wetland areas on the north side of the HTDF in the area of the proposed cut-off wall were delineated as documented in Appendix I. The eight small wetland areas were delineated to complete the proposed location for the installation of the cut-off wall and berm.

All the wetland areas identified through site surveys are similar to wetland habitats that commonly occur within the county. No potential rare or exceptional wetland habitat was identified within the study area. A detailed description of each wetland complex is provided in the KME reports appearing in Appendix C-1, C-2, and I including the types of wetlands present in each complex and a list of identified vegetation.

3.7.2 Proposed Activities Affecting Wetlands

Proposed facilities for the Humboldt Mill Project relative to wetland boundaries will be located in areas shown in Figure 3-13; with the refurbishment of mill facilities taking place in the immediate area of the current mill and outlet containment structure being sited on the north side of the HTDF.

During operation and after reclamation, the presence of the cut-off wall will change the HTDF discharge to Wetland EE from the current seepage to groundwater at the north end to a surface water discharge at the same location. Details on this discharge are described in Section 3.5.

3.7.3 Potential Impacts to Wetlands

Refurbishment and construction planned at the mill will be sited in upland areas next to the current buildings and will not directly impact wetlands identified at the site (Figure 3-13).

The HTDF discharge, as summarized above and in detail in Appendix D to Volume IA of the *Mining Permit Application,* will flow into Wetland EE. As documented in Appendix B-3, this discharge will have little effect on water levels in the wetland and therefore will not hydrologically affect the plant community. Furthermore, since the water that will be discharged will comply with water quality standards specified in the NPDES Permit, water quality in the wetland will be protected. Furthermore, the construction of the HTDF cut-off wall will not directly impact wetlands as documented in Appendix I.

The Black River Wetland, which currently receives impacted stormwater runoff from the facility, will be beneficially affected by the proposed project. Constructed stormwater management structures will improve the quality of stormwater the wetland receives from the mill site

3.7.4 Potential Impacts to Floodplains

Based on a Federal Emergency Management Agency (FEMA) map search performed by Foth on June 25, 2007, no floodplain mapping has been completed for this area.

The proposed project has no construction or operational activities that will change or affect the hydrology of the Black River and Middle Branch Escanaba River. Therefore the existing floodplains of these rivers will not be affected by the project.

3.8 Natural and Wild and Scenic Rivers *(R 425.202(2)(n) and R425.202(2)(o))*

The Federal Congress has the authority to identify wild and scenic rivers under the Wild and Scenic Rivers Act (WSRA) (16 USC 1271, et. seq.). Once Congress designates a river, the WSRA mandates that the U.S. Forest Service (USFS) manage the designated river "in such a manner as to protect and enhance the values which caused it to be included in said system without, insofar as is consistent therewith, limiting other uses that do not substantially interfere with public use and enjoyment of these values" {16 USC 1281(a)}.

The WSRA imposes two obligations on the USFS after a river segment is designated. First, USFS must "establish detailed boundaries" for each designated river within one year of the date of designation {16 USC 1274(b)}. Until publication of the detailed boundaries, the WSRA establishes one-quarter mile boundaries measured from the ordinary high water mark on either side of the river. Second, the USFS must prepare a "Comprehensive Management Plan" for each designated river segment that will "provide for the protection of river values" within three fiscal years of the date of designation {16 USC 1274(d)(1)}.

3.8.1 Existing Natural and Wild and Scenic Rivers

A total of sixteen rivers in Michigan have been designated as "natural rivers" under NREPA. However there are no rivers in Marquette County that have been designated as a natural river.

There are a total of eleven rivers located in Michigan's Upper Peninsula (U.P.) that the U.S. Congress has identified as "Wild and Scenic Rivers" under the WSRA, Table 3-1.

The Black River listed above is one of two rivers in Michigan named Black River. The Black River listed under the WSRA begins near Bessemer, Michigan, and drains northward to Lake Superior. That Black River is independent of the Black River near the project site (shown in Figure 2-1). The Black River near the project site is not a WSRA listed river. None of the Wild and Scenic rivers listed above are located near the Humboldt Mill site nor are any within the Escanaba River Watershed. The closest wild and scenic river to the project site is the Yellow Dog River, located in a separate watershed approximately 15 miles to the northwest of the Humboldt Mill site. The portion of the Yellow Dog River Watershed from its origin at the outlet of Bulldog Lake Dam to the boundary of the Ottawa National Forest was placed on the Wild and Scenic River list by Congress on March 3, 1992. The listed portion is approximately 15 miles northwest of the Humboldt Mill site and is not within the project site watershed. Activities at the Humboldt Mill site area will not impact the Yellow Dog River.

3.8.2 Proposed Mining Activities Affecting Natural and Wild and Scenic Rivers

There are no mining activities proposed at the Humboldt Mill site that could affect Natural or Wild and Scenic Rivers.

3.8.3 Potential Impacts to Natural and Wild and Scenic Rivers

None of the eleven U.P. WRSA-listed rivers will be impacted by the proposed activities at the Humboldt Mill site.

3.8.4 Mitigation of Impacts to Natural and Wild and Scenic Rivers

While impacts to Natural and Wild and Scenic Rivers are not expected to occur for reasons stated above, KEMC will be implementing a Spill Prevention and Countermeasure Control Plan (SPCC) and a Pollution Incident Prevention Plan (PIPP) to assure all nearby rivers are protected from potential contamination from mill activities.

3.9 Residential, Schools and Commercial Development *(R 425.202(2)(p))*

3.9.1 Existing Development

Humboldt Mill is located in a rural area in Humboldt Township. Children in the area attend school in the N.I.C.E. (Negaunee-Ishpeming-Champion-Ely) community school district, 15 miles west in the town of Ishpeming. According to Marquette County 2006 Plat Book, three identifiable residential properties are located within 1,320 ft of the facility as noted on Table 3-2 and Figure 2-3.

Additional residences lie in close proximity to the 1,320 foot boundary around the facility as shown on Figure 2-3. Several homes in a neighborhood northwest of the facility straddle the boundary. A tavern/restaurant is located on the north side of Highway 41 northwest of the HTDF. A small group of homes is present northeast of the HTDF between Wetland EE and the Middle Branch Escanaba River. These homes are along the boundary marked on Figure 2-3. The Humboldt Mill site and surrounding properties have been modified by past mining and ore processing operations.

3.9.2 Proposed Activities Affecting Development and Potential Impacts

Activities at the site that would have the potential to affect adjacent development include changes in stormwater runoff and NPDES permitted discharge and associated groundwater quality impacts. Particulate emissions also could potentially affect nearby development.

3.9.3 Potential Impacts to Development

As described in Section 3.1, 3.4 and 3.5, impacts to surface water flow and quality, and groundwater flow and quality are negligible and therefore will not affect future development or existing development in the area. As described in Section 3.18, the facility will comply with National Ambient Air Quality Standards (NAAQS) and therefore will not deleteriously affect neighboring properties. Note that the NAAQS are developed to be protective of the general public surrounding permitted industrial facilities. Particulate matter deposition from the mill has been evaluated and impacts are shown to be minimal as described in section 3.18.

3.10 Public Roads, Pipelines and Power Lines *(R 425.202(2)(q))*

3.10.1 Existing Infrastructure

Past activities have required electric power, natural gas service, and transportation infrastructure (roads and rail) to the project site. One inactive natural gas pipeline crosses the Humboldt Mill

property. The line lies east of the mill and terminates at the gas main pressure relief station shown on Figure 2-4. Electric power is available, brought in by a 34 kV line with a 34 kV to 2.4 kV transformer. This equipment is functional and is planned for use for the proposed project. The electrical substation is directly north of the mill as shown on Figure 2-4.

Electric heaters and/or propane will be used for space heating. Currently the buildings have minimal space heating. The natural gas pipeline east of the mill will not be used for this operation.

Public roads serving the project site are shown on Figure 1-1. CR 601 provides direct access to the Humboldt Mine property. Other roads leading to CR 601 include State Highway 95, and U.S. Highway 41. These roads provide transportation linkage for commercial and residential services. Previously at the project site, railroad tracks were present to facilitate ore transportation. There are currently used tracks on the former rail spur west of the mill (Figure 2-2).

3.10.2 Proposed Mining Activities Affecting Infrastructure

Transportation of ore, employees and supplies to and from the site along with the transportation by rail of concentrate from the facility are the primary activities that could affect infrastructure.

KEMC is planning to re-install the rail spur in the historical location shown on Figures 2-2 and 2-6 to re-establish a rail link to the rail line north of U.S. Highway 41 operated by Canadian National Rail System. This linkage will be used for the transport of concentrate to an off-site processor.

3.10.3 Potential Impacts to Infrastructure and Mitigation

Approximately 40 50-ton truckloads of ore per day will be delivered to the site. Transportation demands from suppliers and up to approximately 50 mill employees commuting to the site will constitute additional usage of the local highway system and will not impact highway transportation infrastructure or needs in the area.

Installation of the rail spur will not impact current conditions significantly as the rail spur will be constructed on an existing rail bed. The concentrate will be transported to Canada by train that will enter the Humboldt Mill facility to pick up loaded rail cars. This modest rail transportation need utilizing existing and re-established rail lines will not affect rail infrastructure or needs in the region. Particulate emissions from the railcars will be controlled through the use of covered railcars.

3.11 State and Federal Wilderness, Research and Recreational Areas *(R 425.202(r) - (w))*

3.11.1 Existing Designated Areas

The area surrounding the project site was reviewed for the presence of wilderness, recreational, natural and research areas, pursuant to MCL 324.35101. The U.P. in general has many state forests, state parks, and recreational areas. From the project site, Van Riper State Park is four miles northwest. Craig Lake State Park is twelve miles northwest and Beaufort Lake State Forest Campground is 15 miles west of the project site. The southern border of the Escanaba

River State Forest lies one mile north and the northern border of the Copper County State Forest lies five miles south of the project site. There is one natural area in Marquette County: Rocking Chair Lakes Natural Area. Comprised of 240 acres, this natural area is located approximately fifteen miles to the north-northeast of project site.

The McCormick Wilderness is a federal wilderness area (as defined in 16 USC 1131) comprised of about 17,000 acres straddling Baraga and Marquette Counties in and around the Ottawa National Forest. The area is fifteen miles to the northwest of the project site.

The location of federal research natural areas as defined in 36 CFR 251.23 was reviewed. One research natural area currently exists in Marquette County, the McCormick Research Natural Area located in the northeast corner of the McCormick Wilderness.

3.11.2 Proposed Mining Activities Affecting Designated Areas

Mining activities that could potentially affect designated areas include noise and light generated from the facility, particulate emission impacts, and impacts to water resources.

3.11.3 Potential Impacts to Designated Areas

All wilderness, research and recreational areas identified are outside the area potentially affected by the project as defined by surface construction limits, groundwater and surface water effects and potential air emissions. Therefore, activities should not impact the designated use of these areas. The areas are far enough away from the site to not be impacted by any noise or light from the facility. Furthermore, as described in Section 3.18, NAAQS will be met at the facility fence line. Based on this, the low particulate emissions from the facility (see Section 3.18), and the distance between designated areas and the project, there will be no particulate impacts on designated areas and resources described above.

3.12 Land Use *(R 425.202(2)(x))*

3.12.1 Existing and Historical Land Used Conditions

The U.P. has a long, rich history of mining and forestry. Copper, iron, gold, silver, gypsum, slate, salt, coal and limestone have been mined in Michigan. The area around the Humboldt Mill is in an area dense with past and current iron and base metal mines. In the UP, relatively poor soils and severe climate restrict significant agricultural activity. In recent years, a recreation industry has developed supported by vehicle trails, parks, campgrounds and ski hills.

The city of Marquette in Marquette County is the largest city in the U.P. With a population of approximately 20,000 (2000 census) and a location on Lake Superior, the city has served the region as a port for timber and mining products for over 150 years. Moving inland twelve miles directly west, the cities of Negaunee and Ishpeming have been the site of significant mining activity (mostly iron) for over a century. Figure 1-1 notes several mines in the immediate area of the mill. The area around the Humboldt Mill is entirely rural, Humboldt Township has a population of approximately 490.

The current zoning of the Humboldt Mill and surrounding area is as shown in Figure 2-3. The mill site and most of the HTDF is zoned for industrial use. The Humboldt Mill was constructed in 1954 to process iron ore extracted from three underground iron mines northwest of the mill.

As time went on, the three mines merged and surfaced into an open pit mine, historically referred to as the Humboldt Pit. Prior to 1954, the area was a wooded wetland divided by isolated upland areas and low bedrock exposures. Historical aerial photographs appear in Figure 3-4.

Iron ore extraction halted at the Humboldt Mine in 1968 and the open pit was allowed to fill with water. The mill continued processing iron ore from another area mine until 1979. In 1984, milling operations resumed in support of the Ropes Gold Mine (Figure 1-1). Tailings from that milling operation were placed in the flooded mine pit at which time, the former mine became a tailings disposal facility referred to as the HTDF. Those operations ceased in 1989. Limited dry milling has taken place intermittently since that time by Minerals Processing Corporation (MPC).

This property is considered a brownfield site by the USEPA as expanded in 2002 under Public Law 107-118; H.R. 2869 to include mine-scarred lands. Mine-scarred lands are defined as lands, associated waters, and surrounding watersheds where extraction, beneficiation, or processing of ores and minerals has occurred (USEPA, 2004).

3.12.2 Potential Impacts to Land Use

For the refurbishment and resumption of milling operations, impacts to land use are minimal since no change in land use is proposed. Minimal impacts to land could occur during development and construction of the site. These potential impacts include air emissions, erosion of developed land during storm events and HTDF impacts to surface water and groundwater. Construction related soil erosion and control measures are addressed in Volume I of the *Mining Permit Application*, and will prevent erosional impacts to adjacent land. Air impacts are identified in Section 3.18 and will comply with NAAQS at the facility fence line. Based on this and the low particulate emissions from the facility, air impacts to adjacent land uses will be minimal.

Impacts on land use from recommissioning the HTDF will be minimal. The wetland receiving discharge will experience a shift in water inflow from groundwater flow to surface water flow during HTDF operation and after reclamation as described in Sections 3.5 and 3.6. The HTDF will protect groundwater sources downgradient of the HTDF and thus will be protective of land uses north of the HTDF. In addition, this change will not measurably affect surface drainage on adjacent lands (see Sections 3.1 and 3.6) and therefore will not affect adjacent land users.

3.12.3 Mitigation of Impacts to Land Use

During the mill operation and reclamation, the property will be maintained to ensure operations are carried out in a safe, environmentally responsible manner. During the development and construction of the site, potential impacts to land use will be properly controlled through environmental controls and monitoring specified in the applicable permit applications. These controls include groundwater and surface water monitoring, fugitive dust control, and soil erosion and sedimentation controls. Frequent inspections and monitoring supporting these programs will ensure controls remain effective and maintain site use beyond the project life. Monitoring programs will be in place during the project and for 20 years after reclamation documenting that the wetland and surface waters receiving discharges from the HTDF are maintained.

3.13 Aquatic Biology *(R 425.202(2)(y) and (R 425.202(2)(z))*

With mining activities at the Humboldt Mine and Mill dating from 1954, aquatic resources in the area have been evaluated on several occasions. Previous aquatic studies compliment recent baseline studies completed by Advanced Ecological Management, LLC (AEM) in providing a comprehensive perspective on the aquatic resources at the site. The following studies document the aquatic resources at the site:

- Humboldt Pit Hydrogeological Report (Traverse Engineering Services, 1984). This report was commissioned by Callahan Mining Corporation to obtain permits for placement of mill tailings in the Humboldt pit. Biological reconnaissance of the pit was included as part of this investigation. This historical report is included in Appendix B-1.

- The Ropes Closure Document (Callahan Mining Corporation, 1995). This document was prepared for submittal to MDEQ to obtain closure of the Humboldt Mill and HTDF. Biological studies of fish, macroinvertebrates, and zoo plankton are documented in this report and are provided in Appendix D-1.

- Humboldt Mill Aquatic Survey Report 2006 (AEM, 2007a). This report was commissioned by KEMC to obtain permits to recommission the Humboldt Mill property. This report addresses the regional aquatic biology. The report appears in Appendix D-2.

- Aquatics Survey of the HTDF (AEM, 2007b). This report addresses the aquatic life present in the HTDF. The report appears in Appendix D-3

- Summary of Fish Contaminant Data (AEM, 2007c). This memo summarizes the fish tissue contaminant levels in fish sampled from the HTDF and Lake Lory in the 2007 aquatic survey (AEM, 2007c). The memo appears in Appendix D-4.

- Humboldt Mill Project – Aquatic Survey of Wetland EE Complex (AEM, 2007d). This survey was performed to describe the aquatic life present in Wetland EE. The report appears in Appendix D-5.

- Humboldt Mill Aquatic Survey Report 2007 (AEM, 2008a). This report provides an additional year of data on aquatic resources surrounding the Humboldt Mill.

- Humboldt Mill Aquatic Survey Report 2008 (AEM, 2008b). This report supplements data previously reported by AEM (2007a, 2007b, 2007d, and 2008a) on aquatic resources surrounding the Humboldt Mill.

- Humboldt Project – Lake Lory and HTDF Summary of 2008 Fish Metals Data (AEM, 2008c). This report supplements fish metals data previously reported by AEM (2007c).

The rivers and lakes in the project area are classified as warm water. As such, they do not support the salmonid species that typically inhabit coldwater systems which are important for recreational fishing in Michigan. Aquatic resources in the area include:

- The Middle Branch Escanaba River: North of the project, this river is a significant river in the U.P., originating in the north central U.P. and emptying into Lake Michigan at Escanaba.

- The Black River: To the southwest of the project, the Black River is a small river originating from Lake Lory and the Iron Ore Tailings Basin West near the project site and flowing approximately fifteen miles to the south and southeast before joining the Middle Branch Escanaba River. This river supports warm water fish.

- Lake Lory: A natural warm water body of approximately 128 acres draining into the Black River and connected hydraulically to Iron Ore Tailings Basin North and Iron Ore Tailings Basin South. The tailings basins are connected to a man made area of flooded timbers that provide nesting habitat for great blue herons and is referred to as the Heron Rookery. There is an earthen berm and culvert at the discharge point (southern boundary) into Lake Lory.

Additionally:

- HTDF: Upon cessation of mining, the former Humboldt Mine Pit was allowed to fill with water. Originally 350 ft deep, tailings from processing ore from the Ropes Gold mine were placed in the pit bringing the pit depth to approximately 200 ft and turning the excavated pit into a tailings disposal facility. The HTDF is surrounded by bedrock and lies within a small basin. The HTDF is physically isolated from the natural surface water movement in the adjacent area.

The aquatic studies characterize the existing aquatic ecosystems in and near the project area and establish baseline conditions. These studies record conditions over a 24 year period (1984 to 2008) and exceed the requirements of R 425.202(2)(y) and (z). The assessments employed several methodologies. In Michigan, the Great Lakes and Environmental Assessment Section (GLEAS) Procedure #51, Qualitative Biological and Habitat Survey Protocols for Wadable Streams and Rivers (Creel et al. 1998; MDEQ, 2002) is commonly used for performing evaluations of stream quality. Procedure 51 methodology includes investigation of fish, macroinvertebrates, and stream habitat and was used as appropriate. Additional quantitative analysis methods, such as multi-pass removal technique (Van Deventer and Platts 1983) were used by AEM to provide a detailed evaluation of fish distribution and abundance.

Figure 3-14 shows the sampling locations documented in Callahan Mining Corporation's Closure Document (Callahan Mining Corporation, 1995), and AEM (2006, 2007 and 2008) surveys (with the exception of the Lake Lory and HTDF details). Figure 3-15 shows the HTDF sampling locations for the AEM (2007) survey and the Traverse Engineering Services (1984) survey. Figure 3-16 shows the AEM (2006) sampling locations of Lake Lory.

3.13.1 Aquatic Biota within the Mining and Affected Area

This section summarizes historical and recent aquatic studies that are provided in Appendix D.

3.13.1.1 1984 Humboldt Pit Hydrogeological Report

Traverse Engineering Services was hired by Callahan Mining Corporation to prepare the Humboldt Pit Hydrogeological Report (contained in Appendix B-1). The investigation centered on the HTDF geology, hydrology, and biological reconnaissance preceding placement of tailings from the Ropes Mine. The Humboldt Mine had ceased operations in 1968 and the pit had been allowed to fill naturally from groundwater inflow (from a small Quaternary aquifer on the south side of the HTDF) and precipitation. The biological survey was performed in September 1984 and had the objective to:

> "*determine the extent to which the water filled pit, since mining operations ceased, has been colonized by aquatic organisms and to determine the physical structure of the littoral and limnetic zones as may bear on future colonization.*"

The excavated mine and adjacent wetland were scrutinized in the context of permitting the water discharge resulting from tailings placement. Aquatics surveys centered on littoral areas (along the shoreline) and limnetic areas (ecosystems in standing water) because in the large water body of the HTDF, those areas would be expected to sustain aquatic biota. In the deeper open water, the food supply will not include shoreline plants and macroinvertebrates, therefore, fish that can swim to the deeper areas will not be attracted there. By the early 1980's the Humboldt Mine pit was full enough to discharge to the wetland to the north now called Wetland EE (Figure 3-11). At the time of the survey, emergent and submerged vascular aquatic plants had become established in the shallow north and south parts of the water-filled pit near the shoreline. Benthos were few in number and low in diversity by comparison to natural waters at this latitude. Fish were noted as sparse. The limnetic zone was noted to be thermally stratified with the thermocline centered at 10 m (33 ft) depth, only 10% of the 350 ft depth at the time. Soft sediment had accumulated to thicknesses greater than 10 cm (4 inches), but organic debris normally found in natural waters was scarce, indicating reduced biological activity in comparison to a natural lake.

The survey included a point in the middle of the water body (point "A" on Figure 3-15) where water quality data were collected. Gill nets and bottom sediments samples were taken at the north shallows near the point of discharge. An algal mat was noted at that location. Five vascular plants were noted as abundant: cattails (*Typha* sp.), water milfoil (*Myriophyllum* sp.), *Valisneria Americana*, *Elodea* sp., and a thin leaved submergent *Potomegeton* sp.

Only two fish were collected: one brook trout (*Salvelinus fontninalis*) of 13.2 cm (5 inches) length and one creek chub (*Semotilus acromaculatus*) of 15 cm (6 inches in length). The report speculates the presence of small minnows were a food source. The authors opine that the environment was fully adequate to support the reproduction and growth of some fish, but that fish had not yet colonized this water body. With no permanent streams entering the pit and because human access is very limited, the fish stock would be severely restricted.

The report concludes that the biological community seen in the Humboldt Mine pit is typical of communities that develop in the earliest stages of colonization of a new aquatic habitat. The state of the environment and organisms present at the time suggested that the community might be expected to continue developing. At that time however, the pit did not contain a population of

organisms considered to have value as a recreational, commercial, aesthetic or germplasm resource.

Fish in the water filled wetland areas between the north end of pit and Highway 41 were collected by electroshocking: one brook stickleback (*culaen inconstans*), one fine scale dace (*chrosomus neogaeus*), and one central mud minnow (*umbra limi*) were documented, all typical of small bogwater systems.

Callahan Mining Corporation placed mine tailings into the HTDF from processing ore from the Ropes Mine between 1985 and 1989 from the original 350 ft depth to the current approximately 200 ft depth. This greatly impacted the ability of aquatic resources to develop naturally in the pit

3.13.1.2 Ropes Closure Document Aquatics Survey

The Ropes Closure Document was prepared by Callahan Mining Corporation in November, 1995 to evaluate the condition of the HTDF and obtain closure on the NPDES discharge permit (Permit No. MI0044393). The Ropes Closure Document contains two reports (Appendix D-1) that were prepared in 1991 and 1995 and are commented on below.

In 1990, the MDNR performed an aquatics survey (MI/DNR/SWQ-91/049) entitled *A Biological Survey of the Middle Branch, Escanaba River and a Cattail Marsh in the Vicinity of the Callahan Mining Corporation – Humboldt Pit, NPDES #MI 0044393, Marquette County, Michigan, June 25-26, 1990 and July 31, 1990*. This document appears within the Ropes Closure Document, and is provided in Appendix D-1. Aquatics sampling was performed at stations noted as MDNR 1, 2, 4, and 6 on Figure 3-14. Data were collected for fish and/or macroinvertebrates. Stations 1 and 2 on the Middle Branch Escanaba River, upstream and downstream of the HTDF discharge, were assessed as shown in Table 3-3.

Data were also collected at Station 4, however, as a non-stream water body a metric evaluation could not be performed. The report notes that Station 4, located at a culvert by Highway 41 is a freshwater cattail marsh and fish could not be categorized due to lack of suitable ecological reference site in GLEAS Procedure 51. Thirty-six fish were collected at that location, 32 of which were brook stickleback (*Culaea inconstans*).

At Station 6, located at the HTDF outfall and at a nearby wellpad located in the marsh within 100 yards to the northwest of Station 6, a qualitative macroinvertebrate survey was performed in July, 1990. That survey showed Station 6 had sparse macroinvertebrate species and quantities, whereas the wellpad showed abundant numbers of the five taxa sampled.

In 1995, under the direction of Coeur d'Alene Mines (the purchaser of Callahan Mining Corporation holdings at the Humboldt Mill Site), EA Engineering, Science and Technology (EA, 1995) reported on an aquatics survey for zooplankton, fish and macroinvertebrates near the HTDF including Wetland EE (which is termed the "Humboldt Marsh") and reference marshes (Appendix D-1). The general location of the survey stations in Wetland EE are shown in Figure 3-14.

The 1995 EA report showed the wetland stations were comparable in diversity and population of macroinvertebrates to the reference marshes. A comparison of macroinvertebrate taxa richness

among 1993, 1994, and 1995 showed relative consistency from year to year with the 1994 data generally showing more taxa than the other years. During that time frame, the two Middle Branch Escanaba River stations were surveyed for macroinvertebrates. Metric evaluation results are presented in Table 3-4.

The 1995 EA Report documented fish surveys at stations in Wetland EE and the reference marshes. Central mud minnow (*Umbra limi*) dominated at all stations with finescale dace (*Phoxinus heogaeus*) and northern redbelly dace (*Poxinus eos*) present in most stations in lesser amounts. There were similarities between the Wetland EE stations and the reference stations, however all Wetland EE stations showed fewer total species than the reference stations.

The 1995 EA Report in Appendix D-1 also documents a comparative fish population survey done from 1993 to 1995 at the Wetland EE stations, the reference stations, and Middle Branch Escanaba River stations. The number of fish species collected in 1993, 1994, and 1995 in the wetland and two reference stations were fairly consistent over the years surveyed and between stations.

3.13.1.3 2006 and 2007 Evaluation of Aquatic Biota within the Mining and Affected Area

The mining and affected area was recently surveyed for aquatic biota in three complimentary surveys performed by AEM:

- *Humboldt Mill Aquatic Survey Report 2006* (Appendix D-2) – Addresses the mill facility area and south including Lake Lory and the Black River, and the Middle Branch Escanaba River.

- *Aquatic Survey of the Humboldt Tailings Disposal Facility* (Appendix D-3) – Addresses the HTDF.

- *Aquatic Survey of Wetland EE Complex* (Appendix D-5) – Addresses Wetland EE and the wetland complex that flows to the Middle Branch Escanaba River.

Additionally, fish tissue sampling was done on samples collected from the HTDF and Lake Lory. That summary appears in *Summary of Fish Contaminant Data Sampled from Lake Lory and the HTDF* (Appendix D-4).

The survey locations are shown in Figures 3-14, 3-15, and 3-16. Results of the stream evaluations are summarized in Table 3-5.

The West Branch of the Black River (Station 1) was scored as poor in both fish and macroinvertebrates probably due to low dissolved oxygen in the water. Low dissolved oxygen degrades the ability of the aquatic habitat to support a diversity and abundance of aquatic biota. Conductivity at this station was the highest of all stations indicating a higher degree of dissolved metals. The source of those metals is most likely the Iron Ore Tailings Basin West (Figure 3-14). Stations 2 and 3, located on the Lake Lory discharge and the Middle Branch Escanaba River, were scored poor in fish and acceptable in macroinvertebrate communities. Although the stream habitat is rated as excellent, these waters are impaired in water quality characteristics to a degree that impacts the fish and macroinvertebrate communities.

Lake Lory is currently populated (in order of samples collected) by blue gill (*Lepomis macrochirus*), yellow perch (*Perca flavescens*), black crappie (*Pomoxis nigromaculatus*), pumpkin seed (*Lepomis gibbosus*), largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieu*), and white sucker (*Catostomus commersoni*). A total of 194 fish were collected from Lake Lory. Many fish were in good condition, however, black spot, a parasite that burrows into the skin of the fish was frequently observed in the bluegills, black crappie, largemouth bass, smallmouth bass, and yellow perch.

Aquatic vegetation observed along the shoreline of Lake Lory included both floating, submerged, and emergent vegetation. Burreed (*Sparganium,* sp.), floating pondweed (*Potamogeton natans*), bigleaf pondweed (*Ptamogeton amplifolius*), rushes (*Juncus,* sp.), and water starwort (*Callitriche* sp.) were predominant species. Large woody debris from downed trees and submerged standing timber contributes to the aquatic habitat of the lake. Water quality parameters indicate a low conductivity, dissolved oxygen on the surface of 8.1 mg O_2/L and a neutral pH.

The Heron Rookery Pond contains abundant aquatic vegetation and woody debris. Common elodea (*Elodea canadensis*) was predominant, with common cattails (*Typha latifolia*) abundant on the southwest shoreline. Spadderdock and arrowhead (*Saggitaria* sp.) were also observed. Thirty-nine fish were collected from the pond, mostly minnows, including emerald shiners (*Notropis atherinoides*), northern redbelly dace, and bluntnose minnows (*Pimephales notatus*). The minnows likely serve as an important food source for the blue herons that were observed nesting in the area. Water quality parameters were similar to Lake Lory.

The Middle Branch Escanaba River and the Wetland EE stream/culvert (Stations 3 and 4 respectively) are rated similarly in Table 3-5 and indicate poor fish community. The Wetland EE complex survey (Appendix D-5) report notes only three fish were collected in the steam/culvert Station 4 in October, after rather dry conditions during the summer followed by recent rains before the sampling took place. The 2006 survey of the much larger Middle Branch Escanaba River yielded only 35 fish. For Procedure 51 evaluations, sampling yielding less than 50 fish will result in "poor" quality rating for the fish community at that site.

Macroinvertebrate and stream habitat at Stations 3 and 4 showed similarity with other stations. Macroinvertebrates were rated acceptable for both stations and stream habitat, excellent and good respectively. For all stations surveyed (1-4), the stream habitats are rated good or excellent, while the biota (macroinvertebrates and fish) are poor or acceptable.

During June 2007, the fish community of the HTDF was evaluated. Based on the document provided in Appendix D-3, the evaluation concluded that the HTDF does not provide suitable conditions for the development of an abundant and diverse aquatic macroinvertebrate and fish community.

During the June 2007 survey, fish were also collected from the HTDF and Lake Lory and sent to a laboratory for chemical analysis. A summary appears in Appendix D-4. In each water body, a specie was selected on the basis of availability and size. Ten bluegills (*Lepomis macrochirus*) were collected from Lake Lory; ten white suckers (*Catostomus commersonii*) were collected from the HTDF. The whole fish were tested for metals: aluminum, antimony, arsenic, barium,

beryllium, boron, cadmium, chromium, cobalt, copper, iron, manganese, mercury, molybdenum, nickel, selenium, silver, strontium, and zinc. Fish from Lake Lory, a natural water body, and the fish from the man-made HTDF, with no surface water inflow, compared similarly but not the same. Parameter averages measuring over 100% higher in one water body vs. the other were predominantly from fish sampled from the HTDF: antimony, arsenic, cobalt, copper, and nickel. Average mercury concentration in Lake Lory fish, however, were over five times higher than HTDF fish, (0.079 mg/kg wet in Lake Lory fish vs. 0.012 mg/kg wet in HTDF fish), an indicator that mercury scavenging is taking place in the HTDF. In both water bodies, the mercury concentration in the fish sampled were below Michigan fish advisory levels, the lowest of which is 0.5 mg/kg.

3.13.1.3.1 Supplemental Aquatic Studies

Supplemental aquatic resource studies that duplicated those described above in Section 3.13.1.3 were completed by AEM (2008a, 2008b, and 2008c). These reports corroborate the findings described in Section 3.13.1.3 and are provided in Appendix I.

3.13.1.4 Discussion of Historical and Current Aquatics Surveys

Aquatic habitat quality is a function of surficial geology of the surrounding watershed, water quality, land use patterns, climatic conditions and other factors such as natural and manmade habitat alterations within these aquatic systems. The surveys presented provide much information on the project area overall and the ability of the water bodies and streams to support aquatic life. Stations in the Middle Branch Escanaba River consistently showed the river had and has a poor to fair fish community and a fair to good macroinvertebrate community in all surveys. The West Branch of the Black River and Lake Lory both have poor fish communities, with the macroinvertebrate communities being poor and acceptable respectively. Wetland EE complex and Middle Branch Escanaba River are not particularly high in aquatic biota quality, but have in the past supported a fair amount of aquatic habitat.

The Humboldt Mine pit which ultimately turned into a tailings disposal facility, has never been similar to a natural lake as shown in historical surveys. The Traverse Engineering Services (1984) survey was performed on the filled pit prior to placement of tailings from the Ropes Mine in 1984. At that point, there were not many sediment sources impacting water quality, beyond the natural minerals from the excavated mine, however, with no steams flowing into the water-filled pit, there were very few pathways for fish to enter the pit. Fish and the benthos and macroinvertebrates that support them were sparse more than ten years after the pit filled.

The Ropes Mine tailings displaced approximately 45% of the pit depth with material containing high metals concentrations. As documented in a detailed analysis of the HTDF water chemistry in Appendix D of Volume IA of the *Mining Permit Application*, the HTDF shows little evidence of primary production and is not a biologically active system.

3.13.2 Proposed Mining Activities Affecting Aquatic Biota

The mining activities proposed that may affect the aquatic biota are milling operations and tailings disposal in the HTDF. The milling operations will be drawing water from the HTDF and returning some water to the HTDF with the tailings slurry. Treated water from the HTDF, will be discharged to Wetland EE as the tailings are loaded and water is displaced. The mill water

supply and demand on the HTDF will be relatively constant. The proposed HTDF surface water discharge will be of a larger quantity than the current HTDF seepage, but unlike the current situation, the discharge will be controlled.

Proposed mining activities (milling and placement of tailings) will not discharge treated water to the other water bodies near the site, namely the Black River and Lake Lory. Impacts to those water bodies are, therefore, not anticipated. Stormwater discharge to the wetlands surrounding the West Branch of the Black River will also occur, however, not in quantities different from current conditions. With the planned stormwater management improvement structures, an improvement in water quality should occur.

3.13.3 Potential Impacts to Aquatic Biota

The fish in the HTDF do not form a self sustaining population due to limited habitat and lack of primary production. The fish that are present likely represent transient populations introduced by water fowl and/or humans. This limited non-self-sustaining population could be directly impacted by water quality changes in the HTDF through the placement of tailings.

The only aquatic communities that could be impacted by the HTDF are Wetland EE and the Middle Branch Escanaba River. These systems will receive the discharge of treated water during operations. Since the discharge to Wetland EE will be regulated by an NPDES permit designed to protect water quality and aquatic habitat, it is concluded that there will be no impact to these aquatic systems by the discharge. Natural surface drainage from the HTDF to Wetland EE will be established after operations terminate and the water in the epilimnion of the HTDF re-equilibrates to acceptable water quality levels (see Section 3.5). Thus the re-equilibrated HTDF with surface drainage of shallow HTDF waters to Wetland EE and the Middle Branch Escanaba River will also provide protection of these aquatic communities after operations are complete.

The West Branch of the Black River and surrounding Wetland EE constitute the only other aquatic system that could reasonably and theoretically be affected by the project. The mechanism for impact would be through stormwater discharge from the mill to this system. The clean up activities at the mill prior to construction will remove sources of mining residuals that are currently impacting stormwater quality that runs off into this system. Enhanced stormwater management at the site documented in Volume I of the *Mining Permit Application* will further improve stormwater and sediment management at the mill. Collectively, these activities will improve the water quality of stormwater runoff to the West Branch of the Black River resulting in a positive impact. SPCC Plans and the projects PIPP will also aid in protecting against negative stormwater impacts to the West Branch of the Black River.

The reclamation plan for the mill will result in a more environmentally stable and sustainable site that reflects an improvement over current conditions.

3.14 Terrestrial Biota - Flora, Fauna, Habitat and Ecosystems Evaluation (*R 425.202(2)(y), R 425.202(2)(z) and R 425.202(2)(dd)*)

KME completed a detailed assessment of wildlife species and habitat in surveys completed in 2006, 2007 and 2008. The first step in the assessment was the review of available wildlife and habitat data from the following sources:

- Michigan Natural Features Inventory (MNFI), (Michigan State University Extension, 2006).
- Land Use/Land Cover classifications (MDNR, 1999).
- MDEQ Wetland Identification Manual: A Technical Manual for Identifying Wetlands in Michigan (MDEQ, 2001).
- Aerial photography available from the MDNR (MDNR, 2001a).
- MIRIS Current Use Inventory (MDNR, 1990).
- The Atlas of Breeding Birds of Michigan (Brewer, et al., 1991).
- Mammals of the Great Lakes Region (Kurta, 1995).
- Guidelines for Conducting Endangered and Threatened Species Surveys (MDNR, 2001b).
- Michigan Frog and Toad Survey Instructions (MDNR, 2002).

The KME reports on biological, habitat, and ecosystem assessments are provided in Appendix C and Appendix I. As part of the habitat mapping of the area around the project site, a plant inventory including a complete list of vascular species observed was prepared. The KME study meets the requirements of R 425.202(2)(y) in that literature sources based on prior studies were used as part of the assessment which includes one year of site specific data collection.

The study area encompassed approximately 3,169 acres around the project site. The KME biological survey addresses plant community (flora), habitat evaluation, wildlife (fauna), wetlands (Section 3.7), threatened and endangered species (Section 3.15) and invasive species (Section 3.16). Ecosystems are comprised of the flora, habitat, and wildlife in a community that functions as a unit and are addressed in this section.

3.14.1 Terrestrial Biota Within the Mining and Affected Area

3.14.1.1 Plant Community (Flora) and Habitat Evaluation

The 3,169 acre study area contains natural plant communities and anthropogenic land use categories. Figure 3-17 is a map of the plant communities and habitat types in the study area. Table 3-6 summarizes the plant communities and habitat types and associated acreages in the study area.

Figure 3-17 shows the effect of the last 50 years of mining in the project area. The grey shaded area (extractive) encompasses the project area, and iron ore tailings basins. Natural communities and habitat types continue to dominate the study area, although the impact of mining is apparent. A list of overall plant species observed and an overall list of plant species organized by plant community appears in Appendix C-1. The composition of the various plant communities and habitat types are also provided in Appendix C-1.

Mesic Northern Forest: This habitat is a combination coniferous forest which covers 1,023 acres and Broadleaf Deciduous Forest which covers 854 acres in the study area. The broadleaf deciduous forest consists of northern hardwoods including sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*), red oak (*Quercus rubra*), and eastern hemlock (*Tsuga canadensis*) as well as hemlock and low levels of white pine. The broadleaf deciduous forest dominates the northern half of the study area and part of the southwest corner of the study area. The coniferous forest (white pine {*Pinus strobus}* and white spruce {*Picea glauca}*) dominates the southwest half of the study area and is distributed throughout other portions of the study area.

Hardwood-Conifer Swamp/Northern Swamp: Covering 108 acres, this habitat appears in the southwest corner of the study area and appears to a lesser extent throughout the study area in small areas.

Northern Scrub-Shrub Thicket: This community totaling 167 acres in the study area is relatively common and is a fairly persistent scrub-shrub-dominated wetland comprised mostly of speckled alder (*Alnus incana* ssp. *rugosa*) with other shrubs such as withe-rod (*Viburnum nudum*), highbush-cranberry (*V. trilobum*), and sweet gale (*Myrica gale*).

Emergent Marsh: This community comprising 294 acres in the study area is common around drainage areas and is present throughout the study area but particularly in the southwestern quarter around the Black River. Emergent marsh is comprised of shallow water marsh characterized by emergent narrow-and broad-leaved herbs and grass-like plants as well as floating-leaved herbs at the shores of lakes and streams. Characteristic emergent plant genera are water-plantain (*Alisma*), sedge (*Carex*), spikerush (*Eleocharis*), rice cut-grass (*Leersia*), duckweed (*Lemna*), water-lily (*Nyphaea*), smartweed (*Polygonum*), pickerel-weed (*Pontederia*), arrowhead (*Sagittaria*), bulrush (*Scirpus*), bur-reed (*Sparganium*), and cattail (*Typha*).

Muskeg/Poor Conifer Swamp: This community comprising 112 acres in the study area is located in small areas south of the mill. This Muskeg community receives its water from precipitation and is characterized by clumped and scattered trees set in a matrix of Sphagnum moss. Heath, shrubs, and stunted conifers are common. Dominant species are black spruce (*Picea mariana*), leatherleaf (*Chamaedaphne calyculata*), and Labrador-tea (*Ledum groenlandicum*). The poor conifer swamp also receives its water mostly from precipitation, however, limited groundwater contributions can occur as well. Black spruce usually dominates solitarily or with tamarack and balsam fir. Jack pine (*Pinus banksiana*) can dominate, presumably after other conifers were eliminated by fire. The ground layer is usually dominated by sphagnum moss (*Sphagnum* sp.) and three-seed sedge (*Carex trisperma*).

Open Water/Submergent Marsh: The three significant water bodies comprising 265 acres in the study area are classified as open water/submergent marsh: Lake Lory, the Heron Rookery Pond, and the HTDF. The KME report notes (Appendix C-1) that the ability of the HTDF to support submergent marsh is limited due to the great depth and steep rocky sides. The submergent marsh community is described as a submerged marsh of deep to sometimes shallow water in lakes and streams characterized by plant genera such as coontail (*Ceratophyllum*), waterweed (*Elodea*), water-milfoil (*Myriophyllum*), pondweed (*Potamogeton*), naiad (*Najas*), wild-celery (*Vallisneria*), and stonewort (*Chara*).

Cliff: Primarily vertical exposures of bedrock which support few vascular plants, this community is comprised of lichens, mosses, and liverworts covering rock surfaces.

Herbaceous Open Land: This plant community comprising 68 acres in the study area is not significant in the study area. It occurs in roadway and utility easements, and near residential areas. Herbaceous open lands are prairies, grassland, rangeland and are comprised of grasses and forbs. Such areas are mowed, grazed or burned to maintain the herbaceous character. Typical plant species are quackgrass (*Agropyron repens*), Kentucky bluegrass (*Poa pratensis*), upland and lowland sedges (*Carex* sp.), reed canary grass (*Phalaris arundinacea*) and clovers (*Trifolium* sp.)

Shrubland: This plant community comprising 27 acres in the study area is found in few locations. Common components are young stands of paper birch (*Betula papyrifera*), quaking aspen (*Populus tremuloides*), and big tooth aspen (*Populus grandidentata*). The surveyed shrubland contains only the upland shrubland and not the wetland shrubland that the MNFI describes under this category.

Other: The remainder of the land in the study area is comprised of single family/duplexes (20 acres), extractive areas (187 acres), streams and waterways (2 acres) and roadways (42 acres).

3.14.1.2 Wildlife (Fauna) Within the Potentially Affected Area

The wildlife investigation for this study area included a survey for birds, mammals, frogs, and toads as documented in Appendix C-1 and Appendix I. Figure 3-18 shows the sampling locations. The area around the mill has a high density of sampling points since that location will be the area of primary activities throughout the project.

Birds were surveyed with a protocol based on sight and audio observations. The June sampling observes breeding season activities; the September sampling observes migration activity. An assessment was conducted of the great blue heron (*Ardea herodias*) nesting colony and the bald eagle nest, both located adjacent to Lake Lory (Figure 3-18). A complete listing of the identified birds appears in the KME reports in Appendix C-1 and Appendix I. Some of the more common species survey included the American robin (*Turdus migratorius*), blue jay (*Cyanocitta cristata*), and crow (*Corvus brachyrhynchos*). During September 2006, the pine siskin (*Carduelis pinus*), rock pigeon (*Columba livia*) and black capped chickadee (*Poecile articapillus*) were observed.

The great blue heron colony (*Ardea herodias*) at the heron rookery was active during the 2006, 2007, and 2008 surveys. The heron colony appears healthy and the cormorant presence is consistent with the recent expansion of Michigan's population of double-crested cormorants (*Phalacrocorax auritas*), which compete with other colonial water birds for nesting locations. Historically this man-made area has been consistently flooded, providing attractive nesting conditions for these birds.

The summer surveys observed more bird species than the late summer/early fall surveys, not surprisingly due to many summer residents having migrated south. The study area is not located within a known migration pathway, and consistent with that, few observations of waterfowl were made during the late summer/early fall surveys. Details on the threatened and endangered bald eagle appear in Section 3.15.

Small mammals were sampled at the same eleven survey locations as the bird sampling (Figure 3-18). Small mammals representing eight species were identified including deer mouse (*Peromyscus maniculatus*), white-footed mouse (*Peromyscus leucopus*), eastern chipmunk (*Tamias striatus*), least chipmunk (*Tamias minimus*), pygmy shrew (*Sorex hoyi*), red squirrel (*Tamiasciurus hudsonicus*), red backed vole (*Clethrionomys gapperi*) and meadow vole (*Microtus pennsylvanicus*). These observations are typical of those expected in the habitats present in the study area.

Large mammal presence was noted during the small mammal sampling event and during the course of all other site visits. Documentation of scat, tracks, feeding areas or similar evidence was made. Six large mammal species were directly observed: white tail deer (*Odocoileus virginianus*), coyote (*Canis latrans*), red fox (*Vulpes vulpes*), mink (*Mustela vision*), raccoon (*Procyon lotro*), and beaver (*Castor canadensis*). Indirect evidence was observed for cotton tail rabbit (*Sylvilagus floridanus*), gray wolf (*Canus lupus*), muskrat (*Ondatra zibethicus*), skunk (*Mephitis mephitis*), and porcupine (*Erethizon dorsatum*). These mammals are representative of the region. Details on the gray wolf appear in Section 3.15.

Frogs and toads were surveyed according to MDNR Wildlife Division protocol in the spring when mating activity for amphibian species is high. The sampling locations were located near the mill site (Figure 3-18) in semi-permanently flooded areas. A total of six frog species were observed including northern spring peepers (*Pseudacris crucifer*), eastern gray tree frog (*Hyla versicolor*), green frog (*Rana clamitans*), mink frog (*Rana septentrionalis*), western chorus frog (*Pseudacris triseriata*) and northern leopard frog (*Rana pipiens*). One toad specie of toad was observed, the eastern American toad (*Bufo americanus*).

The frog and toad species identified are typical of those expected in the habitats present in the study area. The steep rocky shore does not support submergent and emergent vegetation, an important component of amphibian habitat.

3.14.2 Proposed Mining Activities Affecting Terrestrial Biota

Mining activities possibly affecting terrestrial biota in the project area are refurbishing and operation of the mill, recommissioning and operating the HTDF, and particulate emissions

3.14.3 Potential Impacts to Terrestrial Biota

Aside from potential impacts to wetland vegetative communities (discussed in Section 3.7), mining activities are not expected to impact terrestrial biota during the project. Refurbishing the mill will take place exclusively in the disturbed extractive area shown on Figure 3-17, which has little if any biota present. Recommissioning the HTDF similarly will not have an expected impact on terrestrial biota. Particulate emissions from the mill will comply with NAAQS (Section 3.18) and impacts are considered negligible.

3.15 Threatened and Endangered and Special Concern Species *(R 425.202(2)(aa) and (R 425.202(2)(bb))*

3.15.1 Existing Threatened and Endangered and Special Concern Species

The KME biological surveys appearing in Appendix C-1 and Appendix I included surveys on threatened, endangered, and special concern wildlife and plant species. Before KME surveyed the site, an MNFI review of the study area was done to identify any known occurrences of protected species in or adjacent to the study area. The review resulted in no identified listed plant species. Wildlife species identified in the MNFI database query are discussed below.

The site surveys for plant species were performed during seasons appropriate to observe possible protected species. The site was surveyed for rare plant species during three periods in 2006, June 9-11, August 14-15, and September 27-28, focusing on a detailed study area encompassing the mill site (Figure 3-17). A series of meander surveys was performed within all representative habitats with particular attention to rock ledges that sometimes host rare plants. All the habitats on the site are typical to the area with no unusual plant communities identified. Historical mining and logging activities in the area limit the likelihood of rare plant species being present on the site. Subsequent reviews of the MNFI in 2007 and 2008, as documented in the KME reports, in Appendix I, identified no additional threatened or endangered plant species as being listed for the area.

The MNFI database query conducted in May, 2006 resulted in identification of the bald eagle nest near Lake Lory. No other threatened, endangered, or special concern wildlife species including birds, mammals, and frogs and toads were identified in the query. Three state threatened bird species were observed during the site bird surveys: the bald eagle (*Haliaeetus leucocephalus*), the common loon (*Gavia immer*), and the merlin (*Falco columbarius*). The eagle sightings were located in or near the nesting area on the north side of Lake Lory. The common loons were observed and also heard calling on Lake Lory. The merlin was sighted flying in the vicinity of the mill buildings during the June 2006 survey.

Possible evidence of a gray wolf was observed and consisted of large canine tracks and related scat. This appeared to be an animal traveling through the area. The MDNR indicated the project area is not within a known wolf pack territory and there are no known wolf denning areas nearby. The gray wolf was removed from protection in the western Great Lakes region under the Federal Endangered Species Act in March, 2007.

Special concern plant and animal species were identified by comparing observed species to those species listed for the Ottawa National Forest, the closest forest to the project site. US Forest Service Species of Concern Plant and Animal lists were also reviewed (USFS, 2006a and 2006b). The black-backed woodpecker (*Picoides arcticus*) was observed south of the Humboldt Mill site near the confluence of the east and west branch of the Black River or sample point 5 (Figure 3-18). This woodpecker is considered a Regional Forester Sensitive Species. None of the observed species were included on the Ottawa National Forest list.

3.15.2 Proposed Mining Activities Affecting Threatened and Endangered and Special Concern Species

Mining activities possibly affecting threatened, endangered, or special concern species in the project area are refurbishing and operating the mill, and recommissioning and operating the HTDF.

3.15.3 Potential Impacts to Threatened and Endangered and Special Concern Species

Mining activities are not expected to impact threatened, endangered, or special concern species during the project. Refurbishing and operations of the mill will take place exclusively in the disturbed extractive area shown on Figure 3-17, which has no identified threatened, endangered, or special concern species present. Recommissioning the HTDF similarly will have no expected impact on the noted species. The HTDF is void of threatened, endangered, and special concern species. The bald eagle nest is located more than 1-mile east of the mill and is screened by vegetation.

3.16 Invasive Species *(R 425.202(2)(cc))*

3.16.1 Existing Invasive Species Conditions within the Mining and Affected Area

Database queries and field surveys of the proposed Humboldt Mill site were conducted to determine whether any state or federal invasive plant or animal species are present on the site and to determine whether invasive species pose a threat to current habitat. Invasive plant species were identified in the KME 2006 survey (Appendix C-1) within the project area. Three species, spotted knapweed (*Centaurea aculosa*), reed canary grass (*Phalaris arundinacea*), and purple loosestrife (*Lythrum salicaria*) are present in the area, however, not at problematic levels. The three species observed are listed on the Marquette County Conservation District website along with seven other species identified as U.P. invasive plant species that were not present on the site.

3.16.2 Proposed Mining Activities and Potential Impacts Affecting Invasive Species

The mining activities proposed in refurbishing and operations of the mill and recommissioning the HTDF do not involve excessive landscaping activities. During construction and reclamation, vegetation is nurtured as part of sedimentation and control measures. Potential impacts of invasive species center on current species expanding to problematic levels or the introduction of new invasive species that expand to problematic levels.

As proposed in Volume I of the *Mining Permit Application*, establishing vegetation as soil erosion control measures will employ seed mixtures specified in the Michigan Department of Transportation 2003 Standard Specifications for Construction (MDOT, 2003). These seed mixtures include temporary species such as oats or perennial rye grass that germinate quickly acting as a nurse crop until the slower germinating perennial species become established. This will prevent the encroachment of invasive species related to mill construction activities. Similar to the expectations for any landowner in the state, the site will be monitored for encroaching and problematic invasive species and acted upon appropriately.

3.17 Cultural, Historical and Archaeological Resources *(R425.202(2)(ee))*

A Phase I survey was performed at the Humboldt Mill site to determine whether any cultural, historical or archaeological resources are present at the site. Christopher Bergman, Ph.D., RPA, an employee of the URS Corporation Inc. (URS) performed the cultural resource Principal Investigator duties, which included supervising the field investigation, background research, and report preparation. The URS report (URS, 2007) details the Phase I Cultural Resource Survey and is attached to this EIA as Appendix E. Fieldwork was conducted in September 2006 under optimal weather conditions.

The Humboldt Mill Area of Potential Effect (APE) has two parts. The first part is the "zone of direct effect," which includes ground disturbance by construction activities related to the mill and is generally confined within the facility boundaries. The second part is the "zone of indirect effect," and since the facility is closely surrounded by hills and dense forest, the view shed or indirect effects are non-existent. The remainder of this summary will refer only to the APE's zone of direct effect which is confined to the immediate vicinity of the mill.

Methods included a systematic field sampling of the facility, a background research and record investigation, and laboratory analysis (see Appendix E). The facility area was greatly disturbed by previous mill-related activities. The cultural resource field sampling was limited to those areas likely to contain intact soils around the mill (Figure 3-19).

3.17.1 Existing Resources

On any site, the presence of existing cultural resources are identified through a Phase I Cultural Resource Survey. This includes reviewing references and literature resources as well as performing a field survey. Once a possible resource is identified, an evaluation of its significance is made, i.e. determining eligibility for listing on the National Register of Historic Places (NRHP). A proposed project's impact can then be determined and appropriately mitigated, if necessary.

For the Humboldt Mill Phase I Survey, Ms. Barbara Mead of the Michigan State Historic Preservation Office (MISHPO) was contacted by Dr. Bergman to research previously reported cultural sites and resource surveys within the project boundaries. No previously recorded sites or structures were identified in the state site files for the APE.

The APE field survey encompassed the mill buildings and the area of previous mining activities (Figure 3-19). Most of this area has been disturbed at the ground surface from previous mining activities and is highly unlikely to contain cultural resources. The field survey focused primarily on prior development and areas that were likely to contain intact soils using a sampling strategy approved by the MISHPO. The field survey was concentrated in areas around the perimeter of the existing mill buildings as shown in Figure 3-19.

The field survey identified two possible cultural resources. A possible isolated prehistoric quartz flake (Site 20Mq248) and an area containing a suspected historic structure (20Mq249) were identified. The locations of those resources are shown on Figure 3-19. These resources were not eligible for inclusion in the NRHP.

The results of the survey indicate that a low level of prehistoric and historic activity took place within the APE. The historic period artifact (Site 20Mq249) is the remnant of a small structure, possibly a berm and door was, perhaps, related to recreational activity or logging. The single isolated prehistoric flake shows evidence of low level occupation prehistorically and probably the significant modern disturbance of the parcel.

3.17.2 Proposed Mining Activities and Potential Impacts Affecting Cultural Resources

The proposed project activities are planned for areas that have experienced a great amount of disturbance from past mining activities. These areas are not likely to contain historic or

prehistoric artifacts that might be found in native, undisturbed soils. The two cultural resources evaluated, the possible prehistoric quartz flake and the suspected historic structure remnant, were found in the area south of the mill that will not be part of proposed mining activities. Therefore, there are no cultural resources affected by proposed mining activities for this project.

3.17.3 Mitigation of Impacts to Significant Resources

Planned mitigation to identified cultural resources is not necessary because potentially NRHP eligible resources were not identified. The URS report has included an Accidental Findings Plan as Appendix D in their report, which is attached to this EIA as Appendix E. The Accidental Findings Plan mentions possible courses of action that will comply with Section 106 of the National Historic Preservation Act, and 36 CFR Part 800 in the event artifacts are discovered during the construction process.

3.18 Air Quality and Climatology *(R 425.202(2)(ff) and (R 425.202(2)(gg))*

3.18.1 Existing Air and Climate Conditions in the Study Area

Documentation on existing air quality data suitable for air dispersion modeling and assessing air quality impacts in a manner that meets MDEQ requirements for air permitting was also used for this EIA and is presented in Appendix F-1. Appendix F-1 also provides documentation of meteorological data provided by the National Climatic Data Center for Van Riper State Park located near the Humboldt Mill (see Figure 1-1). Meteorological data available from this station dates back to 1949 and provides a critical data set on the variation in seasonal and annual precipitation conditions at the mill site. This data record is uniquely suited for assessing the hydrologic water balance for the HTDF and was utilized for that purpose as documented in Appendix D of Volume IA of the *Mining Permit Application*. This data record also satisfies the requirements of R 425.202(3).

Air quality in the area reflects the lack of urban areas in the U.P. Marquette County is in an attainment area for the criteria pollutants ozone, PM-2.5, coarse PM, carbon monoxide, lead, nitrous oxides, and sulfur dioxide. There are five air pollution sources in Marquette County operating under a renewable operating permit (ROP). In addition to the air quality data suitable for state sanctioned impact analysis documented in Appendix F-1 it is also worth considering other air quality uses associated with Marquette County. Facilities with ROPs are major sources as defined by R 336.1211 of Michigan Air Pollution Control Rules. Major sources have potential to emit 100 tpy or more of any regulated contaminant and/or 10 tpy of one hazardous air pollutant (HAP) and/or 25 tpy total HAPs. A query of the Michigan Air Emissions Reporting System (MAERS) for the years 1998 – 2005, showed reported emissions for each of the major sources in Marquette County as shown in Table 3-7.

3.18.2 Proposed Mining Activities Affecting Air Quality

Proposed mining activities at the site will potentially affect air quality in the general vicinity of the site during three phases of activity: construction, operations, and reclamation.

During construction, certain activities could affect ambient air quality, mostly from fugitive dust generated from ground disturbance and vehicle traffic. Once facilities are complete, operational emissions are expected as outlined in the *Humboldt Mill Project Michigan Air Use Permit, Permit to Install Application* (Foth, 2008). The majority of emissions are PM from vehicle

travel, material handling of the ore, and concentrate load out (see Table 3-7 for a complete listing of criteria pollutants expected from the Humboldt Mill facility). Once operations are completed, the site will undergo reclamation. During this final stage, operations that could affect air quality could include vehicle roadway dust, and disturbance of soils.

3.18.3 Potential Impacts to Air Quality and Methods of Mitigation

Construction

During construction, fugitive dust will be emitted from soil disturbance and vehicle traffic. Wind blowing over exposed areas of soil add to dust emissions. Elevated ambient concentrations of particulate matter and deposition in the surrounding area could be an impact. To mitigate this potential impact during construction, a soil erosion, sedimentation and control (SESC) plan will be in place that will address vegetating disturbed areas in a timely fashion. Not only does vegetation reduce soil erosion, it reduces fugitive dust. After final grading and construction, permanent soil erosion measures are implemented and maintained. To the extent necessary, roadways will be kept swept and wet during dry periods of the year by a watering program. Since this project includes the refurbishment of an existing facility, soil disturbance and dust emission will not be as extensive as construction of a greenfield facility.

Operations

During operation, emissions are described in the *Humboldt Mill Projects Michigan Air Use Permit – Permit to Install Application* (Foth, 2008). The facility total PM emissions are estimated at 5.8 tons per year. Besides PM, other criteria pollutants are negligible (Table 3-7). Equipment and mill design have been selected with emissions minimization in mind. PM emissions will be minimized by a dust collection system complete with baghouses, enclosures and wet sprays. These control measures reduce both particulates and the toxic air contaminants (TACs) associated with the PM. Baghouses control to an anticipated level of 99.5% or better. Each piece of control equipment will be inspected and maintained during operations.

Bulk materials used in the milling process (lime and soda ash) will be stored in silos. The material will be handled with a pneumatic system. This minimizes any dust emissions. Milling chemicals not stored in bulk silos (xanthate, MIBC, sodium sulfite, and Magnafloc 155) will be delivered in appropriate containers, stored and used in the mill building, therefore, they will not be significant emitters.

Incoming ore trucks will be covered to reduce emissions from transported ore. The ore will be unloaded in the COSA, a fully enclosed structure with a roll-up door to provide truck access while maintaining dust reduction. The primary crusher will be housed in the COSA building and be equipped with a wet spray. Primary crushing is the beginning of ore processing that conveys the ore within enclosed conveyors or within buildings. Ventilation and dust collection will be installed along the dry ore route until the ore will be made into a slurry in the mill and can not produce dust. After milling and flotation, the copper and nickel concentrates will be loaded out and are expected to produce minimal dust due to the high moisture content of the concentrate and the enclosure and dust collection associated with that operation.

Vehicular traffic includes incoming ore trucks, front end loaders, and miscellaneous delivery trucks. During dry weather, a comprehensive on-site sweeping and watering program has been developed to control these fugitive dust sources. A more detailed discussion of the watering

program is included in Appendix D of the *Humboldt Mill Project Michigan Air Use Permit – Permit to Install Application* (Foth, 2008).

To ensure emissions during operations will not have a detrimental impact on human health or the environment, maximum emission rates from each process were evaluated using an air dispersion model in accordance with MDEQ requirements. The results indicate that all emissions from facility operations will meet all USEPA and Michigan ambient air quality standards. Included in Table 3-8 are the results of the maximum impacts for federal criteria pollutants from the modeling study. A comparison of results against federal criteria pollutants for each NAAQS averaging period is included. A more detailed discussion of the modeling results is included in the *Humboldt Mill Project Michigan Air Use Permit – Permit to Install Application* (Foth, 2008).

Besides federal NAAQS compliance, the facility must comply with applicable screening levels for Michigan TACs. Similar to NAAQS, a facility may not emit TACs in excess of specific health based screening levels: Initial Threshold Screening Level (ITSL), Initial Risk Screening Level (IRSL), and Secondary Risk Screening Level (SRSL). Using the method outlines R 336.1227(1)(a) and a spreadsheet available on the MDEQ website, estimated TAC emissions from the facility were analyzed for the need for further modeling. The results of that screening appear in Appendix F-2. Five contaminants were identified for further modeling: arsenic, cobalt, copper, manganese, and nickel. These five contaminants were screened using the AERMOD air dispersion model, pursuant to R 336.1227(1)(c). The results of the modeling analysis are shown in Table 3-9.

In addition to dispersion modeling needed to demonstrate NAAQS and Michigan ambient air quality standards, an emissions deposition impact analysis was performed. Maximum deposition rates for five metals and sulfide were evaluated and are presented in Appendix F-3. The evaluation performed shows deposition of metals and sulfide will result in minimal impacts on the environment.

Closure and Post Closure

After mill operations end, the facility will go through the closure process in accordance with R 425.204. This process will restore the site to its current condition as appropriate for a brownfield site. Similar to the construction phase of the project, fugitive dust may be emitted from exposed soil. To mitigate these activities, soil erosion control measures will be implemented in a timely manner. All areas on site will have permanent erosion controls. With the tailings placed under water in the HTDF, there will be no fugitive dust emissions from tailings storage.

In summary, engineering controls proposed for the Humboldt Mill Project, together with the air modeling analysis documented in the *Humboldt Mill Projects Michigan Air Use Permit – Permit to Install Application* (Foth, 2008) have demonstrated that the project will comply with applicable USEPA and MDEQ air quality standards. No deleterious environmental impacts due to air emissions are expected and no mitigation measures are proposed beyond that which is described above and in the *Air Permit Application* for the project.

3.19 Aesthetic Resources *(R 425.202(2)(hh) – (kk))*

To evaluate potential aesthetic impacts, potentially sensitive receptors located near the project site are identified and quantified. Potentially sensitive receptors in the area are residential areas

around the site as displayed on Figure 2-3, the Heron Rookery and bald eagle nest identified on Figure 3-18.

3.19.1 Proposed Mining Activities Affecting Visual, Noise, Light, and Seismicity

Proposed activities with visual affects include the existing and proposed buildings and vehicular traffic. The mine operations will produce noise during project construction and routine operating activities. During the construction phase, heavy equipment operation will produce noise. During routine operation, vehicular traffic, material handling, and the crushing operations will produce noise. The facility will be constructed with lighting generally suitable for an industrial facility. Vibratory/seismic activity may be generated by vehicular traffic and heavy equipment movement during the construction phase. The vehicular traffic and heavy equipment movement will be as expected for an industrial facility consistent with local zoning.

3.19.2 Potential Impacts

The Humboldt Mill site is naturally obscured by the existing trees and the rock outcrop along the north side of the property. Trees exist along the other edges of the property, and the site will continue to be partially visible from CR 601 at the mill entrance. Thus visual impacts will not change relative to existing conditions.

The crushing operations will take place within buildings, subduing the noise. No sensitive local flora or fauna have been identified at the mill to be potentially affected by the anticipated facility noise. A noise survey was performed to establish baseline conditions and appears in Appendix G.

Ore crushing feeders and screens at the Humboldt Mill will operate at a decibel level of between 95 to 108 dBA within five feet of the machinery. Assuming no muffling, the noise level within 150 ft of this processing equipment will range between 82 and 90 dBA. Considering that all of this equipment will be muffled within buildings, the noise level at the fence line will be below 80 dBA. This assumes a minimal 10% reduction in noise levels due to muffling and distance. Thus a conservative estimate of noise levels at the fence line is less than 80 dBA which is similar to an urban area. Note that the crushing operations will only occur during the day shift.

Overall decibel level of the crushers at the project boundary will be low enough to not exceed normal industrial noise levels. Combined with dampening effect afforded by the trees and topography, minimal noise impacts are expected to surrounding residences, the bald eagle nest and heron rookery. The residences, bald eagle nest and heron rookery are far enough away from the crushing/milling activity and are insulated by topographical features and vegetation such that there will be no impact by noise.

Although the mine operations will require lighting in accordance with MSHA requirements, the Humboldt Mill site is in a sheltered location which lacks additional light sources and potentially sensitive light receptors. Light impacts are expected to be minimal. A light survey was performed to establish baseline conditions and appears in Appendix G.

3.19.3 Mitigation of Visual, Noise, Light, and Seismic Impacts

Due to the natural buffers provided by existing trees and rock outcrops, aesthetic issues are expected to be minimal. The greatest potential for visual and light impacts will be along CR 601 to the southwest of the site. KEMC may selectively plant trees to further obscure the mine facilities from CR 601. Lights will be installed at the minimum necessary height. Fixtures will be shrouded to prevent light straying upward and lights will be directed downward towards the operations area to keep them focused where needed. This should minimize stray light that might unnecessarily illuminate the surrounding area. Vibratory/seismic effects from the milling operation will be negligible since no blasting will occur at the mill. Crushing operations will not produce noticeable seismic impacts.

4. Feasible and Prudent Alternatives *(R 425.202(1)(c))*

The Humboldt Mill Project has been evaluated for feasible and prudent alternatives for key activities. The following features of the Humboldt Project were considered for this alternatives evaluation:

- Processing method,
- Tailings management,
- Transportation,
- Power supply,
- Surface facilities location.

Each topic is developed to address the description of alternatives including those considered but not carried forward, and reasons why the chosen alternatives are preferred. The alternatives analysis presented herein is specific to the Humboldt Mill and surrounding conditions, facilities and infrastructure. Conclusions drawn from this analysis of the Humboldt Mill operations should not be construed as having application to other sites and their associated conditions.

4.1 Processing Method

Processing metal ores is a mature technology. The processing method is selected on the basis of ore characteristics, economic, environmental, and safety issues. The Humboldt Mill will process ore containing Ni and Cu sulfide minerals, therefore, flotation is the method of choice for concentrate production. Flotation separates minerals by using surfactants and wetting agents that make ore particles with high copper and nickel concentrations hydrophobic and become part of the solution froth that can be drawn off. The hydrophilic gangue (unwanted materials having lower copper and nickel content) drops to the bottom of flotation cells to be drawn off. Further detail on the proposed milling process appears in the Volume I of the *Mining Permit Application*. The flotation process occurs quickly and is performed entirely within the mill buildings in contained process equipment. This greatly reduces the opportunity for environmental contamination and increases the level of control. Flotation technology represents standard practice in industry and has been used safely for decades.

The proposed milling process will use industry standard processing equipment and chemicals. The reagents used in the flotation processing method planned for Humboldt Mill are listed in Table 4-1. Material Safety Data Sheets (MSDS) for these chemicals appear in Appendix H. The chemicals used in the milling process are readily available and safely transported in bulk quantities and are commonly used in mining and other industries. With the exception of MIBC, the materials will be transported in granular form, packaged in appropriate containers or hauled by truck in the case of hydrated lime. MIBC will be transported in liquid form in totes. The reagents will be transported to the Humboldt Mill in accordance with a state and federal transportation regulations.

4.2 Tailings Management

Processing ore will generate mill tailings. Tailings are the ground up host rock that remains after metals of interest are separated as product. Over the life of the project, a total of approximately 2.5 million tonnes (2.75 million tons) of total dry weight tailings will be produced from ore processing and will require safe and stable storage in a manner that provides environmental

protection. Mill tailings present challenges affecting the efficient operation of mills. Tailings mass and volume are often large and need to be managed in a safe and stable manner. Several approaches are available for management of tailings ranging from: surface storage of tailings in an engineered facility equipped with a liner and cover system, mixing the mill tailings with a binder (usually cement) to create a paste for use as backfill in the mine of origin, and subaqueous disposal. In considering these alternatives, it is necessary that the chemistry of how tailings interact with the natural environment be considered.

4.2.1 Tailings Geochemistry and Management Alternatives

Geochemical Processes
Natural weathering of rock is a part of the geochemical cycling of elements, and tailings from many types of mining participate in this process. The chemistry of the weathering of tailings begins through simple dissolution reactions and is often limited by the low solubility of many mineral phases. However, tailings produced by the milling of sulfide minerals presents additional management challenges due to the possibility of oxidation of reduced sulfur (sulfide) to more oxidized forms, such as sulfate. This dissolution and oxidation process can occur when sulfide tails are exposed to atmospheric oxygen and water.

Sulfide oxidation may cause the release of metals in sulfide tailings. In the presence of water and atmospheric oxygen, the oxidation reaction removes sulfide from solution, and so enhances dissolution reactions of sulfide minerals. In addition, oxidation of sulfide minerals can produce acidity, through both oxidation of sulfide and formation of metal oxy-hydroxides and sulfate hydroxides. If the acidity from these reactions is not neutralized, solution pH will decrease, often leading to additional dissolution of mineral solid phases. Interrupting or preventing this cycle requires tailings management based on an understanding of the chemistry of sulfide oxidation.

The importance of proper management of sulfide tailings and the possibility of acid rock drainage (ARD) from the tailings of sulfide ores has long been recognized, and much progress has been made in describing the chemistry of sulfide mineral oxidation and ARD formation (e.g., Temple and Delchamps, 1953; Singer and Stumm, 1970; Nordstrom, 1982; Nicholson et al., 1988; Blowes and Jambor, 1990; Elberling and Damgaard, 2001; Herbert and Schippers, 2008). It is now known that oxidation of sulfide minerals is a biogeochemical process that is affected by many variables, including the composition of ore. Because of its abundance, pyrite (FeS_2) is often used as a model when describing sulfide mineral oxidation. The following equations show the major reactions that may occur during the oxidation of pyrite (Peinerud, 2003):

$$FeS_2 + \frac{7}{2}O_2 + H_2O = Fe^{2+} + 2SO_4^{2-} + 2H^+ \quad (1)$$

$$Fe^{2+} + \frac{1}{4}O_2 + H^+ = Fe^{3+} + \frac{1}{2}H_2O \quad (2)$$

$$FeS_2 + 14Fe^{3+} + 8H_2O = 15Fe^{2+} + 2SO_4^{2-} + 16H^+ \quad (3)$$

$$2Fe^{2+} + \frac{1}{2}O_2 + 5H_2O = 2Fe(OH)_3 + 4H^+ \quad (4)$$

$$Fe^{3+} + 3H_2O = Fe(OH)_3 + 3H^+ \quad (5)$$

The oxidation of sulfide minerals is a complex process and the above reactions do not represent a reaction scheme. Instead these reactions capture the types of chemistry that may occur as pyrite (or other sulfide minerals) is oxidized.

Pyrite oxidation is sometimes viewed as occurring in a system that has reached chemical equilibrium; this is best represented by summing Equations 1 and 4 (after dividing Equation 4 by 2):

$$FeS_2 + \frac{15}{4}O_2 + \frac{7}{2}H_2O = Fe(OH)_3 + 2SO_4^{2-} + 4H^+ \quad (6)$$

Equation 6 is often presented as the chemical equation describing pyrite oxidation, but this is an over-simplification largely because of the assumption of chemical equilibrium (Morin, 1990). In an open system with mass flow (i.e., water and oxygen moving through the tailings), products of one reaction may become reactants of another reaction, and mass may leave the system. Under these more realistic assumptions, oxidation of sulfide minerals is viewed as an ongoing process, the rate of which is controlled by chemical kinetics. Management of oxidation is then based on directing chemical reactions towards steady-state conditions where oxidation is minimized. In practice, minimizing oxidation requires limiting the availability of water or oxygen, as one or both of these reactants are essential components of the reactions shown above.

Dry Storage

Limiting exposure of sulfide tailings to water is referred to as dry storage. The feasibility of this approach may depend on the environmental characteristics of the disposal site. Tailings must be placed at an elevation that will always remain above the water table, and tailings must be shielded from atmospheric moisture. After placement at an appropriate elevated location, tailings may be shielded from precipitation through a variety of cover options, as is often done with solid waste disposal facilities. Covers will also limit exposure of tailings to atmospheric oxygen. This is an effective strategy for safe and stable management of tailings.

Subaqueous Storage

Oxidation of sulfide tailings may also be reduced by limiting exposure to atmospheric oxygen. On-going research, including extensive field studies, has shown that the best way to reduce oxygen exposure is through the use of a water cover (e.g., Moses and Herman, 1989; Robertson, 1991; Morin, 1993; Pedersen et al., 1993; Fraser and Robertson, 1994; Peacey et al., 2002).

Water covers over tailings may take many forms depending on implementation, but in all cases this management practice is referred to as subaqueous disposal. A recent literature review of water covers is provided by Peinerud (2003). Also, the Mine Environment Neutral Drainage (MEND) program of Natural Resources Canada (NRCan) directed research on subaqueous disposal of sulfide tailings between 1988 and 2000 and has published many reports and reviews describing this work. Titles of MEND review manuscripts are provided above in Section 1.4; a more extensive listing is found on the MEND web site (http://mend2000.nrcan.gc.ca). Research

such as that conducted by the MEND Program has demonstrated that water covers are the preferred method for sulfide tailings disposal, if a suitable water repository is available.

The effectiveness of water covers as an oxygen barrier is a direct consequence of the low solubility and diffusivity of oxygen in water relative to air. Even when water is fully saturated with dissolved oxygen, the concentration of oxygen in water is about 25,000 times less than that in air, on a mass basis under typical ambient conditions. As Equation 6 shows, a closed pyrite-sulfate system at equilibrium moves toward pyrite as oxygen concentration decreases, and so, decreasing available oxygen will reduce the oxidation of pyrite. While equilibrium will not be obtained in an open system such as a subaqueous tailings disposal facility, the effectiveness of water covers is, to a first approximation, well explained by the large decrease in oxygen concentrations between air and water.

Subaqueous sulfide tailings disposal facilities are open to atmospheric oxygen and contain large quantities of reduced sulfur; thus, these systems are not at equilibrium. Given the low solubility of oxygen in water, the extent of sulfide oxidation will depend on the availability of oxygen. Dissolved oxygen in water at the water-tailings interface will be consumed as the chemistry represented by Equations 1, 2 and 4 proceeds, and a concentration gradient will, therefore, always be present over the depth of a water cover. Atmospheric oxygen will be drawn along this gradient towards the submerged tailings.

The minimum rate at which oxygen advances along the concentration gradient is set by the diffusivity of oxygen in water. Oxygen diffusivity in water is about 10,000 times lower than in air, so, as with solubility, water forms a very effective barrier preventing sulfide tailings oxidation, relative to tailings exposed to the atmosphere.

Molecular diffusivity sets the minimum rate at which oxygen may be replenished in water. The actual rate at which oxygen is replenished in water near the water-tailings interface in a subaqueous disposal facility (and, therefore, the rate at which tailings oxidize) will depend on a number of factors, such as the water depth, and the amount of turbulence in both the water and the atmosphere (often set by the wind speed). Each of these variables has been examined in field and laboratory settings, and many of these studies are presented in the MEND references. An important conclusion of this work is that, in many settings, as little as one to two meters of water depth will provide a very effective cover over sulfide tailings, even given the effects of wind-induced turbulence and the possibility of tailings resuspension. Elberling and Damgaard (2001) have also shown that the rate of oxygen consumption (and so, the rate of tailings oxidation) is not constant, but decreases with increasing age of submerged tailings. This is attributed to the formation of a thin veneer (millimeter-scale) of oxidized tailings at the water-tailings interface. Considered as a whole, the results of the field and laboratory investigations show that water covers of only a few meters depth can reduce sulfide tailings oxidation rates by several orders of magnitude relative to tailings exposed to the atmosphere.

As the depth of a water cover increases, other physical and chemical processes may begin to operate in a subaqueous disposal facility. These processes can further reduce not only the extent of sulfide oxidation, but also the transport of dissolved metals that may be released by oxidation of tailings. Two important processes are the formation of an anoxic hypolimnion and the cycling of reduced and oxidized iron.

The bottom waters of a water cover may become either seasonally or permanently anoxic if a subaqueous disposal facility is of sufficient depth; the necessary depth will depend on basin morphology and turbulence resulting from wind and flow. The lack of oxygen in bottom waters will divide the water column and further prevent oxygen from reaching submerged tailings, thus creating a very stable reducing environment where sulfide oxidation will be very slow. Any small quantity of oxygen that does reach this zone will be consumed by reduced sulfur, and sulfide tailings will therefore be self-stabilizing.

Dissolved metals that can exist in multiple redox states will be in a reduced state in this anoxic environment. As sulfide tailings will often contain iron sulfides, reduced iron will be present in the water covering the tailings, and a reduced-oxidized iron cycle may be established.

Iron cycling is often observed in natural waters that develop an anoxic hypolimnion. The cycle begins as reduced iron diffuses upward and crosses into the oxygenated epilimnion. The reduced iron is then oxidized by dissolved oxygen, as shown in Equation 2. If the water pH is circumneutral, as is most often the case if carbonate minerals are present, the oxidized iron will form hydroxides (Equation 5). As these amorphous solids coagulate and flocculate, iron hydroxide particles will settle back toward the anoxic bottom waters. The iron may again be reduced, either in the water column or after reaching the sediments. The newly formed reduced iron is then available to continue the cycle (Stumm and Morgan, 1996).

The iron cycle can regulate the concentration of other dissolved chemicals because iron hydroxide particles have very active surfaces that will adsorb (through complex formation) many chemical species, particularly dissolved metals (Buffle and De Vitre, 1994). Thus, iron hydroxides particles will sweep the water column of dissolved metals as they settle toward the sediments, and so reduce dissolved metal concentrations. In this way, the iron cycle can form a barrier preventing upward diffusion of dissolved metals and limit transport of these metals from the subaqueous disposal facility.

A number of case studies of subaqueous disposal of sulfide tailings have been documented in the literature; many of these studies are discussed in the MEND Program references.

An example of a subaqueous disposal facility with a shallow water cover is provided by the Stekenjokk tailings pond, created by flooding the tailings impoundment associated with the Stekenjokk copper and zinc mine (Holmström and Öhlander, 1999). The pond contains about four million tons of tailings that contain about 20% sulfur. Average water depth in the tailings pond is 2.5 meters. While some oxidation of tailings has been observed as tailings were allowed to oxidize prior to placement of the water cover, a sulfate mass balance indicates that only a small amount of reduced sulfur has been oxidized, with most sulfate coming from dissolution of gypsum. Based on these results, the water cover has exceeded its design specifications and is viewed as a successful example of a water cover. Additional work (Holmström and Öhlander, 2001) has also shown that water column concentrations of many metals, such as copper, lead and zinc, are reduced because of association with iron and manganese oxy-hydroxides, through a process similar to iron cycling.

Petersen et al. (1997) discuss the use of two natural lakes as water covers for tailings management. No evidence of sulfide oxidation of tailings has been observed in Anderson Lake, Manitoba, even in those areas of the lake with oxygenated waters. Sulfide oxidation may be

reduced by the high concentration of organic carbon in the lake sediments. Metal profiles indicate that metals are moving into the sediments from the water column. A similar process may be operating in Butte Lake, British Columbia, as natural sediments continually cover tailings deposited ten years before this study. No oxidation of these tailings has been observed.

Paste Backfill

Another means of limiting the oxidation of tailings is by mixing the tailings with a binder, usually cement, and using the tailings and cement mixture as backfill in the mine of origin. This tailings management approach is referred to as a paste backfill. Paste backfill limits the oxidation of tailings by creation of a low permeability medium. This, combined with the placement of the tailings back into the mined out voids in an underground mine, limits exposure of the tailings to oxygen during active mining. Upon closure of the mine when the underground voids are allowed to reflood, the cemented tailings are permanently covered in water which further limits oxidation in a manner similar to that described for subaqueous disposal. Where feasible, this method of tailings management has become common industry practice and is a safe and stable means of managing sulfide tailings. This tailings management approach, however, must also be weighed against other mining waste management needs for mines and mills where development rock storage may also be required.

4.2.2 Evaluation of Tailings Management Alternatives

Storage of tailings in a surface facility involves preparing a large area, installing a liner and leak detection system, tailings placement, and capping during closure. The surface facility concept is similar to solid waste management. The tailings exiting the mill would have water extracted to a fairly thick but still moist consistency. The moist tailings would be purposefully placed in the facility in sections which would be covered as much as possible during the process. After operations, capping would be completed.

At the Humboldt Mill site, a surface facility could be located southeast but adjacent to the mill facility, extending into the pre-existing iron ore tailings area (Figure 2-6). The surface facility would be approximately 130 acres.

Use of tailings as a paste backfill in the mine of origin involves mixing it with a binder, usually cement, and pumping the material into mined out stopes in the mine of origin. The tailings volume will exceed the volume of space available for backfill due to bulking. Therefore, not all of the tailings can be placed underground resulting in the need for management of the remaining tailings through land based and/or sub-aqueous methods.

Sub-aqueous tailings impoundment involves pumping tailings in slurry form from the mill to the impoundment area and placing the slurry purposefully below water. At the Humboldt Mill site, the existing HTDF will serve as this impoundment area. The HTDF is the excavated Humboldt iron ore mine which is now filled with water from groundwater and precipitation. The HTDF was converted to a tailings disposal facility when tailings were placed in it from processing ore from the Ropes Mine.

While the geochemical considerations strongly indicate that subaqueous disposal of sulfide tailings is the best tailings management approach, Table 4-2 compares a range of criteria that were considered in evaluating and selecting a tailings management plan for the Humboldt Mill.

The analysis presented in Table 4-2 demonstrates that subaqueous disposal is the preferred alternative for the Humboldt Mill based on all the criteria that were evaluated.

In summary, the advantages of sub-aqueous tailings disposal make use of the HTDF the preferable alternative for several reasons:

- The HTDF maintains the tailings at all times under water in an anoxic environment. No portion of the tailings can reach conditions supporting significant oxidative reactions.

- The HTDF is currently in place, contains sulfide tailings, and has demonstrated that subaqueous placement of tailings has been successful. This is supported by data on the anoxic hypolimnion, chemocline, thermocline and water quality in the epilimnion of the HTDF. Placing new tailings in the HTDF does not represent a new use of this facility whereas a facility placed, constructed, and maintained on the surface will affect a large land area.

- The HTDF provides stable geotechnical and geochemical conditions for placement of tailings during operations and after closure.

- Aesthetically a surface facility would be a visible structure on the landscape of the project area. The HTDF appearance will remain the same for the foreseeable future.

4.3 Transportation

Transportation of ore and concentrate, which is regulated by state and federal transportation requirements, is a significant issue for any operation. The large quantities of materials moved from one location to another is costly and impacts overall economics of the project. Selection of processing location is directly related to transportation plans.

Transportation of ore and concentrate is greatly improved with the development of the Humboldt Mill. The impact of transportation is not only an economic issue, but also an environmental issue when considering energy use, vehicle miles traveled, and greenhouse gas emissions generated.

The advantage of milling ore locally centers on less material shipped to Canada. With separation of tailings from the copper and nickel concentrates performed at the Humboldt Mill, a significant reduction in weight and volume of material shipped is achieved. Table 4-3 presents the comparison between shipping coarse ore to Canada (Direct Ship) versus shipping copper and nickel concentrates to Canada (Process at Humboldt Mill).

The number of tonne-miles traveled with the Humboldt Mill alternative is less than 20% of the tonne-miles traveled for the direct shipment of ore to Canada. The transportation costs and environmental impact of milling at the Humboldt Mill are far more attractive than the direct ship alternative. This holds true whether concentrate is loaded directly onto railcars at the mill or concentrate is loaded onto a truck and brought to a local railhead.

4.4 Power Supply

The Humboldt Mill is equipped with a functioning 34 kV utility line with 6 MVA 34-2.4 kV transformer for a main power source. This line is adequately sized for the proposed mill. A

generator may be used for a secondary/back-up power source. No other alternatives were evaluated for this service.

4.5 Surface Facilities Location and Mill Access

Refurbishing a local mill has advantages in capital costs, and benefits the community with environmental improvement of a brownfield site. With Michigan's U.P. having a rich mining history, several mills might be candidates for this project. Availability of this site was a factor, and after conducting appropriate due diligence, no environmental issues were identified to prevent the beneficial use of this mill. Besides its availability, the presence of a viable sub-aqueous tailings disposal facility makes this alternative the most attractive compared to other local mills or construction of a new mill.

Access to the mill for ore haul trucks is proposed to be of off CR 601 as shown on Figure 2-6. Figure 4-1 shows an alternative access road for trucks hauling ore to the Humboldt Mill. Trucks would access the mill via a redeveloped road off of Highway 41. This potentially redeveloped road would be used by multiple users, including Kennecott, and would be developed by a business entity other than KEMC. At this time the development of the road by prospective business interests has not been formalized. As such, this mill access option, which may come to fruition in the future, represents an alternative that is not viable at this time, but may become viable in the future.

Tables

Table 1-1
List of Qualified Professionals

Organization	Individual	Qualifications
Advanced Ecological Management, LLC 2692 165th Ave. Morely, MI 49336	R. Douglas Workman, Ph.D.	Aquatic Scientist
Foth Infrastructure & Environment, LLC 2737 S Ridge Rd, Ste 600 P.O. Box 12326 Green Bay, WI 54304	Stephen V. Donohue, P.H. Andrea Martin, P.E. John Starke, P.E. John Fassbender, P.E. Curt Dungey, CHMM Jeff Lynott, P.G. Gerald Eykholt, Ph.D., P.E. Michael Pretti, P.E. Steve Lehrke, Ph.D. Sharon Felix, P.G. Jonathan Manchester, Ph.D., P.E.	Professional Hydrologist Professional Engineer Professional Engineer Professional Engineer Certified Hazardous Materials Mgr. Professional Geologist Professional Engineer Professional Engineer Statistician Geologist Professional Engineer
Geochimica, Inc. 206 North Signal St, Ste M Ojai, CA 93023	Mark Logsdon	Geochemist
Kennecott Eagle Minerals Company 504 Spruce Street Ishpeming, MI 49849	Jon Cherry, P.E. Alicia Duex Andrew Ware Victoria Peacey	Professional Engineer Environmental Scientist Exploration Geologist Environmental Engineer
King & MacGregor Environmental Inc. 2520 Woodmeadow Dr SE Grand Rapids, MI 49546	Matt MacGregor	Biologist/Wetland Scientist
M3 Engineering & Technology Corp. 2440 W Ruthrauff Rd Ste 170 Tucson, AZ 85705	Jim Norine, P.E.	Professional Engineer
North Jackson 1004 Harbor Hills Dr PO Box 218 Marquette, MI 49855	Daniel Wiitala, P.G.	Professional Geologist

Table 1-1 *(con't)*

Organization	Individual	Qualifications
SGS Lakefield Research Ltd PO Box 4300 185 Concession St. Lakefield, Ontario, Canada K0L 2H0	Daniel Imesan, MSC	Senior Project Metallurgist
URS Corporation 26 East Seventh St Ste 2300 Cincinnati, OH 45202	Christopher Bergman, Ph.D.	RPA Archaeologist

Prepared by: AKM
Checked by: SVD1

Table 3-1
Wild and Scenic Rivers of the Upper Peninsula

River	Location in U.P.	Drains to
Black	Western	Lake Superior
Carp	Central	Lake Superior
Indian	Southern	Lake Michigan
Ontonagon	Western	Lake Superior
Paint	Central	Lake Michigan
Presque Isle	Western	Lake Superior
Sturgeon in Hiawatha National Forest	Southern	Lake Michigan
Sturgeon in Ottawa National Forest	Northern	Lake Superior
Tahquamenon	Central	Lake Michigan
Whitefish	Central	Lake Michigan
Yellow Dog	Central	Lake Superior

Prepared by: AKM
Checked by: SVD1

Table 3-2
Residences Close to the
Humboldt Mill Project Site

Property	Location	Distance from Closest KEMC Project Location Boundary
Christopher & Holly Ray	Directly west of HTDF	1,100 ft
Ogea	East of the north end of the HTDF	1,100 ft
T&T Rosten or J&J Ogea	South of the mill	450 ft

Prepared by: AKM
Checked by: SVD1

Table 3-3

June 1990 Aquatic Evaluation of Escanaba River

Metric	Station 1 Upstream of HTDF Discharge	Station 2 Downstream of HTDF Discharge
Fish Metric Evaluation	Fair (moderately impaired)	Fair (moderately impaired)
Macroinvertebrate Metric Evaluation	Good (slightly impaired)	Good (slightly impaired)
Habitat Evaluation	Good (slightly impaired)	Fair (moderately impaired)

Prepared by: AKM
Checked by: SVD1

Table 3-4

Macroinvertebrate Metric Evaluation for Upstream and Downstream Stations on Middle Branch Escanaba River - 1993 and 1995 Surveys

Station	June 1993	August 1993	October 1993	August 1995
Upstream Station	Fair	Good	Good	Fair
Downstream Station	Fair	Good	Fair	Fair

Prepared by: AKM
Checked by: SVD1

Table 3-5
2006 and 2007 Aquatics Survey Results for Four Stream Locations[1]

	Station 1 Black River West Branch	Station 2 Lake Lory Discharge	Station 3 Middle Branch Escanaba River	Station 5 Wetland EE Complex
Fish Community	Poor	Poor	Poor	Poor
Macroinvertebrate Community	Poor	Acceptable	Acceptable	Acceptable
Stream Habitat	Excellent	Excellent	Excellent	Good

[1] Procedure 51

Prepared by: AKM
Checked by: SVD1

Table 3-6
Plant Communities and Habitat Types
for Humboldt Mill Study Area

Plant Community/Habitat Type	Classification System	Acreage
Mesic Northern Forest[1]	MNFI	1,877
Hardwood-Conifer Swamp/Northern Swamp	MNFI	108
Northern Shrub Thicket	MNFI	167
Emergent Marsh	MNFI	294
Muskeg/Poor Conifer Swamp	MNFI	112
Open Water/Submergent Marsh	MNFI	265
Cliff	MNFI	N/A[2]
Herbaceous Open Land	MIRIS	68
Shrubland	MIRIS	27
Single Family/Duplex	MIRIS	20
Extractive	MIRIS	187
Streams and Waterways	MIRIS	2
Road Transportation	MIRIS	42
		Total: 3,169 acres

[1]Combination of coniferous and broadleaved deciduous.
[2]Not enough acreage to measure.

Prepared by: AKM
Checked by: SVD1

Table 3-7
Criteria Pollutant Emissions from Marquette County Major Sources – Reported Annual Averages 1998-2005 and KEMC Eagle Project, Humboldt Mill Project Calculated Emissions in Tons/Year

	CO	**NO_x**	**PM**	**SO_2**	**VOC**
Marquette Board of Light & Power[1]	88	421	8	555	6
Wisconsin Electric[1]	450	10,718	372	18,274	58
Tilden Mine[1]	510	5,234	723	1,756	100
Empire Mine[1]	149	5,655	380	830	24
Sawyer Lumber Co. [1]	N/A	N/A	90	N/A	114
Eagle Mine (calculated)[2]					
Actual	20.4	197	11.5	63	5
Humboldt Mill (calculated)[3]					
Actual	ng	ng	5.8	ng	ng

Prepared by: AKM
Checked by: SVD1

Notes:

[1] Reported to MAERS, Point Source Air Emissions Inventory Download MAERS 1998-2005, http://www.michigan.gov/deq/0,1607,7-135-331041034193-148360--,00.html

[2] Foth & Van Dyke, 2006. Eagle Project Michigan Air Use Permit Application, Permit to Install updated with MVAR filter

[3] Foth, 2008. Humboldt Mill Project Michigan Air Use Permit Application, Permit to Install

Abbreviations:
CO – Carbon monoxide
NO_x – Nitrous oxides
PM – Particulate matter
SO_2 – Sulfur dioxide
VOC – Volatile organic compounds
N/A – not available
ng – negligible (a small amount from exempt sources)

Table 3-8
Criteria Pollutants
Comparison of Maximum Source Impacts to
NAAQS Concentrations

Criteria Pollutant	Averaging Period	Year[1]	Maximum Source Impact ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	Total Impact ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
PM-10	Annual	2003	2.59	16.0	18.59	50
PM-10	24-Hr Avg	2004	21.02	28.0	49.02	150
Lead	Calendar Quarter Avg	2nd Qtr 2004	0.00038	0.01	0.0104	1.5

[1]The years 2003-2007 were the basis of the evaluation. The year listed is the year of highest maximum impact of the years modeled.

Prepared by: AKM
Checked by: LJS

Table 3-9
Comparison of Maximum Source Impacts for Michigan Toxic Air Contaminants to Appropriate ITSL, IRSL, or SRSL Screening Levels

Listed TAC[1]	Screening Level ($\mu g/m^3$)	Screening Level Averaging Time	Type of Screening Level	Maximum Predicted Ambient Impact ($\mu g/m^3$)
Arsenic	0.0002	Annual	IRSL	0.00005
Cobalt	0.2	8-Hr Avg	ITSL	0.00574
Copper	2.0	8-Hr Avg	ITSL	0.30
Manganese	0.05	24-Hr Avg	ITSL	0.045
Nickel	0.0042	Annual	IRSL	0.00336

(1) Remaining identified TACs are in compliance with all screening levels using the screening tool provided under R 336.1227 (a). See Appendix F-2.

Prepared by: AKM
Checked by: SVD1

Table 4-1
Humboldt Mill Beneficiation Chemicals

Reagent	Alternate Name	Chemical Formula
Sodium Sulfite	NA	Na_2SO_3
MIBC (frothing agent)	Methyl Isobutyl Carbinol	$C_6H_{14}O$
SIPX	Sodium Isopropyl Xanthate	$C_4H_7NaOS_2$
Hydrated Lime (slaked lime)	Calcium Hydroxide	$Ca(OH)_2$
Soda Ash	Sodium Carbonate	Na_2CO_3
Magnafloc 155	Polymer of acrylate and acrylamide	Mixture

Prepared by: AKM
Checked by: SVD1

Table 4-2
Comparison of Tailings Management Alternatives

	Potential to Oxidize	Potential to Acidify	Fugitive Dust	Geotech Stability	Successful Implementation i.e. Examples	Best Practice	Site Availability	Relative Impact to Features (Flora, Fauna, Aesthetics, etc)	Transportation	Overall Cost	Average
Paste Fill	2	3	3	3	3	2	1	3	1	1	2.2
Dry Stack	2	2	2	3	3	2	3	2	2	2	2.3
Sub Aqueous	3	3	3	3	3	3	3	3	3	3	3

Scale: 1-3

A number between 1 and 3 was assigned for each criterion that was considered in comparing the three alternatives. For each criterion considered a 3 was assigned to the best alternative, a 2 was assigned to the next best alternative and 1 was assigned to the last remaining alternative. For any given criterion in which two of the alternatives were considered equal, a 2 or 3 was assigned to the alternative. If all three alternatives were considered equal a 3 was assigned to all alternatives.

Prepared by: AMD
Checked by: SVD1

Table 4-3
Weight, Volume, Tonne-Miles for Alternatives of Shipping Ore vs. Shipping Concentrate

Alternative	Shipment	Weight Shipped per day (tonnes/day)	Miles	Tonne-miles
Direct Ship: Ship coarse ore to Canada for processing	Rail ship to Canada	1884	328	617,952 (train)
			Total	761,136 tonne-miles
Process at Humboldt Mill: Ship copper and nickel concentrates from Humboldt Mill to Canada for processing	Rail ship nickel and copper concentrate to Canada	Copper concentrate: 6.8 Nickel concentrate: 14	328	6,822 (train)
			Total	150,006 tonne-miles

[1] Assumes transportation to Sudbury, Ontario

Prepared by: AKM
Checked by: SVD1

Figures



Lake Superior

Lanse Twp
Baraga
Michigamme Twp
Silver Lake Basin
Champion Twp
Powell Twp
Ishpeming Twp
Marquette Twp
Peshekee River
Log Lake
Wolf Lake
Dead River Storage Basin
Deer Lake
Kipple Creek
Middle Branch of Escanaba River
Second River
Ely Twp
Negaunee Twp
US 41
Marquette
Marquette
Lake Michigamme
Van Riper State Park
Deer Lake
Ropes Mine Site
~24 Miles
Humboldt Mill Project Location
Champion Mine Site
Teal Lake
Fish Lake
Humboldt Tailings Disposal Facility
Horseshoe Lake
Perch Lake
Heron Rookery Pond
Lowmoor Lake
Ishpeming
Negaunee
US 41
Goose Lake
Republic Twp
US 95
CR 601
Lake Lory
Sands Twp
Greenwood Reservoir
Tilden Mine Site
Empire Mine Site
Granite Lake
Chocolay Twp
Tilden Twp
Tailings Pond
Richmond Twp
Tailings Pond
Tower Lake
Humboldt Twp
Middle Branch of Escanaba River
Schweitzer Basin
Black River
Tailings Pond
Tailings Pond
West Branch
West Branch Twp
Skandia Twp

NOTES

1. Horizontal datum based on NAD 83/94. Horizontal coordinates based on UTM Zone 16.
2. All base information downloaded from Michigan Center of Geographic Information (http://www.michigan.gov/cgi).
3. Site Location - Project Site within Sections 2 and 11, T47N, R29W, Humboldt Township, Marquette County, Michigan.

LEGEND

- Counties
- Municipalities
- Minor Civil Divisions
- Lakes and Rivers
- KEMC Project Location
- Highways
- Major Roads
- Minor Roads
- Railroads

N

Foth Infrastructure & Environment, LLC

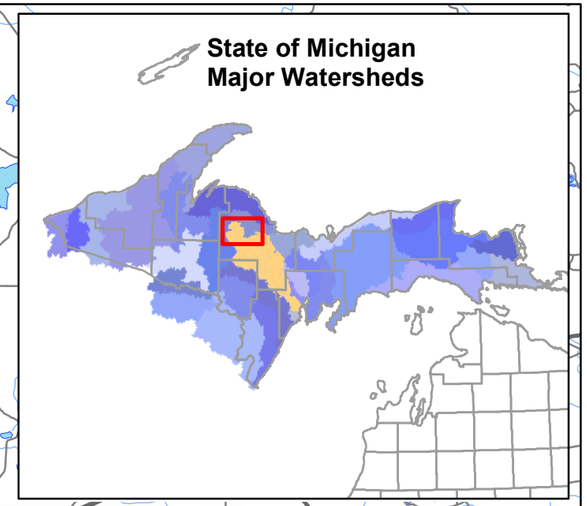
M:\06w003\mxd\EIA\kmc_humboldt_ProjectLocation_11x17.mxd September 23, 2008

Foth Infrastructure & Environment, LLC				
REVISED	DATE	BY	DESCRIPTION	
CHECKED BY:		AKM	DATE:SEPT. '08	
APPROVED BY:		SVD1	DATE:SEPT. '08	
APPROVED BY:			DATE:	

Kennecott Eagle Minerals

FIGURE 1-1
HUMBOLDT MILL EIA
PROJECT LOCATION

Scale: 0 1.5 3 Miles
Date: SEPTEMBER, 2008
Prepared by: DAT
Project No: 06W003



Middle Branch Escanaba River

East Branch Escanaba River

Dead River Storage Basin

Lake Michigamme

Deer Lake

Boston Lake

Middle Branch Escanaba River

Mud Lake

Fish Lake

Perch Lake

Humboldt Tailings Disposal Facility

Heron Rookery Pond

Lowmoor Lake

Iron Ore Tailings Basin West

Goose Lake

Mud Lake

Autio Lake

Lake Lory

CR601

US95

US41

Teal Lake

Negaunee

Ishpeming

Goose Lake

Greenwood Reservoir

Black River Main Branch

Granite Lake

Tower Lake

Tailings Pond

Tailings Pond

Schweitzer Basin

Schweitzer Creek

Tailings Pond

Tailings Pond

Tailings Pond

Black River

Middle Branch of Escanaba River

NOTES

1. Base Information, USGS georeferenced Digital Raster Graphics (DRG) and 1998 Digital Orthophoto Quads are from Michigan Center of Geographic Information (http://www.michigan.gov/cgi/)
2. Horizontal datum based on NAD 83/96. Horizontal coordinates based on Michigan State Plane North.
3. Site Location - Project Site within Sections 2 and 11, T47N, R29W, Humboldt Township, Marquette County, Michigan.

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LEGEND

- KEMC Project Location
- Major Watershed Boundary
- Watershed Boundary between Middle and East Branch of Escanaba River
- Sub-Watershed Boundary
- Lakes and Rivers
- Highways
- Major Roads
- Minor Roads

N

Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

CHECKED BY: JSL	DATE:SEPT. '08
APPROVED BY: SVD1	DATE:SEPT. '08
APPROVED BY:	DATE:

Kennecott Eagle Minerals

FIGURE 2-1
HUMBOLDT MILL EIA
REGIONAL SETTING AND WATERSHED BOUNDARIES

Scale: 0 4,500 9,000 Feet

Date: SEPTEMBER, 2008

Prepared by: DAT

Project No: 06W003

26,017,000 E | 26,018,000 E | 26,019,000 E | 26,020,000 E | 26,021,000 E | 26,022,000 E | 26,023,000 E | 26,024,000 E

627,000 N | 626,000 N | 625,000 N | 624,000 N | 623,000 N | 622,000 N | 621,000 N | 620,000 N | 619,000 N | 618,000 N

N

41 28

MIDDLE BRANCH ESCANABA RIVER

1 2 3 10 11 12 13 14 15

LEAN ORE AND WASTE ROCK

MILL ENTRANCE

OLD CRUSHER BUILDING

CRUSHER PLANT

FORMER SECONDARY CRUSHER BUILDING

FACILITY WATER TOWER

MILL BLDG

OFFICE/ MAINTENANCE BUILDING

FOUNDATION

TAILINGS POND

LAKE LORY

LEGEND

- EXISTING ELEV. CONTOUR IN FEET
- PAVED ROAD
- UNPAVED ROAD
- TRAIL
- TREE
- TREE LINE
- FENCE
- SURFACE WATER
- SWAMP/WETLAND
- STREAM/LAKE
- BUILDING
- HUMBOLDT TAILINGS DISPOSAL FACILITY (HTDF)
- KEMC PROJECT LOCATION
- SECTION LINES
- TOWN DEVELOPMENT ZONING DISTRICT
- RESOURCE PRODUCTION (RP-10) ZONING DISTRICT
- RESOURCE PRODUCTION (RP-20) ZONING DISTRICT
- INDUSTRIAL (I) ZONING DISTRICT
- RESIDENTIAL (R) ZONING DISTRICT
- TIMBER PRODUCTION (TP-40) ZONING DISTRICT

NOTES:

1. TOPOGRAPHIC AND PLANIMETRIC DATA SUPPLIED BY AERO-METRIC ENGINEERING, SHEBOYGAN, WISCONSIN. DATE OF PHOTOGRAPHY: APRIL 27, 2006.
2. CONTOUR INTERVAL BASED ON NORTH AMERICAN VERTICAL DATUM OF 1988. HORIZONTAL DATUM BASED ON NAD 83/96. HORIZONTAL COORDINATES BASED ON MICHIGAN STATE PLANE.
3. SITE LOCATION: PROJECT SITE WITHIN SECTIONS 2 AND 11, T47N, R29W, HUMBOLDT TOWNSHIP, MARQUETTE COUNTY, MICHIGAN.
4. CONTOUR INTERVAL SHOWN IS 10 FOOT.
5. ZONING DISTRICT INFORMATION FROM HUMBOLDT TOWNSHIP, ECI OF ISHPEMING, MI., MAY 12, 2003.

0 300' 600'

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

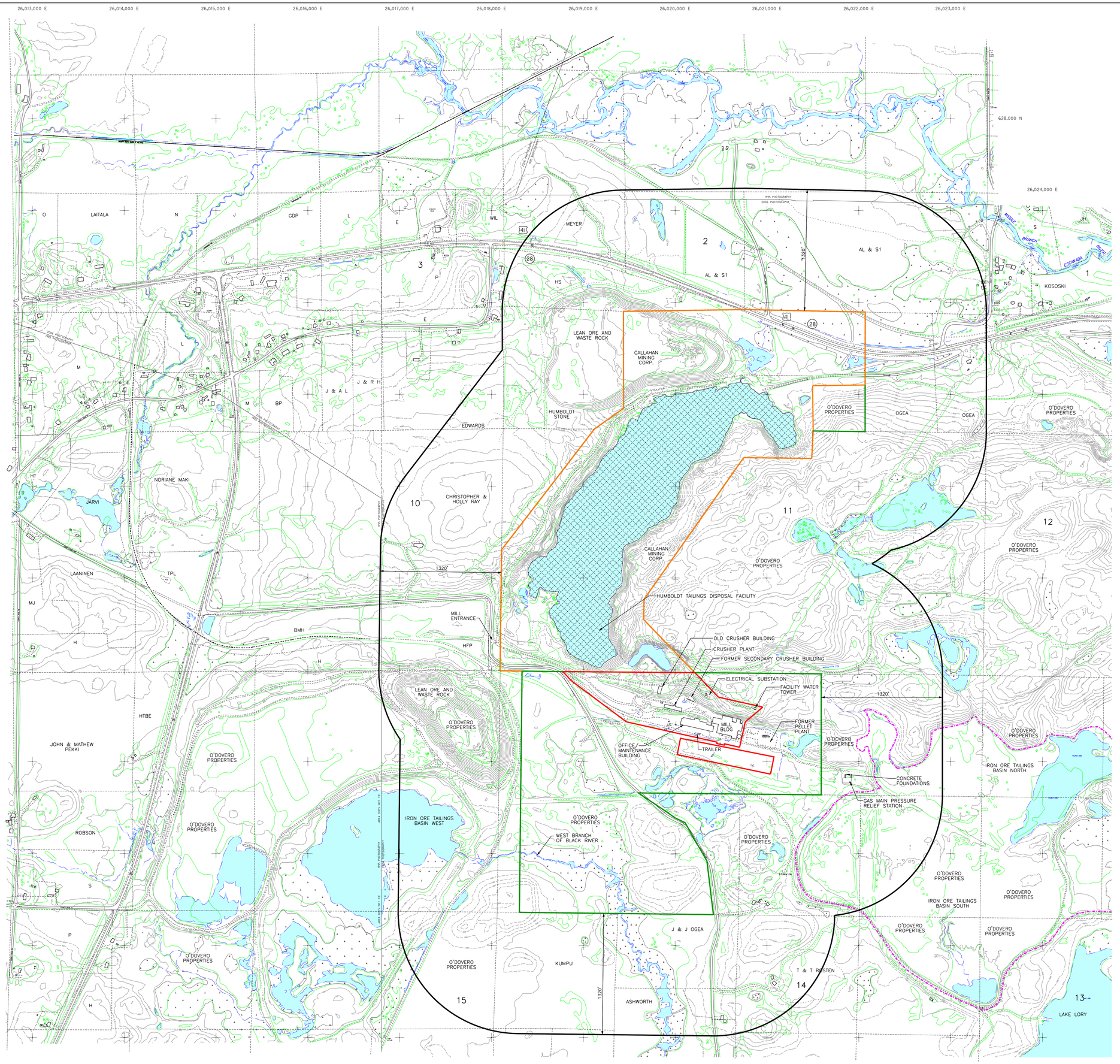
Kennecott Eagle Minerals

FIGURE 2-2

HUMBOLDT MILL EIA
HUMBOLDT TOWNSHIP ZONING DISTRICTS

Scale: AS SHOWN	Date: DECEMBER, 2007
Prepared By: JOW	Project No. 06W003

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12/19/2008 bjw1



N

LEGEND

- EXISTING ELEV. CONTOUR IN FEET
- PAVED ROAD
- UNPAVED ROAD
- TRAIL
- TREE
- TREE LINE
- FENCE
- SURFACE WATER
- SWAMP/WETLAND
- STREAM/LAKE
- BUILDING
- HUMBOLDT TAILINGS DISPOSAL FACILITY
- APPROXIMATE LIMITS OF PRE-EXISTING IRON ORE TAILINGS DISPOSAL FACILITY
- KEMC PROJECT LOCATION
- PROPERTY BOUNDARY
- CALLAHAN PROPERTY OWNERSHIP (KEMC PURCHASE OPTION)
- KENNECOTT EAGLE LAND, LLC PRPERTY OWNERSHIP
- O'DOVERO PROPERTY OWNERSHIP (KEMC PURCHASE OPTION)
- EXISTING RAIL LINE

NOTES:

1. TOPOGRAPHIC AND PLANIMETRIC DATA SUPPLIED BY AERO-METRIC ENGINEERING, SHEBOYGAN, WISCONSIN. DATE OF PHOTOGRAPHY: APRIL 27, 2006, UNLESS OTHERWISE NOTED.
2. CONTOUR INTERVAL BASED ON NORTH AMERICAN VERTICAL DATUM OF 1988. HORIZONTAL DATUM BASED ON NAD 83/96. HORIZONTAL COORDINATES BASED ON MICHIGAN STATE PLANE.
3. SITE LOCATION: PROJECT SITE WITHIN SECTIONS 2 AND 11, T47N, R29W, HUMBOLDT TOWNSHIP, MARQUETTE COUNTY, MICHIGAN.
4. CONTOUR INTERVAL SHOWN IS 10 FOOT.
5. KEMC PURCHASE OPTIONS ARE ASSIGNABLE AND MAY BE ASSIGNED TO KENNECOTT RELATED ENTITY.

Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

CHECKED BY:	AKM	DATE: SEPT. '08
APPROVED BY:	SVD!	DATE: SEPT. '08
APPROVED BY:		DATE:

Kennecott Eagle Minerals

FIGURE 2-3
HUMBOLDT MILL EIA
PROPERTY OWNERSHIP

Scale: 0 200' 400'

Date: SEPTEMBER, 2008

Prepared By: JOW

Project No. 06W003

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12/19/2008 bjw1

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628,000 N
627,000 N
626,000 N
625,000 N
624,000 N
623,000 N
622,000 N
621,000 N
620,000 N
619,000 N
618,000 N

N

LEGEND

- EXISTING ELEV. CONTOUR IN FEET
- PAVED ROAD
- UNPAVED ROAD
- TRAIL
- TREE
- TREE LINE
- FENCE
- SURFACE WATER
- SWAMP/WETLAND
- STREAM/LAKE
- BUILDING
- HUMBOLDT TAILINGS DISPOSAL FACILITY
- APPROXIMATE LIMITS OF PRE-EXISTING IRON ORE TAILINGS DISPOSAL FACILITY
- KEMC PROJECT LOCATION

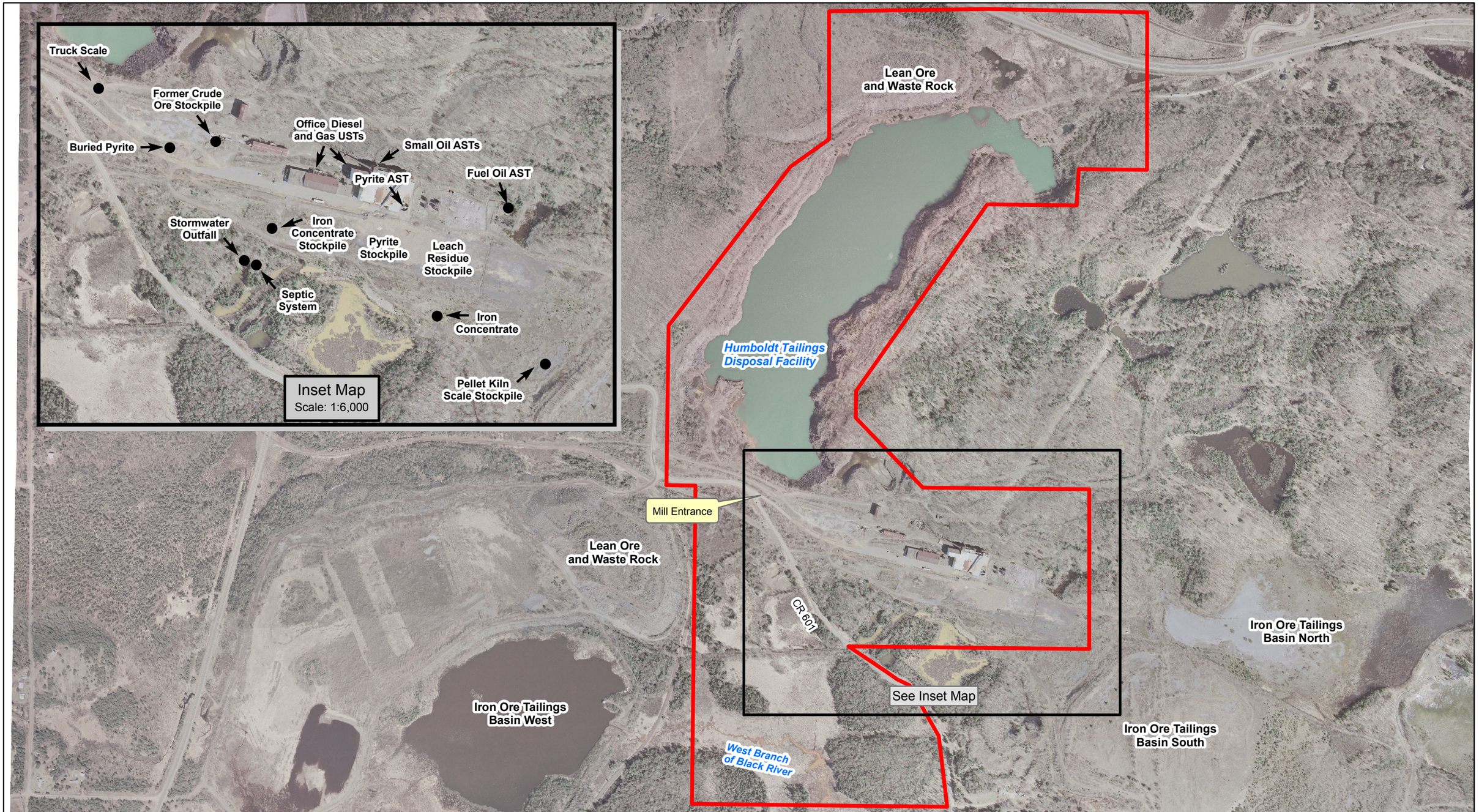
ST. HWY. 28
U.S.H. 41
ST. HWY. 95
CR 601
LEAN ORE AND WASTE ROCK
HUMBOLDT TAILINGS DISPOSAL FACILITY
MILL ENTRANCE
OLD CRUSHER BUILDING
CRUSHER PLANT
FORMER SECONDARY CRUSHER BUILDING
ELECTRICAL SUBSTATION
FACILITY WATER TOWER
MILL BLDG
FORMER PELLET PLANT
CONCRETE FOUNDATIONS
TRAILER
OFFICE/ MAINTENANCE BUILDING
STORMWATER OUTFALL
SEPTIC SYSTEM
GAS MAIN PRESSURE RELIEF STATION
IRON ORE TAILINGS BASIN NORTH
APPROXIMATE LOCATION OF TAILINGS SEEP AND SURFACE STAINING
WEIR
EFFLUENT DISCHARGE PIPE
IRON ORE TAILINGS BASIN WEST
WEST BRANCH OF BLACK RIVER
EXISTING WELL PUMP HOUSE
PRIVATE RESIDENCE
IRON ORE TAILINGS BASIN SOUTH
DECANT WATER EFFLUENT RISER PIPE
PUMP HOUSE FOUNDATION
LAKE LORY
APPROXIMATE LOCATION OF TAILINGS SEEP AND SURFACE STAINING
WEST BRANCH BLACK RIVER
ESCANABA RIVER
1995 PHOTOGRAPHY
2006 PHOTOGRAPHY

NOTES:

1. TOPOGRAPHIC AND PLANIMETRIC DATA SUPPLIED BY AERO-METRIC ENGINEERING, SHEBOYGAN, WISCONSIN. DATE OF PHOTOGRAPHY: APRIL 27, 2006, UNLESS OTHERWISE NOTED.
2. CONTOUR INTERVAL BASED ON NORTH AMERICAN VERTICAL DATUM OF 1988. HORIZONTAL DATUM BASED ON NAD 83/96. HORIZONTAL COORDINATES BASED ON MICHIGAN STATE PLANE.
3. SITE LOCATION: PROJECT SITE WITHIN SECTIONS 2 AND 11, T47N, R29W, HUMBOLDT TOWNSHIP, MARQUETTE COUNTY, MICHIGAN.
4. CONTOUR INTERVAL SHOWN IS 2 FOOT.

Foth Infrastructure & Environment, LLC				Kennecott Eagle Minerals
REVISED	DATE	BY	DESCRIPTION	FIGURE 2-4 HUMBOLDT MILL EIA EXISTING CONDITIONS
CHECKED BY: AKM			DATE: SEPT. '08	
APPROVED BY: SVDI			DATE: SEPT. '08	Scale: 0 250 500
APPROVED BY:			DATE:	Prepared By: JOW
				Date: SEPTEMBER, 2008
				Project No. 06W003

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12/19/2008 bjw1



NOTES

1. Orthophotography supplied by Aero-Metric Engineering, Sheboygan, Wisconsin. Date of photography: April 27, 2006.
2. Horizontal datum based on NAD 83/96. Horizontal coordinates based on Michigan State Plane North.
3. Site Location - Project Site within Sections 2 and 11, T47N, R29W, Humboldt Township, Marquette County, Michigan.

LEGEND

KEMC Project Location

N

Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

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

Kennecott Eagle Minerals

FIGURE 2-5

HUMBOLDT MILL EIA
AREAS OF INVESTIGATION

Scale: 0 400 800 Feet

Date: DECEMBER 2007

Prepared by: DAT

Project No: 06W003

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26,018,000 E
26,020,000 E
26,022,000 E
26,024,000 E
626,000 N
624,000 N
622,000 N
620,000 N
3
2
1
10
11
12
PRIVATE RESIDENCES
US HWY 41
EFFLUENT PIPE DISCHARGE INTO WETLAND
PROPOSED BERM TO ELEVATION 1543
LEAN ORE AND WASTE ROCK
PROPOSED CUT-OFF WALL
WWTP EFFLUENT PIPELINE
SURFACE WATER ELEVATION = 1537.88 (JUNE 5, 2007)
DISCHARGE PIPE W/DIFFUSER
SPLITTER MANHOLE
FLOATING BARGE (LOCATION WILL VARY BASED UPON OPERATIONS)
WWTP INFLUENT PIPELINE (LOCATION MAY VARY BASED ON OPERATIONS)
WASTEWATER TREATMENT PLANT
PROCESS WATER INFLUENT PIPELINE
DUMP POCKET/PRIMARY CRUSHER
SECONDARY CRUSHER FEED CONVEYOR
SECONDARY CRUSHER BUILDING
TRANSFER CONVEYOR
TERTIARY CRUSHER
TRANSFER STATION
PIPELINE WATER RELEASE POINT FOR NON-OPERATION PERIOD
TAILINGS SLURRY PIPELINE TO HTDF
MILL EXIT ROAD FOR ORE HAUL TRUCKS
MILL ENTRANCE
WATER TANKS
OFFICE/MAINTENANCE BUILDING
MILL FEED CONVEYOR
MILL BLDG
CMP CULVERT
GATE HOUSE
COARSE ORE STORAGE AREA
CONCENTRATE CONVEYORS
FUEL STORAGE SKID (LOCATION WILL VARY BASED UPON OPERATIONS)
MANHOLE
LEAN ORE AND WASTE ROCK
CMP CULVERT
DRAINAGE DITCH
FORMER PELLET PLANT
CONCRETE FOUNDATIONS
FENCED EQUIPMENT STORAGE \ STAGING AREA
SECONDARY CRUSHER
EMPLOYEE/ VISITOR PARKING
RAILROAD SPUR
IRON ORE TAILINGS BASIN NORTH
SEDIMENTATION BASIN
CR 601
CMP CULVERT
CONCENTRATE LOADOUT BUILDING
BUMPER
GAS MAIN PRESSURE RELIEF STATION
TEMPORARY SOIL STOCKPILE AREA
IRON ORE TAILINGS BASIN WEST
WEST BRANCH OF THE BLACK RIVER
EXISTING POTABLE WELL (TO BE REFURBISHED)
EXISTING WELL PUMP HOUSE
OUT BUILDINGS
PRIVATE RESIDENCE
IRON ORE TAILINGS BASIN SOUTH
14

N

LEGEND

- EXISTING ELEV. CONTOUR IN FEET
- TREE
- TREE LINE
- BUILDING
- TRAIL
- PAVED ROAD
- UNPAVED ROAD
- STREAM/LAKE
- HUMBOLDT TAILINGS DISPOSAL FACILITY (HTDF)
- PRE-EXISTING IRON ORE TAILINGS DISPOSAL FACILITY
- KEMC PROJECT LOCATION
- GRAVEL SURFACE
- RAILROAD SPUR
- SURFACE WATER FLOW DIRECTION
- BITUMINOUS PAVED AREA
- CMP CULVERT
- FENCE
- TAILINGS SLURRY PIPELINE TO HTDF
- BERMED AREA TO ELEVATION 1543
- WWTP EFFLUENT PIPELINE (LOCATION WILL VARY BASED UPON OPERATIONS)
- WWTP INFLUENT PIPELINE (LOCATION WILL VARY BASED UPON OPERATIONS)
- PROCESS WATER INFLUENT PIPELINE (LOCATION WILL VARY BASED UPON OPERATIONS)
- PROPOSED CUT-OFF WALL
- WATERSHED BOUNDARY

NOTES:

1. TOPOGRAPHIC AND PLANIMETRIC DATA SUPPLIED BY AERO-METRIC ENGINEERING, SHEBOYGAN, WISCONSIN. DATE OF PHOTOGRAPHY: APRIL 27, 2006.
2. CONTOUR INTERVAL BASED ON NORTH AMERICAN VERTICAL DATUM OF 1988. HORIZONTAL DATUM BASED ON NAD 83/96. HORIZONTAL COORDINATES BASED ON MICHIGAN STATE PLANE.
3. KEMC PROJECT LOCATION WITHIN SECTIONS 2 AND 11 T47N, R29W, HUMBOLDT TOWNSHIP, MARQUETTE COUNTY, MICHIGAN.
4. CONTOUR INTERVAL SHOWN IS 10 FOOT.

Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

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

Kennecott Eagle Minerals

FIGURE 2-6

HUMBOLDT MILL EIA
SITE DEVELOPMENT PLAN

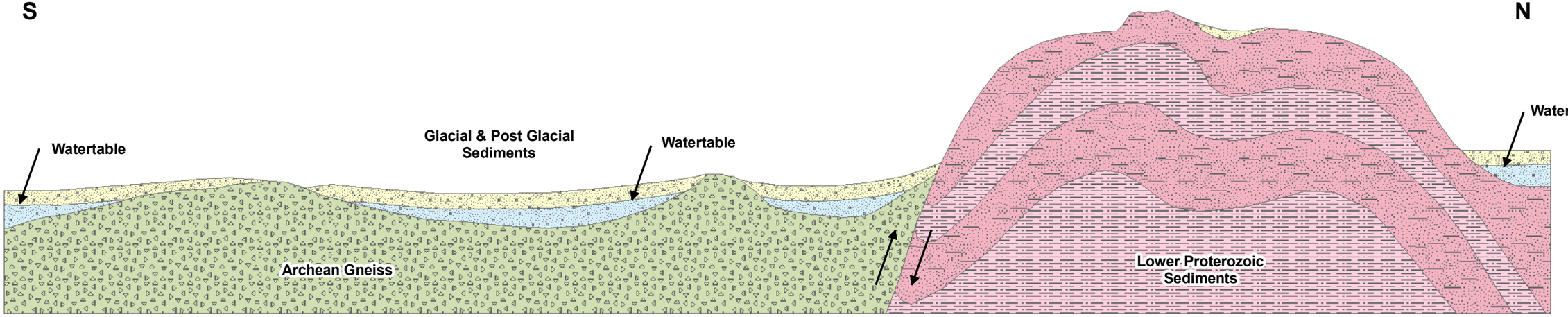
Scale: 0 200' 400'

Date: SEPTEMBER, 2008

Prepared By: JOW

Project No. 06W003

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12/19/2008 bjw1



Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

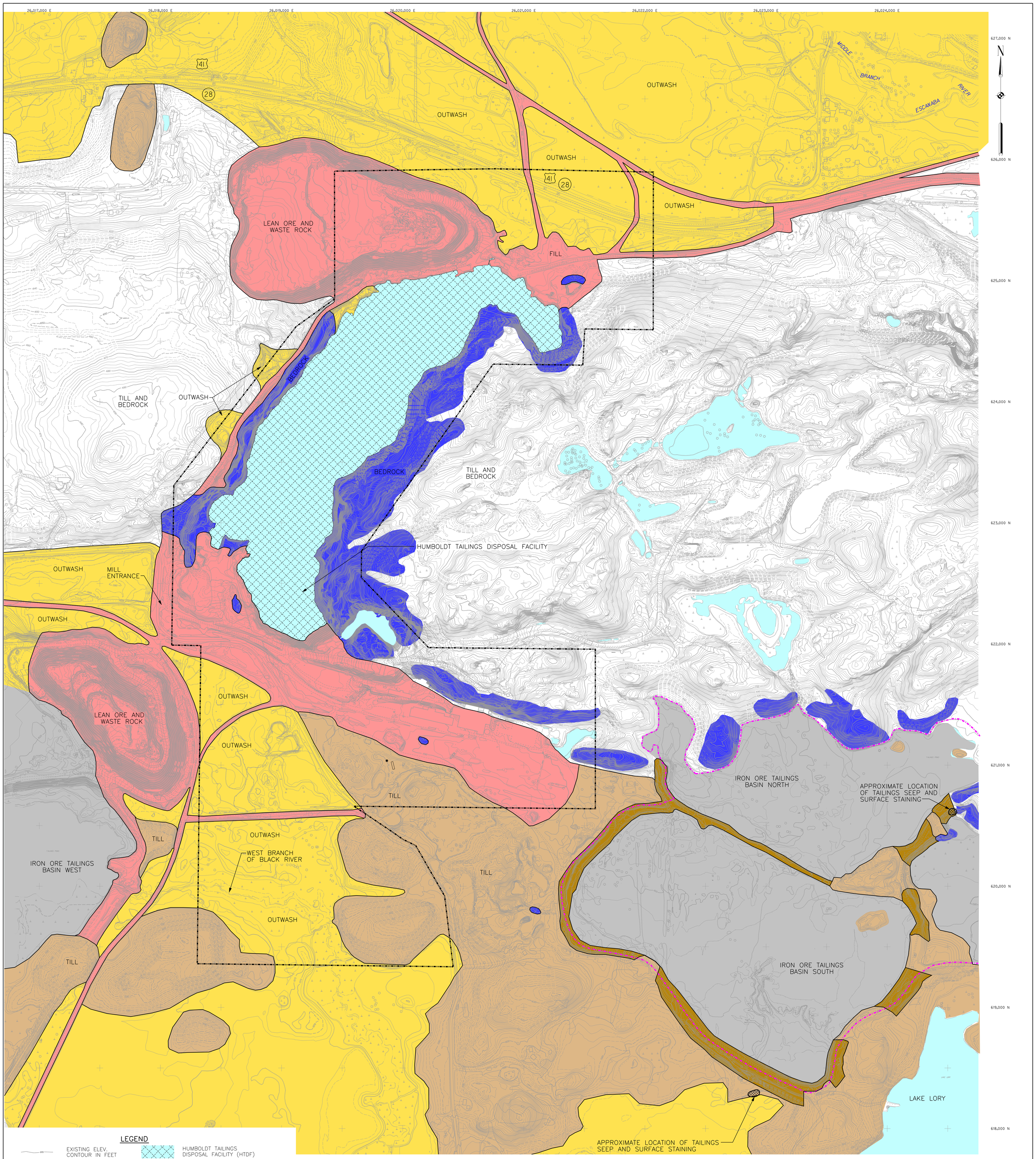
CHECKED BY: JSL	DATE: DEC. '07
APPROVED BY: SVD1	DATE: DEC. '07
APPROVED BY:	DATE:

Kennecott
Eagle Minerals

FIGURE 3-1
HUMBOLDT MILL EIA
GENERALIZED GEOLOGIC CROSS-SECTION

Scale:	Date: DECEMBER 2007
Prepared by: DAT	Project No: 06W003

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LEGEND

- EXISTING ELEV. CONTOUR IN FEET
- PAVED ROAD
- UNPAVED ROAD
- TRAIL
- TREE
- TREE LINE
- FENCE
- SURFACE WATER
- SWAMP/WETLAND
- STREAM/LAKE
- BUILDING
- HUMBOLDT TAILINGS DISPOSAL FACILITY (HTDF)
- APPROXIMATE LIMITS OF PRE-EXISTING IRON ORE TAILINGS DISPOSAL FACILITY
- KEMC PROJECT LOCATION
- APPROXIMATE LIMITS OF NATIVE SOIL IN AREA OF INTEREST
- APPROXIMATE LIMITS OF EXISTING STRUCTURAL FILL
- APPROXIMATE LIMITS OF EXISTING IRON ORE TAILINGS
- APPROXIMATE LIMITS OF EXISTING BERM
- APPROXIMATE LIMITS OF EXPOSED BEDROCK
- APPROXIMATE LIMITS OF OUTWASH

NOTES:

1. TOPOGRAPHIC AND PLANIMETRIC DATA SUPPLIED BY AERO-METRIC ENGINEERING, SHEBOYGAN, WISCONSIN. DATE OF PHOTOGRAPHY: APRIL 27, 2006.
2. CONTOUR INTERVAL BASED ON NORTH AMERICAN VERTICAL DATUM OF 1988. HORIZONTAL DATUM BASED ON NAD 83/96. HORIZONTAL COORDINATES BASED ON MICHIGAN STATE PLANE.
3. SITE LOCATION: PROJECT SITE WITHIN SECTIONS 2 AND 11, T47N, R29W, HUMBOLDT TOWNSHIP, MARQUETTE COUNTY, MICHIGAN.
4. CONTOUR INTERVAL SHOWN IS 10 FOOT.

0 300' 600'

Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

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

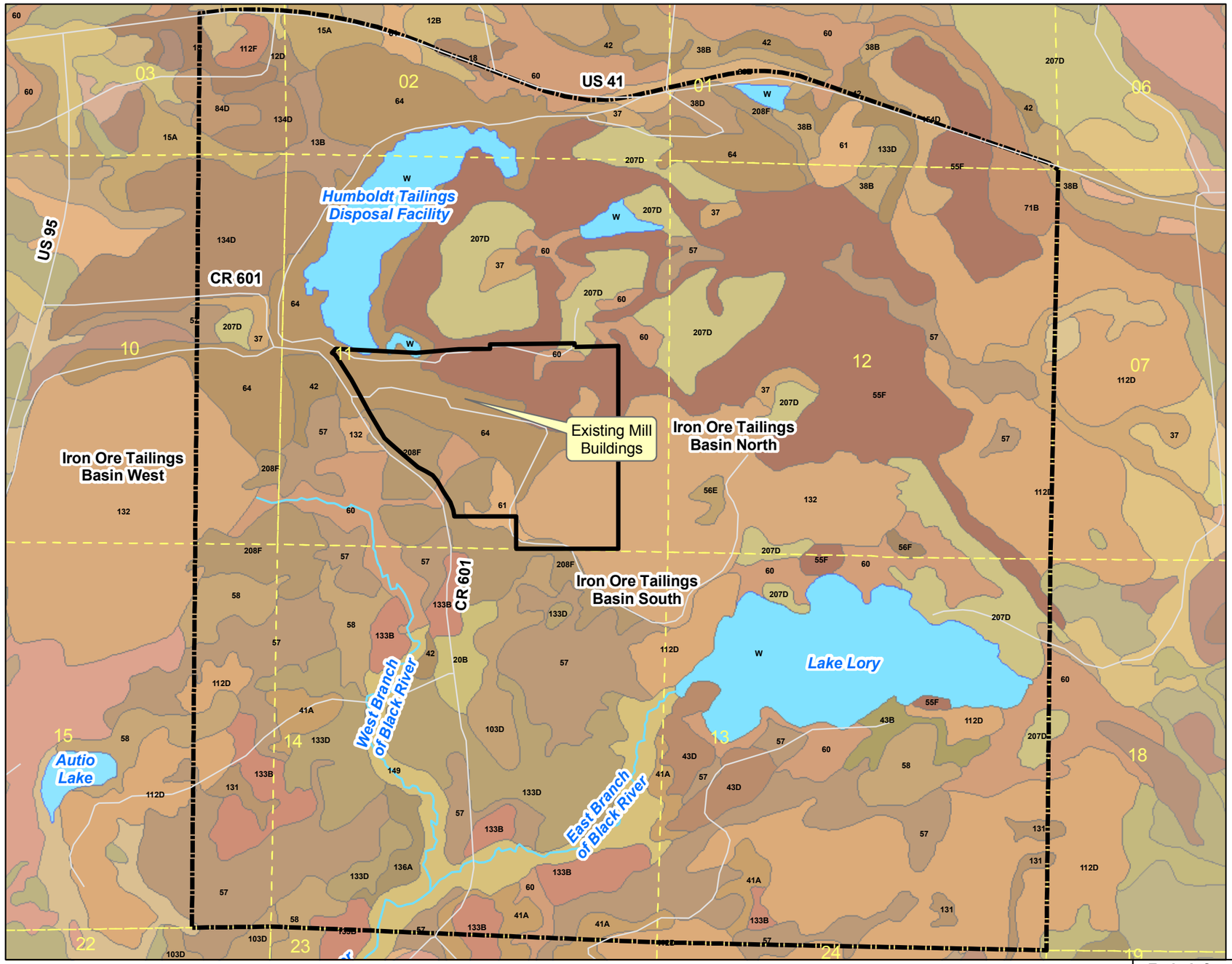
Kennecott Eagle Minerals

FIGURE 3-2

HUMBOLDT MILL EIA
SURFICIAL GEOLOGY

Scale:	AS SHOWN	Date:	DECEMBER, 2007
Prepared By:	JOW	Project No.	06W003

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12/19/2008 bjw1



SSURGO Soils

- 57 - Carbondale and Tawas soils
- 41A - Channing fine sandy loam - 0 to 3 percent slopes
- 15A - Croswell sand - 0 to 3 percent slopes
- 207D - Dishno-Michigamme-Rock outcrop complex - 6 to 25 percent slopes - very bouldery
- 149 - Evart-Cathro complex
- 71B - Evart-Pelkie-Sturgeon complex - 0 to 4 percent slopes
- 58 - Greenwood and Dawson soils
- 60 - Histosols and Aquents - ponded
- 13B - Kalkaska sand - 0 to 6 percent slopes
- 43B - Karlin sandy loam - 1 to 6 percent slopes
- 43D - Karlin sandy loam - 6 to 18 percent slopes
- 134D - Keewaydin cobbly fine sandy loam - 6 to 18 percent slopes - bouldery
- 133B - Keewaydin-Dishno complex - 1 to 6 percent slopes - rocky - bouldery
- 133D - Keewaydin-Dishno complex - 6 to 18 percent slopes - rocky - bouldery
- 208F - Keewaydin-Michigamme cobbly fine sandy loams - 18 to 45 percent slopes - rocky - very bouldery
- 112F - Keewaydin-Michigamme-Rock outcrop complex - 25 to 60 percent slopes - very bouldery
- 112D - Keewaydin-Michigamme-Rock outcrop complex - 6 to 25 percent slopes - very bouldery
- 18 - Kinross muck
- 55F - Michigamme-Rock outcrop complex - 25 to 70 percent slopes - very bouldery
- 42 - Minocqua muck
- 136A - Minocqua-Channing complex - 0 to 3 percent slopes
- 38B - Pence fine sandy loam - 0 to 6 percent slopes
- 38D - Pence fine sandy loam - 6 to 18 percent slopes
- 56E - Peshekee-Rock outcrop complex - 18 to 35 percent slopes - very bouldery
- 56F - Peshekee-Rock outcrop complex - 35 to 70 percent slopes - very bouldery
- 61 - Pits - borrow
- 64 - Pits and Dumps - mine
- 20B - Rousseau-Ocqueoc fine sands - 0 to 6 percent slopes
- 12B - Rubicon sand - 0 to 6 percent slopes
- 12D - Rubicon sand - 6 to 18 percent slopes
- 84D - Rubicon-Ishpeming-Rock outcrop complex - 6 to 25 percent slopes
- 103D - Rubicon-Ocqueoc-Rock outcrop complex - 6 to 25 percent slopes
- 154D - Rubicon-Sayner complex - 6 to 18 percent slopes - rocky
- 132 - Slickens
- 66B - Udipsamments-Urban land complex - nearly level and gently sloping
- W - Water
- 37 - Witbeck very stony muck - extremely bouldery
- 131 - Witbeck-Cathro complex - very bouldery

NOTES

1. Base Information, USGS georeferenced Digital Raster Graphics (DRG) and 1998 Digital Orthophoto Quads are from Michigan Center of Geographic Information (http://www.michigan.gov/cgi/)
2. Horizontal datum based on NAD 83/94. Horizontal coordinates based on UTM Zone 16.
3. Site Location - Project Site within Sections 2 and 11, T47N, R29W, Humboldt Township, Marquette County, Michigan.

LEGEND

- Detailed Wetland Study Area for 2006 Biological Survey
- Soils Study Area
- 22 Section Number
- Roads
- Lakes and Rivers

N

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REVISED	DATE	BY	DESCRIPTION

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

Kennecott Eagle Minerals

FIGURE 3-3
HUMBOLDT MILL EIA
MARQUETTE COUNTY SSURGO SOILS

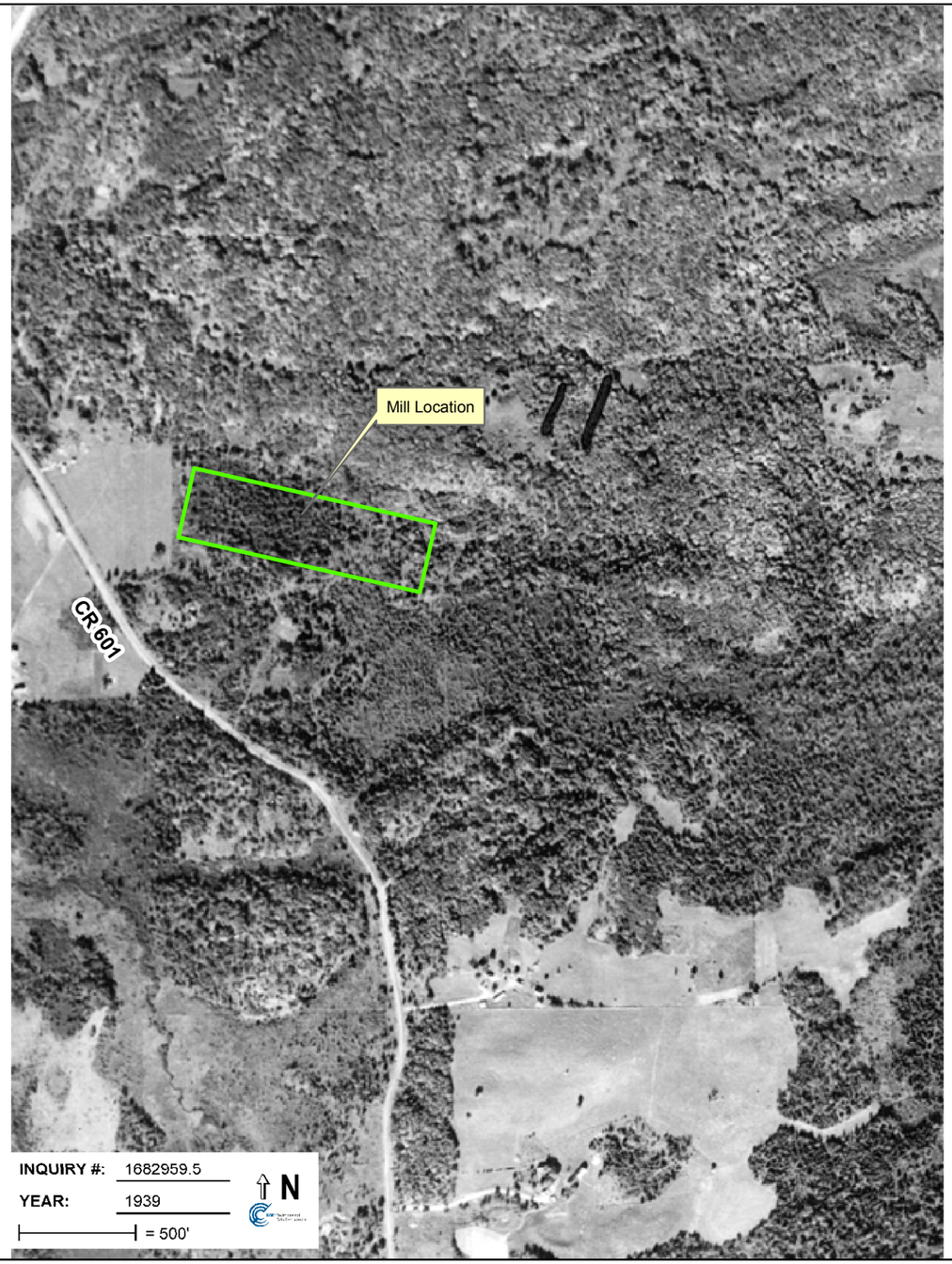
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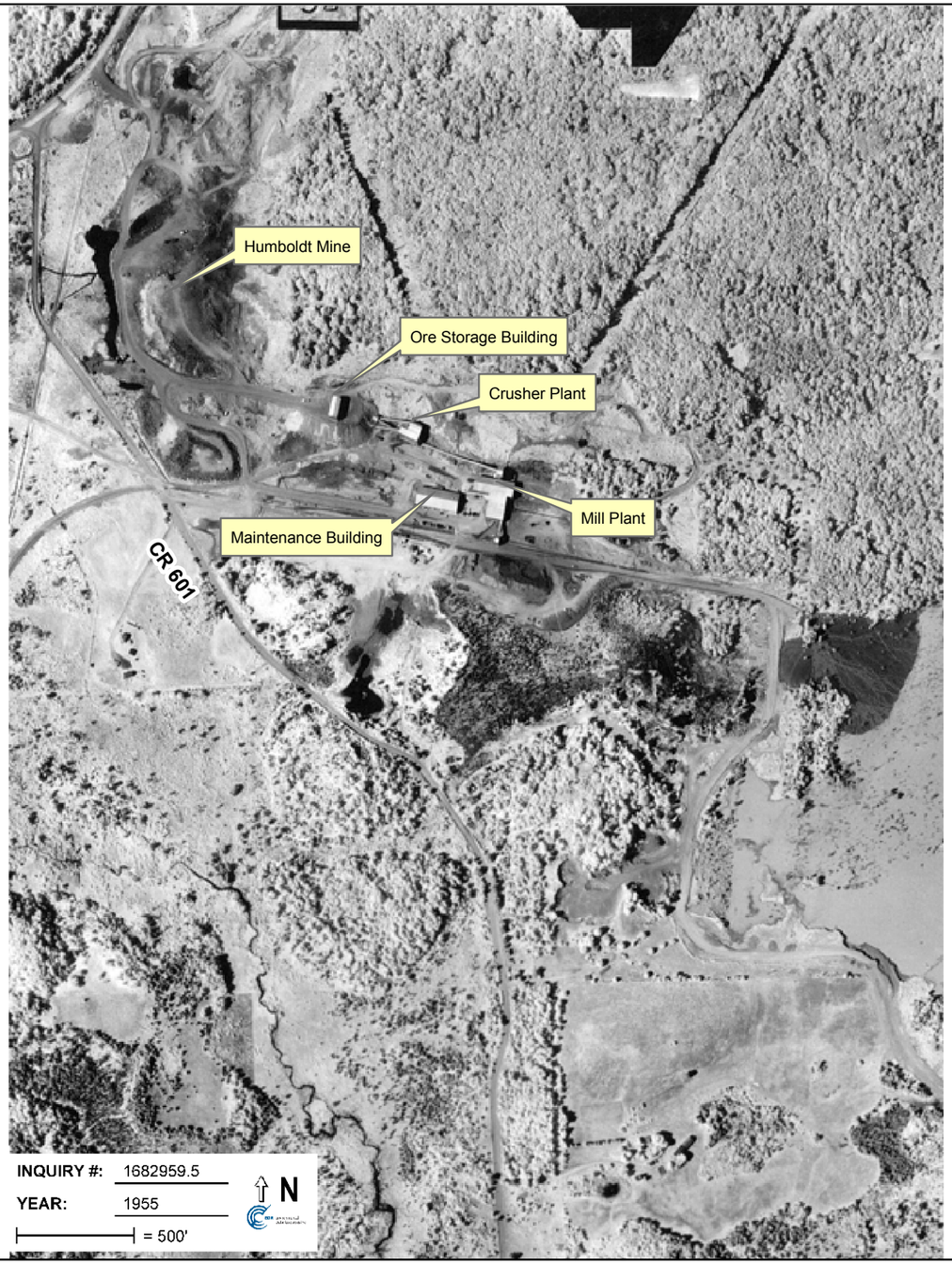
Date: DECEMBER 2007

Prepared by: DAT

Project No: 06W003

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NOTES

1. Historical Aerial Photos supplied by Environmental Data Resources Inc.
2. Horizontal datum based on NAD 83/94.
   Horizontal coordinates based on UTM Zone 16.
3. Site Location - Project Site within Sections 2 and 11, T47N, R29W,
   Humboldt Township, Marquette County, Michigan.

N

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REVISED	DATE	BY	DESCRIPTION

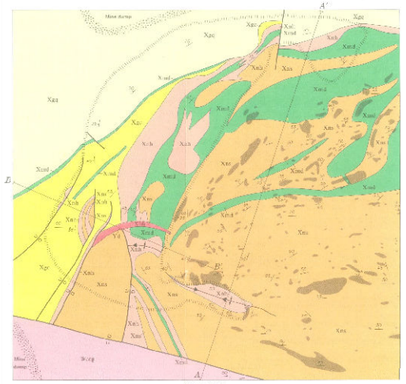
CHECKED BY:	AKM	DATE: DEC. '07
APPROVED BY:	SVD1	DATE: DEC. '07
APPROVED BY:		DATE:

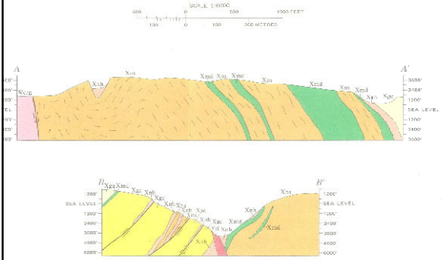
Kennecott
Eagle Minerals

FIGURE 3-4
HUMBOLDT MILL EIA
HISTORICAL AERIAL PHOTOS

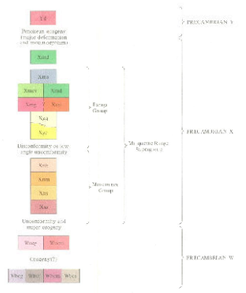
Scale: AS SHOWN	Date: DECEMBER 2007
Prepared by: DAT	Project No: 06W003

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DETAILED GEOLOGIC MAP AND SECTIONS OF THE HUMBOLDT MINE AREA



CORRELATION OF MAP UNITS

DESCRIPTION OF MAP UNITS

MISCELLANEOUS INVESTIGATIONS SERIES
MAP I-861

MICHIGAMME FORMATION (PRECAMBRIAN X) — Very thick gray-wacke-slate iron formation sequence with lesser amounts of volcanic rocks and iron formation. Only lowest part of formation present in quadrangle

Xmd Lower slate member — Poorly exposed unit. Laminated (mm-scale) to massive gray to dark brown chemical sedimentary quartz-mineral rock; subordinate thin (as much as a few inches thick) beds of impure quartzite. Very highly contorted bedding with minor fold axes generally accordant with regional fold axes.

Xmcv Chocolay Volcanics Member — Single outcrop in the quadrangle is sheared agglomeratic with matrix mafic pyroclastic fragments set in subordinate chert fragments. The presence of the member across much of the northern edge of the quadrangle is inferred by the low (subsidiary) Greenwood Iron Formation Member, largely by magnetic measurements. More extensive outcrops of the Chocolay Volcanics Member are found immediately east of the quadrangle and have been described by Cannon (1973).

Xmg Greenwood (=slate member) Member — Banded silicate-magnetite iron formation. Typically 10–15 percent magnetite with grunerite, hornblende, and biotite; rarely common iron-silicate minerals. Quartz (commonly recrystallized into mosaics of granular and sutured quartz) is chalcedonic, bed rocks of bare chert, typical of many iron formations, are absent. Mineral is commonly disseminated throughout quartz matrix. Outcrops exhibit an assumed concept of multiple fold axis and traces were made magnetically. Decrease in magnetic intensity to the west of outcrop area suggests the unit thins to the west, as grades laterally into lower slate member.

Xmf Banded silica-magnetite iron formation at base of Michigamme Formation in the Republic syncline — Very similar to Greenwood Iron Formation Member and although the two units are not physically continuous, they are probably correlative. Differs from Greenwood only in presence of cherty layers because of higher metamorphic grade in the vicinity of Republic.

GOODRICH QUARTZITE (PRECAMBRIAN X)

Xgq Thick upward clastic sequence with thin, discontinuous unit of iron silicate-bearing carbon pebble conglomerate at base, grading upward into thickly bedded, coarse- to medium-grained, orthoquartzite, which in turn grades up into more argillaceous rock. Dominantly is conglomeratic ore mostly angular to subrounded and as much as about 1 foot in longest dimension. Quartzite is medium-bedded at the lower 200 feet but contains some highly feldspathic beds in upper part of unit. Most argillaceous beds commonly contain abundant biotite, garnet, or chlorite.

Xgc Thick lenses of basal conglomerate — Best exposed in Humboldt and Republic open pit mines. Marked lateral changes in thickness, as much as several hundred feet thick in places. Polymictic conglomerate with pebble to cobble size angular to subrounded clasts of iron formation and layered to massive siliceous rocks, and well-rounded pebbles and cobbles of white quartz. Unpebbly sandstones, such as the matrix of the conglomerate, are quartz, arkosic, ferruginous, and argillitic, but little or no feldspar. Matrix is very much like and is mined for ceramic-grade iron ore at Republic open pit.

NEGAUNEE IRON-FORMATION (PRECAMBRIAN X)

Xnh Hematite-rich ore facies iron formation — Typically contains thick-bedded Fe and is the major iron producing unit in the quadrangle. Locally contains masses of high-grade, hard hematitic and magnetitic ore near open contact. In Republic syncline is mostly very-fine-grained jasperite with red and maroon jasper, pretty cherty, overlapped with similar fine-grained to even-size layers. Variable amounts of magnetite are disseminated in hematite layers. Magnetite is commonly coarser of the materials in varying degrees. Riebeckite, stilpnomelane, chlorite, hornblende, and garnet are common accessory minerals. Note: Hematite-rich ore is similar to that in Republic syncline but is more extensively faulted and brecciated, and gray chert is predominant over jasper.

Xnm Magnetite-rich ore facies iron formation — Iron-bearing chert-magnetite iron formation in Dutch beds. Mapped only around near Republic pit as a unit directly beneath jasperite but also present as a thin, discontinuous unit at same stratigraphic horizon in and near Humboldt pit. Consists of gray chert and many iron layers of magnetite with only trace amounts of iron silicates. Magnetite is sufficiently fine grained to digestly altered to martite. Mined along with overlying jasperite as concentrating grade ore at both Republic and Humboldt pits.

Xns Iron silicate-rich iron formation — Mostly banded grunerite-magnetite iron formation, consisting of layers of coarse-grained, greenish, well-banded magnetite and fine- to medium-grained, interlayered with gray chert, or locally chert free. Grunerite is typically massively oriented or in clusters of slender grains, or rarely oriented parallel to cleavage. Pinkish stilpnomelane is common, is disseminated throughout grunerite layers, and blades and aggregates are common accessory minerals. Al, Ca, Mg-silicates, calcite and calcite are locally common. In upper parts of the unit at Republic, enough Fe-carbonate may be sufficient for concentrating grade magnetite ore but in general, unit has only 10–15 percent magnetite.

Xsa SIAMO SLATE AND AJIBIK QUARTZITE, UNDIFFERENTIATED (PRECAMBRIAN X) — Poorly exposed unit of rusty-weathering schist similar to Siamo slate and siltstone essentially similar to Ajibik. Quartzite elsewhere in the Marquette area. Staple outcrops in Marquette synclinorium are in or on garnet schist with garnet porphyroblasts up to nearly 1 inch diameter in highly siliceous biotite-sericite matrix. Note Republic, most outcrops are siltstone quartzite which makes them resistant to widely fractured and locally cut by vein containing ferruginous fine-fine garnet grunerite schist which grades upward into Negaunee Iron-formation.

COMPANY CREEK GNEISS (PRECAMBRIAN W)

Wccg Granitic gneiss — Massive to prominently foliated and locally-gneissic granitic rocks. Largely granitic in composition but contains minor amounts of more potassic gneiss. Commonly has complex composition patches. Biotite, schistose and, in places, abundant rounded to subrounded quartz eyes and amphibolite. Described most fully by Cannon and Simmons (1972).

Wccm Granodiorite — Light to medium-gray, generally layered to gneissic hornblende-biotite rock. Dominantly as small bodies and veins of migmatite and gneiss.

HULL CREEK GNEISS (PRECAMBRIAN W) — Unit is described in more detail by Cannon and Simmons (1973).

Whcg Granitic gneiss — Commonly well porphyritic rock, mostly xenolithic with enough xenoliths to confuse mapping (as much as about 5–10 percent) which form about 1/2 of rock. Groundmass is largely 5–7 mm grains of quartz, plagioclase, mostly oligoclase, and microcline; rarely forms as much as 10 percent of rock, and chlorite, calcite, and sparse are common accessory minerals. Cryptic forming veins as much as 1 inch wide are common; unsplit rock abundance. Unit also contains more than 1 dyke inches to a few meters or more thick of fine-grained granitic rocks and metabasic rocks.

Whgl Granitic gneiss similar in mineralogy to Whcg but finer grained. More than 1 square mile of 1–2 cm long lens mostly of 1–2 mm grains. Unit has gradational contact with Whcg across which grain size gradually changes through a zone several hundred feet wide.

Whmg Mafic gneiss — Fine-banded, massive or prominently banded diabase-hornblende ± clinopyroxene gneiss, generally with medium-grained granoblastic texture. Locally contains lenses of blotchy metamorphosed basic dikes (dikes are not shown on map) and migmatite. All such zones are too small to map, but boulders where they occur are indicated by an X.

Whm Migmatite — Gray to pinkish fine-medium grained rock, mostly xenolithic (1–20 percent biotite and/or hornblende inclusions), with white to pink, massive to foliated leucocratic granite-gneiss such as Company Creek gneiss. Layers generally about 1 foot thick with irregular gneiss commonly injected through layers of darker feldspathic gneiss

MAP SYMBOLS

The geology shown in the Republic and Humboldt mine areas does not conform to later mine maps because of post-1975 mine activities. Outcrops are rare.

Area of bedrock outcrop

Contact — Short dash where concealed, as in open pit. Accuracy of location can be inferred from distribution of outcrops. Dashed where inferred

Fault — Dotted in suffix U, ball on down side, D, down on ball side

Syncline — Showing trace of axial plane and direction of plunge

Strike and dip of bedding
- Inclined
- Vertical
- Overturned

Strike and dip of foliation or cleavage — Where given where known
- Inclined
- Vertical

Strike of lineation — Dip not measured

Bearing and plunge of fold axes

Traverse of magnetic anomaly

Margin of iron pit

Margin of tailings basin

Margin of stripping cases

Note: Topographic contours do not conform to the surface within open pits. Contours inaccurate for those areas. Steeply dipping pit walls in places distort the map view of the geology. In particular, the thick-bedded units overlying the ore zone is commonly exaggerated, especially in the Humboldt pit, because the pit floor walls commonly are parallel to, or folding. Folded pattern shown area of tailings basin is [illegible]

NOTES

1. Bedrock Geologic Map of the Republic Qudarangle, Marquette County, Michigan by William F. Cannon, 1975.
2. Site Location - Project Site within Sections 2 and 11, T47N, R29W, Humboldt Township, Marquette County, Michigan.

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Foth Infrastructure & Environment, LLC

Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION

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

Kennecott
Eagle Minerals

FIGURE 3-5
HUMBOLDT MILL EIA
BEDROCK GEOLOGY

Scale: NOT TO SCALE	Date: DECEMBER 2007
Prepared by: DAT	Project No: 06W003

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26,017,000 E | 26,018,000 E | 26,019,000 E | 26,020,000 E | 26,021,000 E | 26,022,000 E | 26,023,000 E | 26,024,000 E

627,000 N | 626,000 N | 625,000 N | 624,000 N | 623,000 N | 622,000 N | 621,000 N | 620,000 N | 619,000 N | 618,000 N

LEAN ORE AND WASTE ROCK

BEDROCK UPLANDS COVERED WITH THIN VENEER OF GLACIAL TILL

HUMBOLDT TAILINGS DISPOSAL FACILITY

IRON ORE TAILINGS BASIN WEST

IRON ORE TAILINGS BASIN NORTH

IRON ORE TAILINGS BASIN SOUTH

APPROXIMATE LOCATION OF TAILINGS SEEP AND SURFACE STAINING

WEIR

EFFLUENT DISCHARGE PIPE

DECANT WATER EFFLUENT RISER PIPE

APPROXIMATE LOCATION OF TAILINGS SEEP AND SURFACE STAINING

LAKE LORY

MIDDLE BRANCH ESCANABA RIVER

WATER ELEV. 1537.88
WATER ELEV. 1712.4
WATER ELEV. 1723.2
WATER ELEV. 1730.5
WATER ELEV. 1734.5
WATER ELEV. 1672.6
WATER ELEV. 1621.5
WATER ELEV. 1576.5
WATER ELEV. 1589.2
WATER ELEV. 1569.3
WATER ELEV. 1606.1
WATER ELEV. 1592.3
WATER ELEV. 1564.8

1533.91 HW-6A
1533.39 HW-6
1535.60 HYC-7
1535.66 HW-1
1534.33 HMP-009 HMP-002
HMP-004 1531.85
1535.70 HW-1A
1536.83 HW-5A
1536.49 HW-5
HMP-008 1537.88
1536.28 HW-2
1543.43 HMP-005
HW-3 1549.23
1552.67 HW-4
PW-3 1551.35
HMP-007 1571.27
1556.51 KMW-5
KMW-6A
KMW-9P
KMW-9 1556.12
KMW-7 1557.04
1558.42 KMW-4
1583.33 KMW-1
1583.51 MW-104
1579.48 PW-1
1583.48 PW-2
MW-106
MW-107
MW-1
MW-9 1590.09
MW-5
KMW-2
MW-7 1565.24
MW-10
MW-4 1583.32
MW-6
MW-102 1590.06
MW-601 1598.55
1600.54 HMS-001
KMW-3 1576.58
MW-12 1585.67
MW-103 1587.43
MW-11 1587.42
HMS-006 1585.18
MW-101 1595.71
1589.19 KMW-10
1589.23 RMS-005
1578.28 HMS-007
MW-604 1589.17
P-604 1588.60
1604.31 MW-602
P-602 1604.28
1607.32 TDP-002
MW-603 1596.38
1590.53 HMS-002
MW-605 1590.00
1590.03 P-605
MW-606 1602.28
HMS-003 1589.97
1589.83 HMS-004
1597.33 TDP-001
FOUNDATION

LEGEND

- EXISTING ELEV. CONTOUR IN FEET
- PAVED ROAD
- UNPAVED ROAD
- TRAIL
- FENCE
- SURFACE WATER
- SWAMP/WETLAND
- STREAM/LAKE
- BUILDING
- HUMBOLDT TAILINGS DISPOSAL FACILITY (HTDF)
- APPROXIMATE LIMITS OF PRE-EXISTING IRON ORE TAILINGS DISPOSAL FACILITY
- KEMC PROJECT LOCATION
- KMW-10 1589.19 — MONITORING WELL NUMBER, LOCATION AND GROUNDWATER ELEVATION
- 1570 — JUNE 2007 GROUNDWATER CONTOUR (DASHED CONTOURS REPRESENT INFERRED)
- GROUNDWATER FLOW DIRECTION
- APPROXIMATE GROUNDWATER DIVIDE
- WATERSHED BOUNDARY

NOTES:

1. TOPOGRAPHIC AND PLANIMETRIC DATA SUPPLIED BY AERO-METRIC ENGINEERING, SHEBOYGAN, WISCONSIN. DATE OF PHOTOGRAPHY: APRIL 27, 2006.
2. CONTOUR INTERVAL BASED ON NORTH AMERICAN VERTICAL DATUM OF 1988. HORIZONTAL DATUM BASED ON NAD 83/96. HORIZONTAL COORDINATES BASED ON MICHIGAN STATE PLANE.
3. SITE LOCATION: PROJECT SITE WITHIN SECTIONS 2 AND 11, T47N, R29W, HUMBOLDT TOWNSHIP, MARQUETTE COUNTY, MICHIGAN.
4. GROUNDWATER CONTOUR INTERVAL SHOWN IS 1 FOOT NORTH OF HUMBOLT TAILINGS DISPOSAL FACILITY (HTDF) AND 5 FOOT SOUTH OF HTDF. TOPOGRAPHIC CONTOUR INTERVAL IS 10 FOOT.
5. LAKE/POND ELEVATIONS BASED ON APRIL 27, 2006 AERIAL PHOTOGRAPHY UNLESS OTHERWISE MEASURED BY STAFF GAUGE.

0 300' 600'

Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION
CHECKED BY: JSL		DATE: SEPT. '08	
APPROVED BY: SVD1		DATE: SEPT. '08	
APPROVED BY:		DATE:	

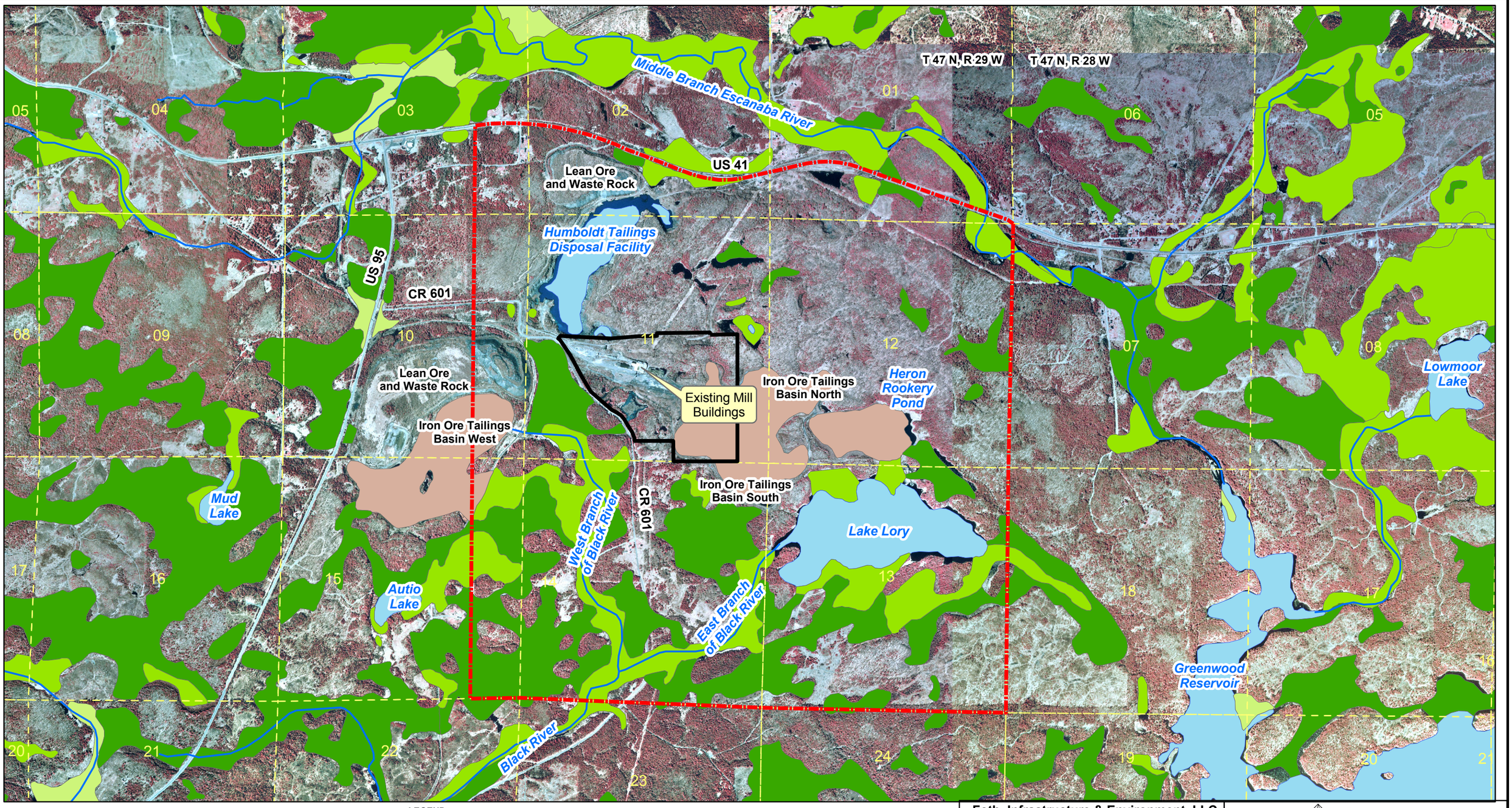
Kennecott Eagle Minerals

FIGURE 3-6

HUMBOLDT MILL EIA
JUNE 2007 GROUNDWATER CONTOURS

Scale: AS SHOWN	Date: SEPTEMBER, 2008
Prepared By: JOW	Project No. 06W003

L:\06w003\EIA\eia_june07_gw.3d
12/19/2008 bjw1



NOTES

1. Base Information, USGS georeferenced Digital Raster Graphics (DRG) and 1998 Digital Orthophoto Quads are from Michigan Center of Geographic Information (http://www.michigan.gov/cgi/)
2. Horizontal datum based on NAD 83/94. Horizontal coordinates based on UTM Zone 16.
3. Site Location - Project Site within Sections 2 and 11, T47N, R29W, Humboldt Township, Marquette County, Michigan.

LEGEND

- Overall Study Area for 2006 Biological Survey
- Detailed Wetland Study Area for 2006 Biological Survey
- PLSS Sections

Marquette County NWI

- Emergent
- Scrub-Shrub
- Forested
- Unconsolidated Bottom
- Open Water/Unknown Bottom

N

Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

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

Kennecott Eagle Minerals

FIGURE 3-7
HUMBOLDT MILL EIA
NWI IDENTIFIED WETLANDS

Scale: 0 1,000 2,000 Feet

Date: DECEMBER 2007

Prepared by: DAT

Project No: 06W003

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T 47 N, R 29 W
T 47 N, R 28 W
Middle Branch Escanaba River
US 41
Lean Ore and Waste Rock
Humboldt Tailings Disposal Facility
US 95
CR 601
Existing Mill Buildings
Iron Ore Tailings Basin North
Heron Rookery Pond
Lowmoor Lake
Iron Ore Tailings Basin South
Mud Lake
West Branch of Black River
Lake Lory
Autio Lake
East Branch of Black River
Greenwood Reservoir
Black River

NOTES

1. Base Information, USGS georeferenced Digital Raster Graphics (DRG) and 1998 Digital Orthophoto Quads are from Michigan Center of Geographic Information (http://www.michigan.gov/cgi/)
2. Horizontal datum based on NAD 83/94. Horizontal coordinates based on UTM Zone 16.
3. Site Location - Project Site within Sections 2 and 11, T47N, R29W, Humboldt Township, Marquette County, Michigan.

LEGEND

Overall Study Area for 2006 Biological Survey

Detailed Wetland Study Area, Wetlands in this area not shown

PLSS Sections

	Area (Acres)
Emergent	289.5
Scrub-Shrub	166.9
Forested	281.4
Open Water/Unknown Bottom	270.3

N

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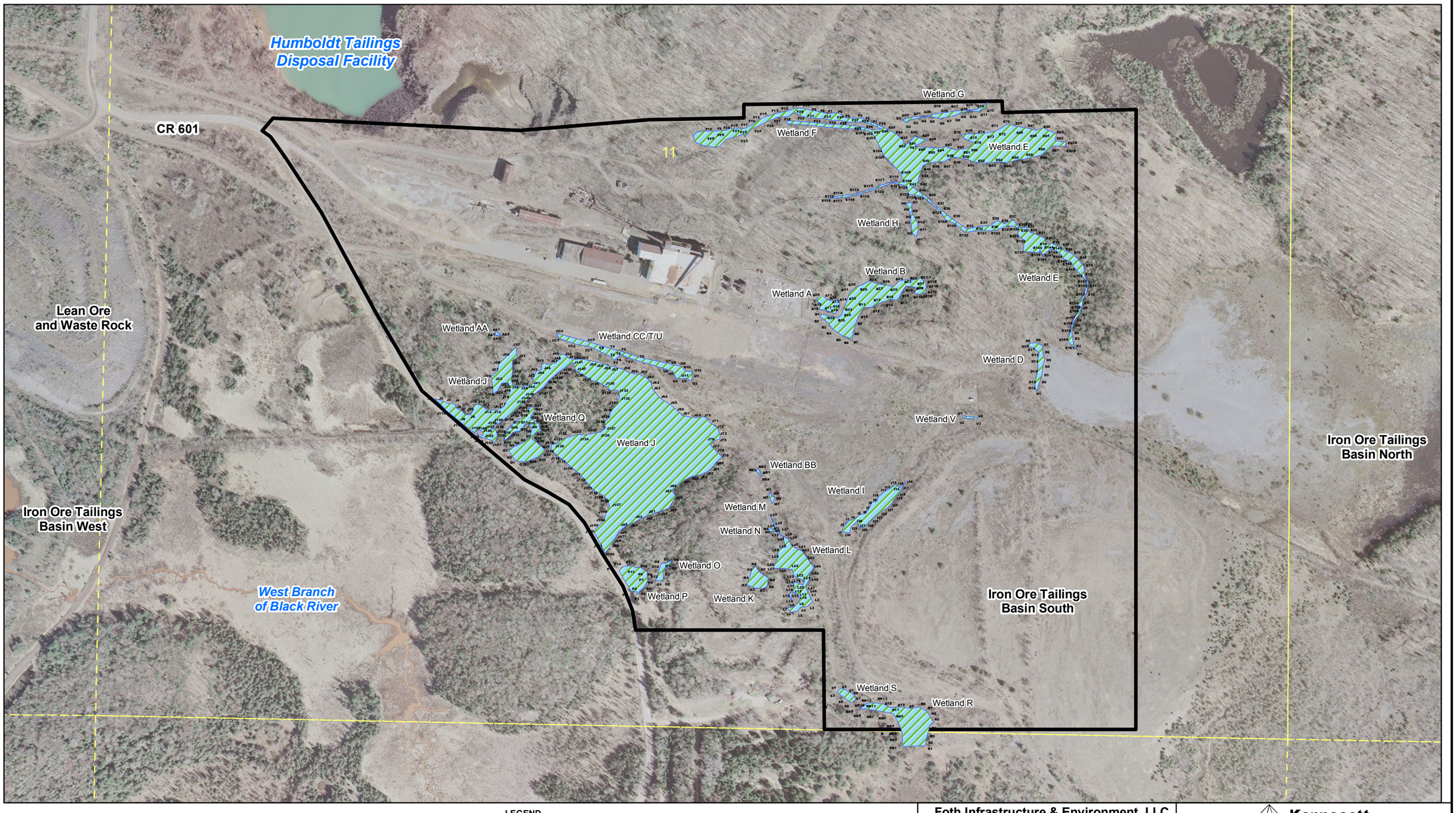
CHECKED BY:	AKM	DATE: DEC. '07	
APPROVED BY:	SVD1	DATE: DEC. '07	
APPROVED BY:		DATE:	

Kennecott Eagle Minerals

FIGURE 3-8
HUMBOLDT MILL EIA
PRELIMINARY WETLAND EVALUATION MAP

Scale: 0 1,000 2,000 Feet
Date: DECEMBER 2007
Prepared by: DAT
Project No: 06W003

M:\06w003\mxd\EIA\kmc_humboldt_WetlandsEvaluation_11x17.mxd December 4, 2007



NOTES

1. Orthophotography supplied by Aero-Metric Engineering, Sheboygan, Wisconsin. Date of photography: April 27, 2006.
2. Horizontal datum based on NAD 83/96. Horizontal coordinates based on Michigan State Plane North.
3. Site Location - Project Site within Sections 2 and 11, T47N, R29W, Humboldt Township, Marquette County, Michigan.
4. Level 3 Wetland Boundary GPS data supplied by King & MacGregor Environmental, Inc. via email on 09/25/2007.

LEGEND

- Overall Study Area for 2006 Biological Survey
- Detailed Wetland Study Area for 2006 Biological Survey
- PLSS Sections
- R7 Wetland Boundary Flagging
- Wetlands
- Detailed Wetland Study Area

N

Foth Infrastructure & Environment, LLC

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APPROVED BY:		DATE:	

Kennecott Eagle Minerals

FIGURE 3-9
HUMBOLDT MILL EIA
WETLAND BOUNDARY FLAGGING
IN THE DETAILED STUDY AREA

Scale: 0 200 400 Feet

Date: DECEMBER 2007

Prepared by: DAT

Project No: 06W003

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Middle Branch Escanaba River

03

02

01

Lean Ore
and Waste Rock

US 41

Humboldt Tailings
Disposal Facility

10

11

12

NOTES

1. Base Information, USGS georeferenced Digital Raster Graphics (DRG) and 1998 Digital Orthophoto Quads are from Michigan Center of Geographic Information (http://www.michigan.gov/cgi/)
2. Horizontal datum based on NAD 83/94. Horizontal coordinates based on UTM Zone 16.
3. Site Location - Project Site within Sections 2 and 11, T47N, R29W, Humboldt Township, Marquette County, Michigan.

LEGEND

- 2007 Wetland Survey Location of Wetland EE
- Overall Study Area Boundary for 2006 Biological Survey
- KEMC Project Location
- PLSS Sections

Marquette County NWI

- Emergent
- Scrub-Shrub
- Forested

N

Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

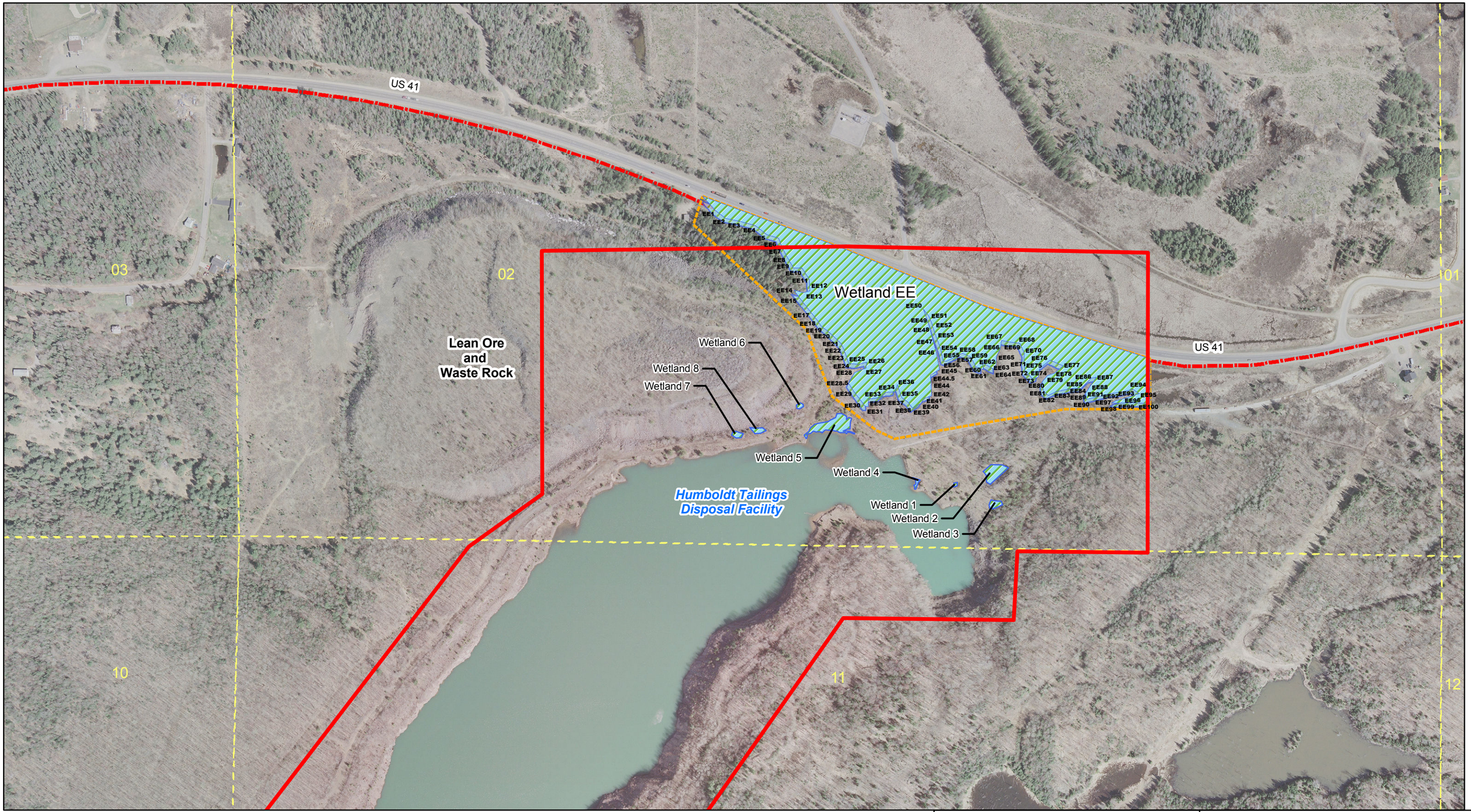
CHECKED BY:	AKM	DATE: DEC. '07	
APPROVED BY:	SVD1	DATE: DEC. '07	
APPROVED BY:		DATE:	

Kennecott
Eagle Minerals

FIGURE 3-10
HUMBOLDT MILL EIA
WETLAND EE & ADJACENT LAND TO THE NORTH
NWI IDENTIFIED WETLANDS

Scale: 0 250 500 Feet	Date: DECEMBER 2007
Prepared by: DAT	Project No: 06W003

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NOTES

1. Orthophotography supplied by Aero-Metric Engineering, Sheboygan, Wisconsin. Date of photography: April 27, 2006.
2. Horizontal datum based on NAD 83/96. Horizontal coordinates based on Michigan State Plane North.
3. Site Location - Project Site within Sections 2 and 11, T47N, R29W, Humboldt Township, Marquette County, Michigan.
4. Revised Wetland Boundary GPS data supplied by King & MacGregor Environmental, Inc., September, 2008

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LEGEND

- Overall Study Area for 2006 Biological Survey
- PLSS Sections
- EE7 Wetland Boundary Flagging
- Wetland
- Wetland Study Area
- KEMC Project Location

N

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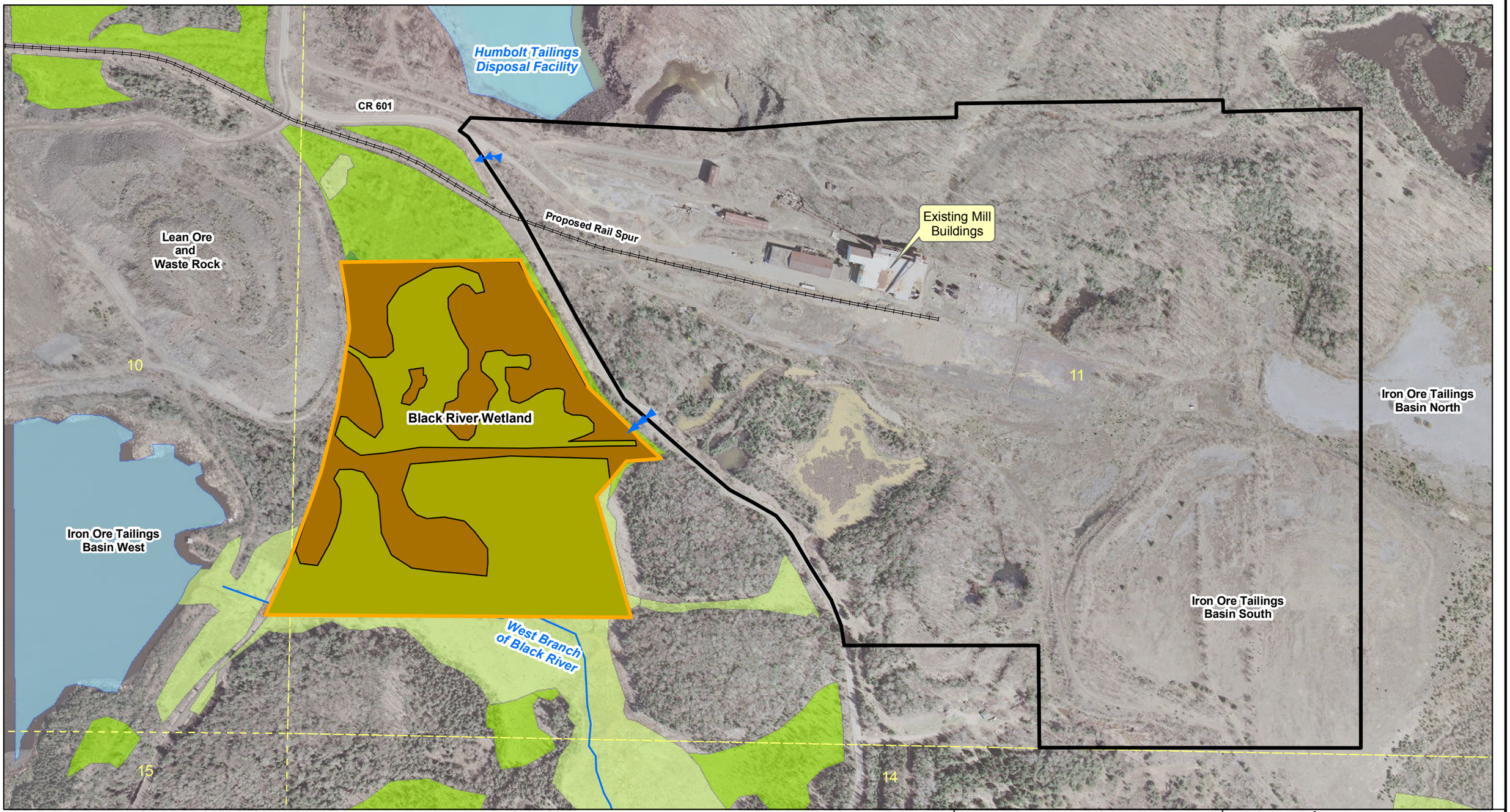
FIGURE 3-11
HUMBOLDT MILL EIA
WETLAND EE BOUNDARY

Scale: 0 200 400 Feet

Date: DECEMBER, 2008

Prepared by: DAT

Project No: 06W003



NOTES

1. Base Information, USGS georeferenced Digital Raster Graphics (DRG) and 1998 Digital Orthophoto Quads are from Michigan Center of Geographic Information (http://www.michigan.gov/cgi/)
2. Horizontal datum based on NAD 83/94.
   Horizontal coordinates based on UTM Zone 16.
3. Site Location - Project Site within Sections 2 and 11, T47N, R29W, Humboldt Township, Marquette County, Michigan.
4. Wetland boundary adjusted for presence of rail bed

LEGEND

- Black River Wetland
- Detailed Wetland Study Area, Wetlands in this area not shown
- PLSS Sections
- Proposed Renovation of LS&I Railroad Spur
- Approximate Location of Storm Water Discharge Outlet

Marquette County NWI

- Emergent
- Scrub-Shrub
- Forested
- Open Water/Unknown Bottom

KME June/July 2007 Survey

- Approximate Upland Areas
- Approximate Wetland Areas

N

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

Kennecott Eagle Minerals

FIGURE 3-12
HUMBOLDT MILL EIA
WETLAND EVALUATION
OF BLACK RIVER WETLAND

Scale: 0 200 400 Feet | Date: DECEMBER 2007

Prepared by: DAT | Project No: 06W003

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26,018,000 E
26,020,000 E
26,022,000 E
26,024,000 E
626,000 N
624,000 N
622,000 N
620,000 N
EFFLUENT PIPE DISCHARGE INTO WETLAND
PROPOSED BERM TO ELEVATION 1543
US HWY 41
LEAN ORE AND WASTE ROCK
Wetland EE
PROPOSED CUT-OFF WALL
WWTP EFFLUENT PIPELINE
SURFACE WATER ELEVATION = 1537.88 (JUNE 5, 2007)
SPLITTER MANHOLE
DISCHARGE PIPE W/DIFFUSER
FLOATING BARGE (LOCATION WILL VARY BASED UPON OPERATIONS)
WWTP INFLUENT PIPELINE
PIPELINE WATER RELEASE POINT FOR NON-OPERATION PERIOD
WASTEWATER TREATMENT PLANT
PROCESS WATER INFLUENT PIPELINE
DUMP POCKET/PRIMARY CRUSHER
TAILINGS SLURRY PIPELINE TO HTDF
SECONDARY CRUSHER FEED CONVEYOR
SECONDARY CRUSHER BUILDING
TRANSFER CONVEYOR
TERTIARY CRUSHER
TRANSFER STATION F
Wetland G
Wetland E
MILL EXIT ROAD FOR ORE HAUL TRUCKS
MILL ENTRANCE
WATER TANKS
OFFICE/MAINTENANCE BUILDING
LIME & SODA ASH SILOS
CMP CULVERT
GATE HOUSE
MILL BUILDING
FUEL STORAGE SKID (LOCATION WILL VARY BASED UPON OPERATIONS)
COARSE ORE STORAGE AREA
CONCENTRATE CONVEYORS
Wetland H
LEAN ORE AND WASTE ROCK
CMP CULVERT
TOILET PLANT
Wetland A
FENCED EQUIPMENT STORAGE STAGING AREA
DRAINAGE DITCH
Wetland B
Wetland D
CONCRETE FOUNDATIONS
CR 601
Wetland AA
EMPLOYEE/ VISITOR PARKING
Wetland CC/TW
IRON ORE TAILINGS BASIN NORTH
SEDIMENTATION BASIN
RAILROAD SPUR
GAS MAIN PRESSURE RELIEF STATION
SECONDARY CRUSHER
CMP CULVERT
Wetland Q
BUMPER
Wetland V
TEMPORARY SOIL STOCKPILE AREA
Wetland J
Wetland BB
Wetland I
CONCENTRATE LOADOUT BUILDING
Wetland M
IRON ORE TAILINGS BASIN WEST
Wetland N
WEST BRANCH OF THE BLACK RIVER
Wetland O
Wetland K
Wetland L
EXISTING POTABLE WELL (TO BE REFURBISHED)
Wetland P
EXISTING WELL PUMP HOUSE
Wetland S
OUT BUILDINGS
Wetland R
PRIVATE RESIDENCE
IRON ORE TAILINGS BASIN SOUTH

N

LEGEND

- EXISTING ELEV. CONTOUR IN FEET
- TREE
- TREE LINE
- BUILDING
- TRAIL
- PAVED ROAD
- UNPAVED ROAD
- STREAM/LAKE
- HUMBOLDT TAILINGS DISPOSAL FACILITY (HTDF)
- PRE-EXISTING IRON ORE TAILINGS DISPOSAL FACILITY
- KEMC PROJECT LOCATION
- GRAVEL SURFACE
- RAILROAD SPUR
- SURFACE WATER FLOW DIRECTION
- BITUMINOUS PAVED AREA
- CMP CULVERT
- FENCE
- TAILINGS SLURRY PIPELINE TO HTDF
- WETLAND AREA GPS DATA SUPPLIED BY KING & MACGREGOR ENVIRONMENTAL, INC.
- BERMED AREA TO ELEVATION 1543
- WWTP EFFLUENT PIPELINE (LOCATION WILL VARY BASED UPON OPERATIONS)
- WWTP INFLUENT PIPELINE (LOCATION WILL VARY BASED UPON OPERATIONS)
- PROCESS WATER INFLUENT PIPELINE (LOCATION WILL VARY BASED UPON OPERATIONS)
- PROPOSED CUT-OFF WALL

NOTES:

1. TOPOGRAPHIC AND PLANIMETRIC DATA SUPPLIED BY AERO-METRIC ENGINEERING, SHEBOYGAN, WISCONSIN. DATE OF PHOTOGRAPHY: APRIL 27, 2006.
2. CONTOUR INTERVAL BASED ON NORTH AMERICAN VERTICAL DATUM OF 1988. HORIZONTAL DATUM BASED ON NAD 83/96. HORIZONTAL COORDINATES BASED ON MICHIGAN STATE PLANE.
3. KEMC PROJECT LOCATION WITHIN SECTIONS 2 AND 11 T47N, R29W, HUMBOLDT TOWNSHIP, MARQUETTE COUNTY, MICHIGAN.
4. CONTOUR INTERVAL SHOWN IS 10 FOOT.

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12/19/2008 bjw1

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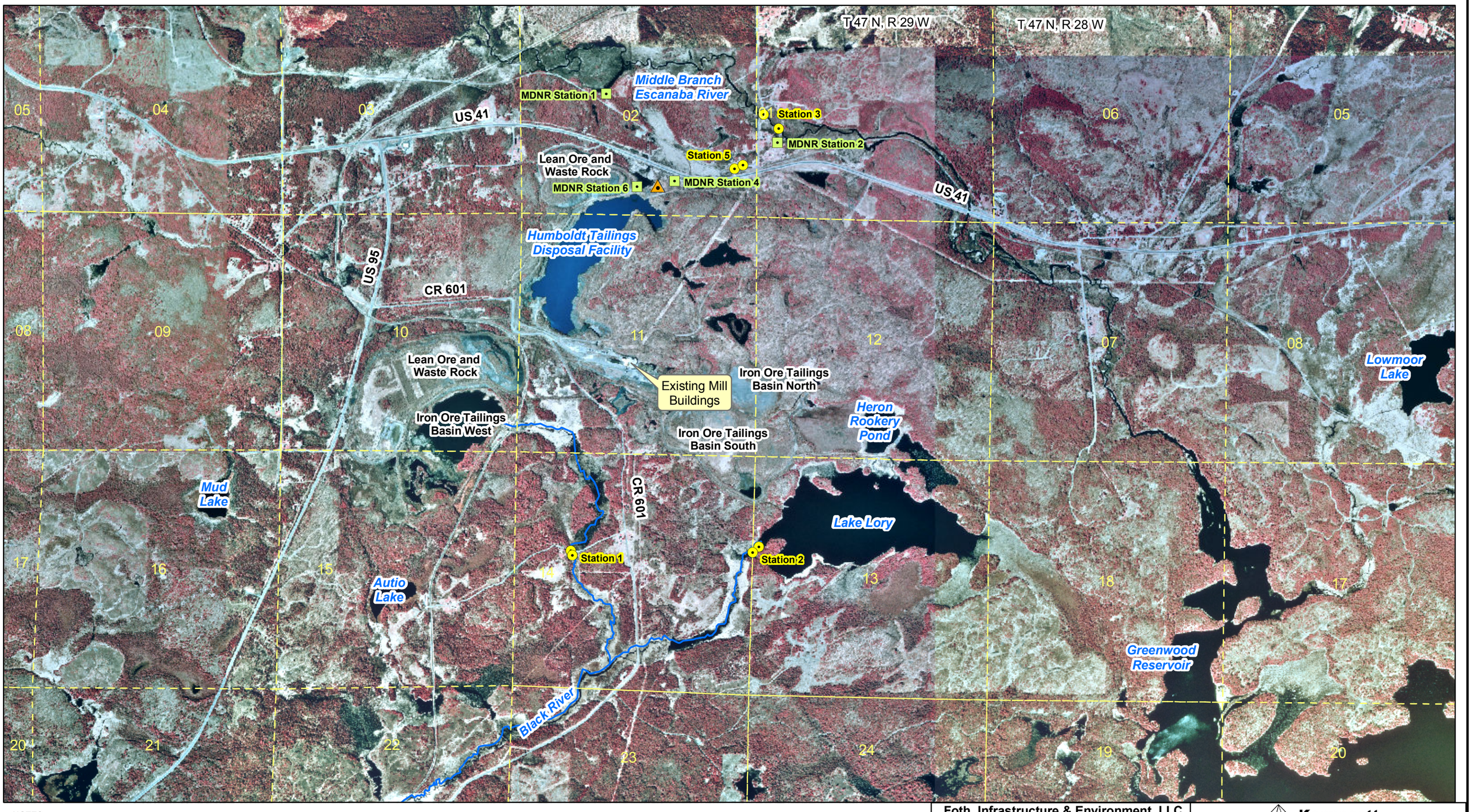
REVISED	DATE	BY	DESCRIPTION

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

Kennecott Eagle Minerals

FIGURE 3-13
HUMBOLDT MILL EIA
PROPOSED FACILITY AND WETLAND LOCATIONS

Scale: 0 200' 400'
Date: SEPTEMBER, 2008
Prepared By: JOW
Project No. 06W003



NOTES

1. Base Information, USGS georeferenced Digital Raster Graphics (DRG) and 1998 Digital Orthophoto Quads are from Michigan Center of Geographic Information (http://www.michigan.gov/cgi/)
2. Horizontal datum based on NAD 83/94. Horizontal coordinates based on UTM Zone 16.
3. Site Location - Project Site within Sections 2 and 11, T47N, R29W, Humboldt Township, Marquette County, Michigan.
4. Sample details of Lake Lory and HTDF are shown elsewhere.

LEGEND

- PLSS Sections
- MDNR 1990 survey locations (from Callahan, 1995)
- AEM 2006/2007 Stream Sample Location Extents (upstream and downstream)
- Multiple EA Sample Locations North of HDTF (from Callahan, 1995)

N

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REVISED	DATE	BY	DESCRIPTION

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

Kennecott Eagle Minerals

FIGURE 3-14
HUMBOLDT MILL EIA
SAMPLING LOCATIONS FOR HISTORICAL AND 2006/2007 AQUATIC SURVEYS

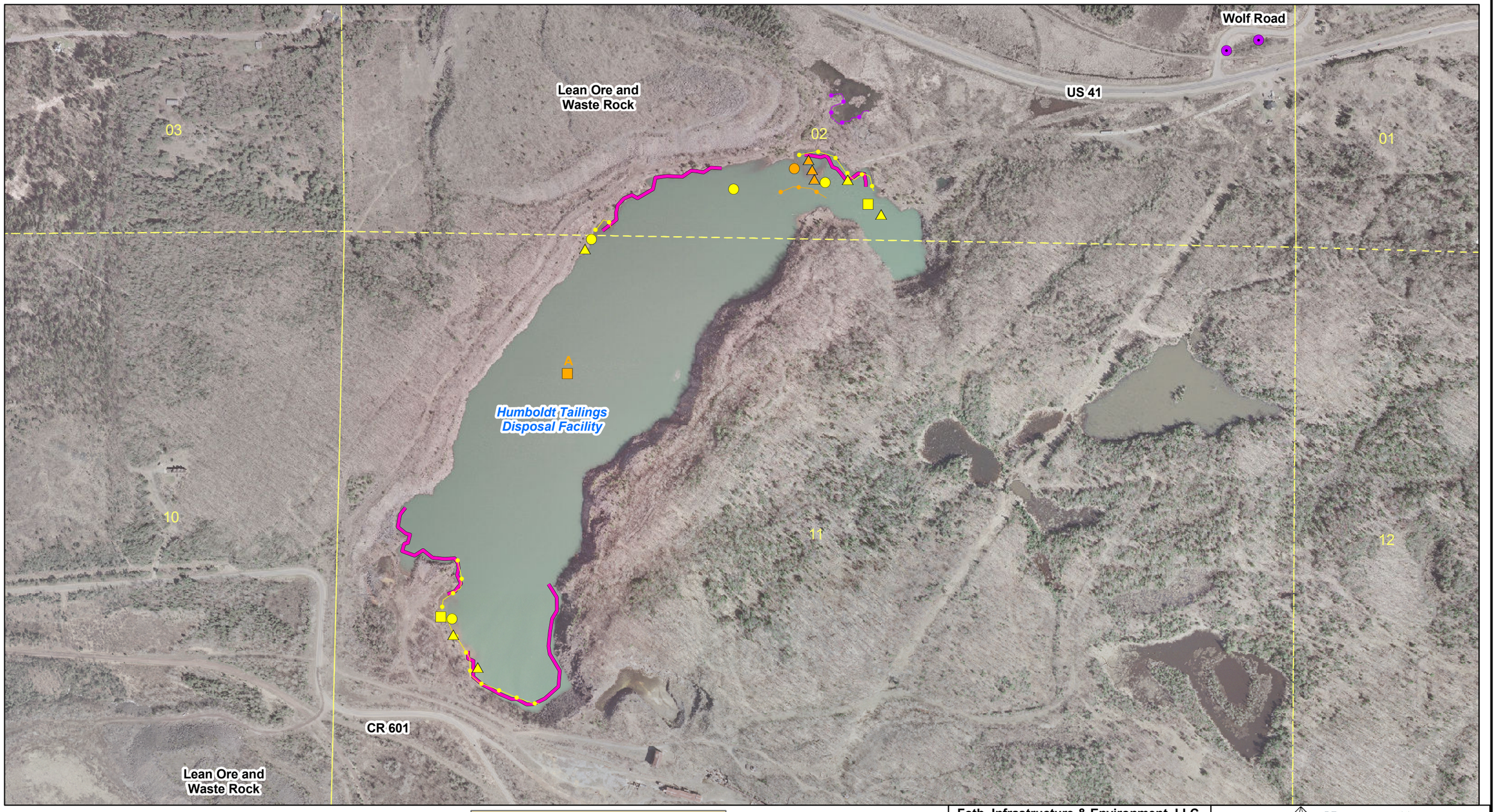
Scale: 0 1,000 2,000 Feet

Date: DECEMBER 2007

Prepared by: DAT

Project No: 06W003

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NOTES

1. Orthophotography supplied by Aero-Metric Engineering, Sheboygan, Wisconsin. Date of photography: April 27, 2006.
2. Horizontal datum based on NAD 83/94. Horizontal coordinates based on UTM Zone 16.
3. Site Location - Project Site within Sections 2 and 11, T47N, R29W, Humboldt Township, Marquette County, Michigan.

LEGEND

PLSS Sections

1984 Survey	2007 Surveys
Water Sampling	Hoop Net Locations
Algal Mat	Gill Net Locations
Bottom Samples	Ponar Macro
Gill Net	Pit Bug Transect
	Boom Shocker Transect
	Stream Location
	Pond Backpack Transect

N

Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

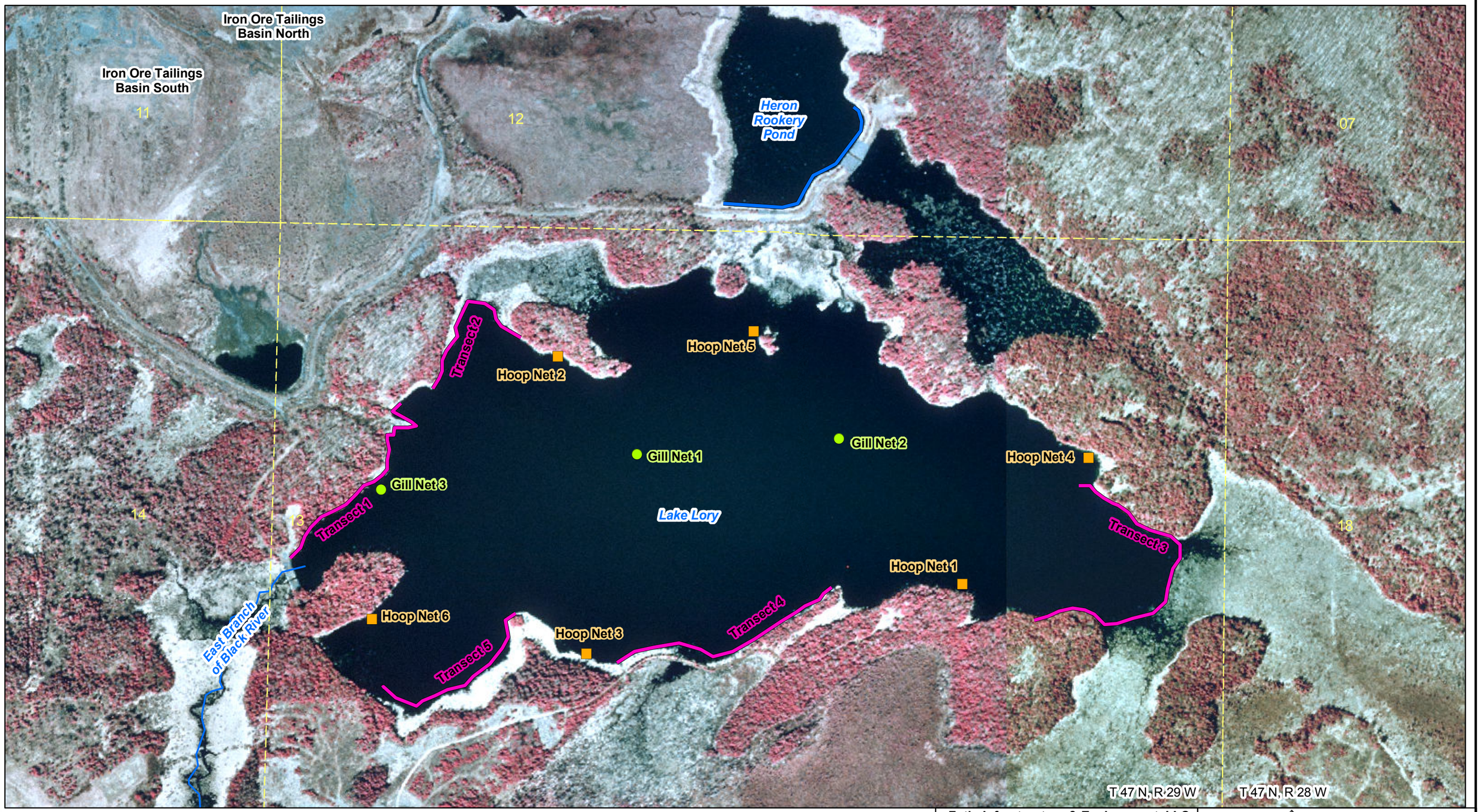
CHECKED BY:	AKM	DATE: DEC. '07
APPROVED BY:	SVD1	DATE: DEC. '07
APPROVED BY:		DATE:

Kennecott Eagle Minerals

FIGURE 3-15
HUMBOLDT MILL EIA
HISTORICAL AND 2007 HTDF AND WETLAND
EE COMPLEX AQUATIC SURVEY LOCATIONS

Scale: 0 250 500 Feet	Date: DECEMBER 2007
Prepared by: DAT	Project No: 06W003

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NOTES

1. Base Information, USGS georeferenced Digital Raster Graphics (DRG) and 1998 Digital Orthophoto Quads are from Michigan Center of Geographic Information (http://www.michigan.gov/cgi/)
2. Horizontal datum based on NAD 83/94. Horizontal coordinates based on UTM Zone 16.
3. Site Location - Project Site within Sections 2 and 11, T47N, R29W, Humboldt Township, Marquette County, Michigan.

LEGEND

- PLSS Sections
- Hoop Net Locations
- Gill Net Locations
- Backpack Shocker Transect
- Boom Shocker Transect

N

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

Kennecott Eagle Minerals

FIGURE 3-16
HUMBOLDT MILL EIA
LAKE LORY 2006
AQUATIC SURVEY LOCATIONS

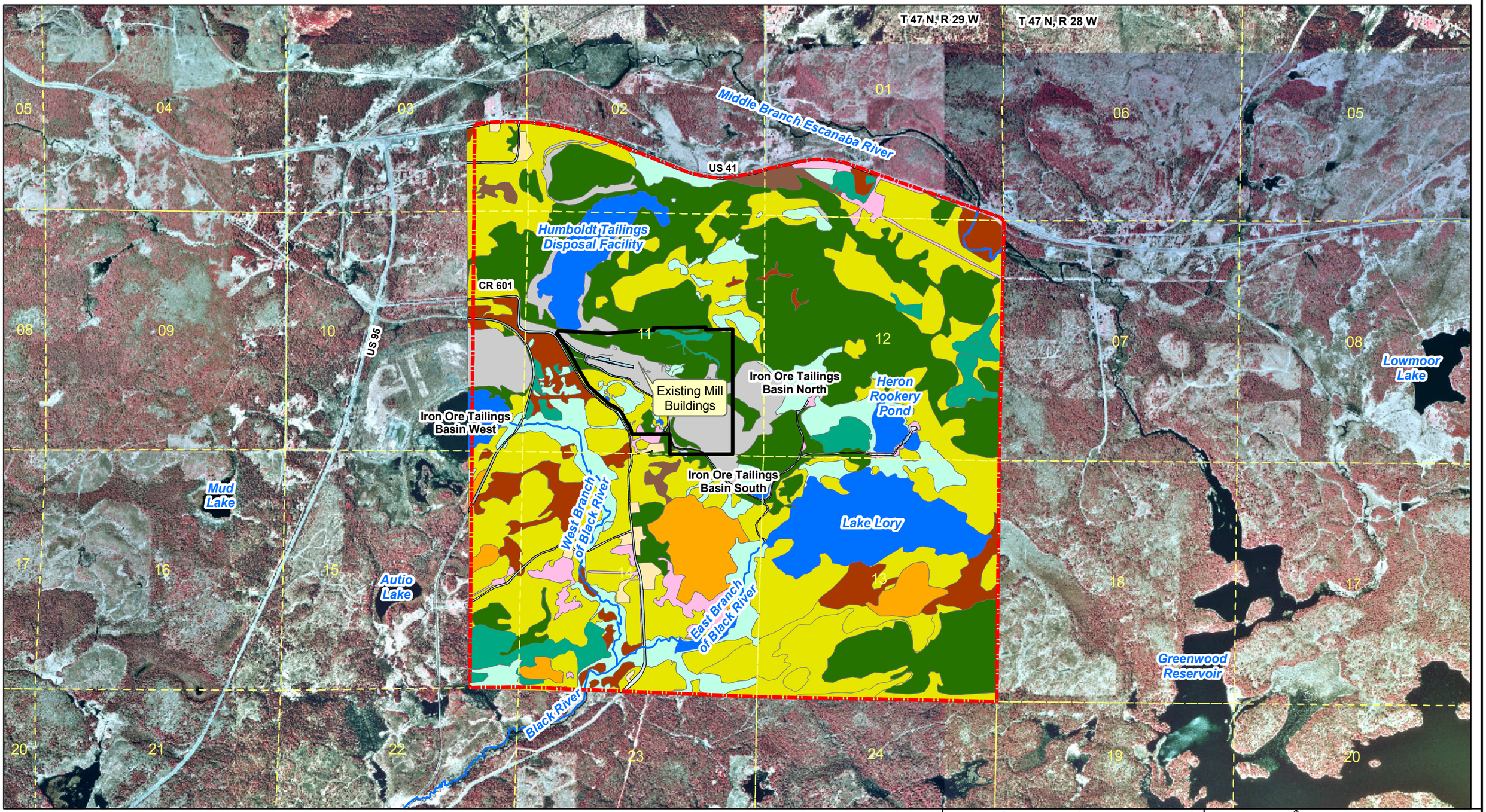
Scale: 0 250 500 Feet

Date: DECEMBER 2007

Prepared by: DAT

Project No: 06W003

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NOTES

1. Base Information, USGS georeferenced Digital Raster Graphics (DRG) and 1998 Digital Orthophoto Quads are from Michigan Center of Geographic Information (http://www.michigan.gov/cgi/)
2. Horizontal datum based on NAD 83/94. Horizontal coordinates based on UTM Zone 16.
3. Site Location - Project Site within Sections 2 and 11, T47N, R29W, Humboldt Township, Marquette County, Michigan.

LEGEND

- Overall Study Area for 2006 Biological Survey
- Detailed Wetland Study Area for 2006 Biological Survey
- PLSS Sections

- Mesic Northern Forest (Coniferous)
- Mesic Northern Forest ((Boradleaved Forest) (Generally Deciduous))
- Muskeg/Poor Conifer Swamp
- Hardwood Conifer Swamp/Northern Swamp
- Emergent Marsh
- Shrubland
- Northern Shrub Thicket
- Residential Single Family/ Duplexes
- Extractive
- Streams and Waterways
- Open Water/Submergent Marsh
- Herbaceous Openland
- Road Transportation

N

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

Kennecott Eagle Minerals

FIGURE 3-17
HUMBOLDT MILL EIA
PLANT COMMUNITY AND HABITAT/ LAND USE DESCRIPTIONS

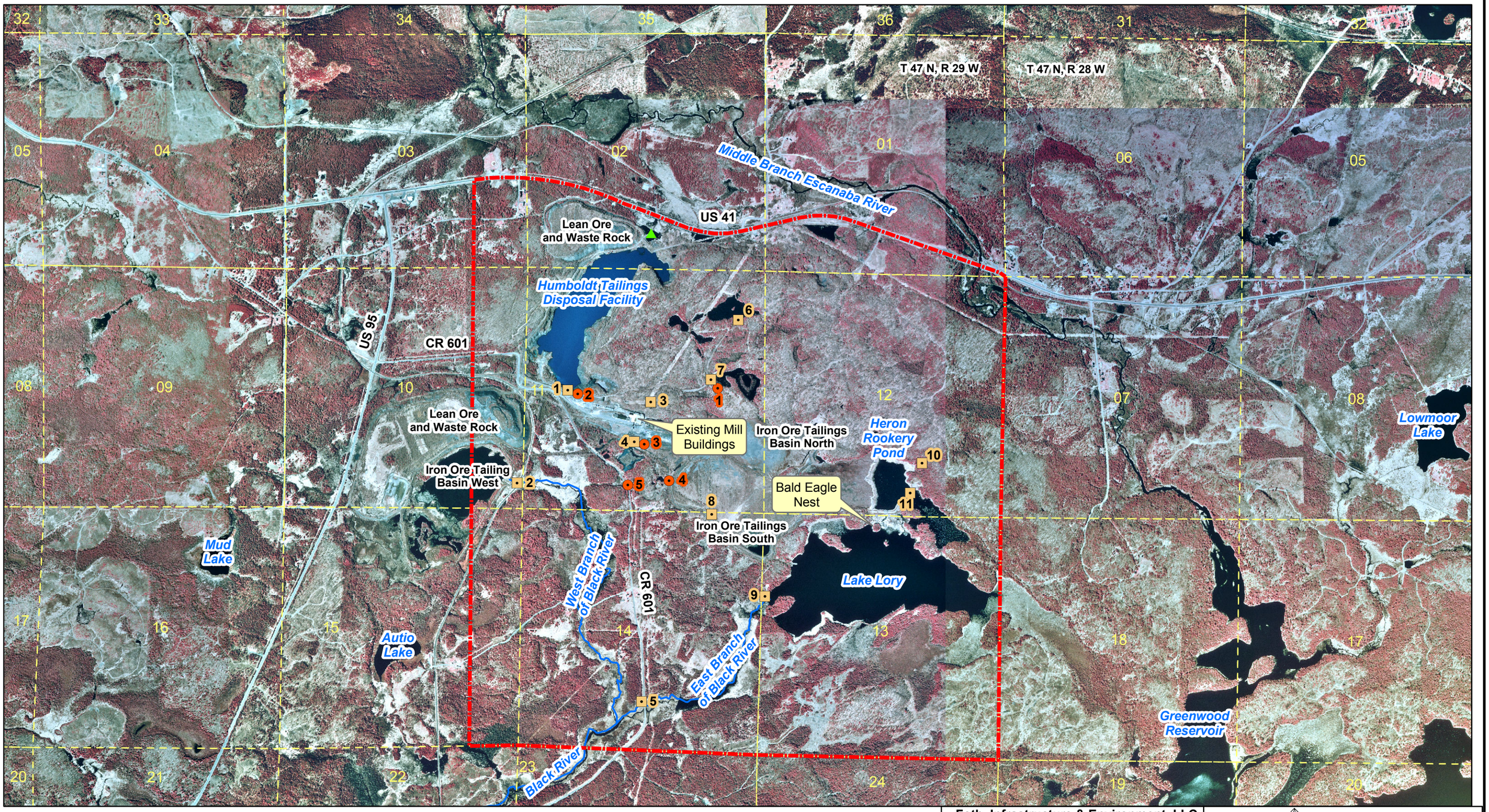
Scale: 0 1,000 2,000 Feet

Date: DECEMBER 2007

Prepared by: DAT

Project No: 06W003

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NOTES

1. Base Information, USGS georeferenced Digital Raster Graphics (DRG) and 1998 Digital Orthophoto Quads are from Michigan Center of Geographic Information (http://www.michigan.gov/cgi/)
2. Horizontal datum based on NAD 83/94.
   Horizontal coordinates based on UTM Zone 16.
3. Site Location - Project Site within Sections 2 and 11, T47N, R29W, Humboldt Township, Marquette County, Michigan.

LEGEND

- Overall Study Area for 2006 Biological Survey
- PLSS Sections
- 2006 Spring frog and toad sample locations
- 2006 Avian and small mammal sample locations
- 2007 Wetland EE Survey

N

Foth Infrastructure & Environment, LLC

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

Kennecott Eagle Minerals

FIGURE 3-18
HUMBOLDT MILL EIA
2006 WILDLIFE SURVEY
SAMPLE LOCATIONS

Scale: 0 1,000 2,000 Feet

Date: DECEMBER 2007

Prepared by: DAT

Project No: 06W003

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NOTES

1. Orthophotography supplied by Aero-Metric Engineering, Sheboygan, Wisconsin. Date of photography: April 27, 2006.
2. Horizontal datum based on NAD 83/96. Horizontal coordinates based on Michigan State Plane North.
3. Site Location - Project Site within Section 11, T47N, R29W, Town of Humboldt, Marquette County, Michigan.
4. Archeological GPS data supplied by URS via email.

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LEGEND

- Pedestrian
- Positive Shovel Test
- Shovel Test
- Slope
- Archeological Study Area
- PLSS Sections

cc1 = 20MQ248 - Possible Isolated Prehistoric Quartz Flake
ff5 = 20 MQ249 - Suspected Historic Structure

N

Foth Infrastructure & Environment, LLC

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APPROVED BY:	SVD1	DATE: DEC. 07	
APPROVED BY:		DATE:	

Kennecott Eagle Minerals

FIGURE 3-19
HUMBOLDT MILL EIA
CULTURAL RESOURCES
SAMPLE POINTS AND RESOURCE LOCATIONS

Scale: 0 250 500 Feet | Date: DECEMBER 2007

Prepared by: DAT | Project No: 06W003

26,018,000 E
26,020,000 E
26,022,000 E
26,024,000 E
626,000 N
624,000 N
622,000 N
620,000 N
N
2
3
1
10
11
12
PRIVATE RESIDENCES
US HWY 41
EFFLUENT PIPE DISCHARGE INTO WETLAND
PROPOSED BERM TO ELEVATION 1543
LEAN ORE AND WASTE ROCK
PROPOSED CUT-OFF WALL
WWTP EFFLUENT PIPELINE
SURFACE WATER ELEVATION = 1537.88 (JUNE 5, 2007)
DISCHARGE PIPE W/DIFFUSER
SPLITTER MANHOLE
FLOATING BARGE (LOCATION WILL VARY BASED UPON OPERATIONS)
WWTP INFLUENT PIPELINE (LOCATION MAY VARY BASED ON OPERATIONS)
WASTEWATER TREATMENT PLANT
PROCESS WATER INFLUENT PIPELINE
DUMP POCKET/PRIMARY CRUSHER
SECONDARY CRUSHER FEED CONVEYOR
SECONDARY CRUSHER BUILDING
TRANSFER CONVEYOR
TERTIARY CRUSHER
TRANSFER STATION
PIPELINE WATER RELEASE POINT FOR NON-OPERATION PERIOD
TAILINGS SLURRY PIPELINE TO HTDF
MILL EXIT ROAD FOR ORE HAUL TRUCKS
MILL ENTRANCE
WATER TANKS
OFFICE/MAINTENANCE BUILDING
MILL FEED CONVEYOR
MILL BLDG
CMP CULVERT
GATE HOUSE
FUEL STORAGE SKID (LOCATION WILL VARY BASED UPON OPERATIONS)
CONCENTRATE CONVEYORS
COARSE ORE STORAGE AREA
MANHOLE
CMP CULVERT
DRAINAGE DITCH
FORMER PELLET PLANT
LEAN ORE AND WASTE ROCK
SECONDARY CRUSHER
FENCED EQUIPMENT STORAGE \ STAGING AREA
EMPLOYEE/ VISITOR PARKING
CONCRETE FOUNDATIONS
IRON ORE TAILINGS BASIN NORTH
RAILROAD SPUR
SEDIMENTATION BASIN
CR 601
GAS MAIN PRESSURE RELIEF STATION
CMP CULVERT
CONCENTRATE LOADOUT BUILDING
BUMPER
TEMPORARY SOIL STOCKPILE AREA
IRON ORE TAILINGS BASIN WEST
WEST BRANCH OF THE BLACK RIVER
EXISTING POTABLE WELL (TO BE REFURBISHED)
EXISTING WELL PUMP HOUSE
OUT BUILDINGS
PRIVATE RESIDENCE
IRON ORE TAILINGS BASIN SOUTH

LEGEND

- EXISTING ELEV. CONTOUR IN FEET
- TREE
- TREE LINE
- BUILDING
- TRAIL
- PAVED ROAD
- UNPAVED ROAD
- STREAM/LAKE
- HUMBOLDT TAILINGS DISPOSAL FACILITY (HTDF)
- PRE-EXISTING IRON ORE TAILINGS DISPOSAL FACILITY
- KEMC PROJECT LOCATION
- GRAVEL SURFACE
- RAILROAD SPUR
- SURFACE WATER FLOW DIRECTION
- BITUMINOUS PAVED AREA
- CMP CULVERT
- FENCE
- TAILINGS SLURRY PIPELINE TO HTDF
- BERMED AREA TO ELEVATION 1543
- WWTP EFFLUENT PIPELINE (LOCATION WILL VARY BASED UPON OPERATIONS)
- WWTP INFLUENT PIPELINE (LOCATION WILL VARY BASED UPON OPERATIONS)
- PROCESS WATER INFLUENT PIPELINE (LOCATION WILL VARY BASED UPON OPERATIONS)
- PROPOSED CUT-OFF WALL
- WATERSHED BOUNDARY
- ALTERNATIVE MILL ACCESS ROAD FOR ORE TRUCKS

NOTES:

1. TOPOGRAPHIC AND PLANIMETRIC DATA SUPPLIED BY AERO-METRIC ENGINEERING, SHEBOYGAN, WISCONSIN. DATE OF PHOTOGRAPHY: APRIL 27, 2006.
2. CONTOUR INTERVAL BASED ON NORTH AMERICAN VERTICAL DATUM OF 1988. HORIZONTAL DATUM BASED ON NAD 83/96. HORIZONTAL COORDINATES BASED ON MICHIGAN STATE PLANE.
3. KEMC PROJECT LOCATION WITHIN SECTIONS 2 AND 11 T47N, R29W, HUMBOLDT TOWNSHIP, MARQUETTE COUNTY, MICHIGAN.
4. CONTOUR INTERVAL SHOWN IS 10 FOOT.

Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

CHECKED BY:	KKB	DATE: SEPT. '08
APPROVED BY:	SVD1	DATE: SEPT. '08
APPROVED BY:		DATE:

Kennecott Eagle Minerals

FIGURE 4-1
HUMBOLDT MILL EIA
ALTERNATIVE MILL ACCESS ROAD FOR ORE TRUCKS

Scale: 0 200' 400'
Date: SEPTEMBER, 2008
Prepared By: BJW1
Project No. 06W003

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12/19/2008 bjw1

Appendix A

EIA Checklist

R 425.101 et. seq. - Mining Permit Application Checklist

Rule 425.101 Seq.	Rule 425.101 Seq. Requirements	Location in Application
Rule 202	Environmental Impact Assessment	
1a	EIA requirements for each condition and feature listed in subrule (2)	Volume II Section 2-3 and Appendices
1a(i)	Description of condition or feature	Volume II Section 2-3 and Appendices
1a(ii)	Mining activity that may affect the condition or feature	Volume II Section 2-3
1a(iii)	Potential impacts and effects on the condition or feature and, where applicable, the effects of the conditions or feature on the mining activity	Volume II Section 2-3
1a(iv)	Mitigation measures	Volume II Section 2-3
1a(v)	Maps and photographs	Volume II and Appendices
1b	Cumulative impacts for each condition or feature listed in subrule (2)	Volume II Section 2-3
1c(i) - (iii)	Alternatives	Volume II Section 4
1d	Name of person(s) who prepared EIA	Volume II Section 1.2
1e	Methodologies	Volume II Section 1.3 and Appendices
1e(i)	QA/QC	Volume II Section 1.3 and Appendices
1e(ii)	Demonstrated appropriate and effective methodologies	Volume II Section 1.3 and Appendices
1f	Reference sources of information	Volume II Section 1.4 and Appendices
2	Requirements in Rule 202(2) for the following conditions and features	Volume II Section 3 and Appendices
2a	Topography	Volume II Section 3.1 and Appendices
2b	Soils series	Volume II Section 3.2 and Appendices
2c	Geology of bedrock and unconsolidated materials	Volume II Section 3.3 and Appendices
2d	Groundwater occurrence	Volume II Section 3.4 and Appendices
2d(i)	Thickness, k, connections between aquifers and surface water	Volume II Section 3.4, 3.5 and Appendices
2d(ii)	Depth, recharge, flow direction, gradients, velocity, 3-D flow paths	Volume II Section 3.4, 3.5 and Appendices
2d(iii)	Seasonal variations of d(ii) items	Volume II Section 3.4, 3.5 and Appendices
2e	Surface water features (lakes, ponds, streams, etc.)	Volume II Section 3.4, 3.5 and Appendices
2e(i)	Levels and/or discharge rates	Volume II Section 3.4, 3.5 and Appendices
2e(ii)	Seasonal and long-term variations of levels and/or discharge rates	Volume II Section 3.4, 3.5 and Appendices
2f	Water balance	Volume II Section 3.4, 3.5 and Appendices
2g	Groundwater and surface water quality	Volume II Section 3.4, 3.5 and Appendices
2g(i)	Specific conductance	Volume II Section 3.4, 3.5 and Appendices
2g(ii)	Temperature	Volume II Section 3.4, 3.5 and Appendices
2g(iii)	Hydrogen ion concentration	Volume II Section 3.4, 3.5 and Appendices
2g(iv)	Dissolved oxygen	Volume II Section 3.4, 3.5 and Appendices
g(v)	Concentrations of the following:	Volume II Section 3.4, 3.5 and Appendices
2g(v)(A)	Cations of calcium, sodium, magnesium, potassium and iron	Volume II Section 3.4, 3.5 and Appendices
2g(v(B)	Anions of chloride, sulfate, and bicarbonate	Volume II Section 3.4, 3.5 and Appendices
2g(v)(C)	Other dissolved elements and compounds associated with the mining activity	Volume II Section 3.4, 3.5 and Appendices

R 425.101 et. seq. - Mining Permit Application Checklist

Rule 425.101 Seq.	Rule 425.101 Seq. Requirements	Location in Application
2g(vi)	Predicted seasonal variations of parameters - 2g(i) - (v)	Volume II Section 3.4, 3.5 and Appendices
2h	Existing, known groundwater contamination	Volume II Section 3.4, 3.5 and Appendices
2i	Private water supply wells	Volume II Section 3.6 and Appendices
2j	Public water supply wells	Volume II Section 3.6 and Appendices
k	Irrigation and disposal wells	Volume II Section 3.6 and Appendices
2l	Designated wellhead protection areas	Volume II Section 3.6 and Appendices
2m	Floodplains, Great Lakes shorelines, wetlands	Volume II Section 3.7 and Appendices
n	Natural Rivers, as defined in Section 30501	Volume II Section 3.8 and Appendices
2o	Wild and Scenic Rivers, per 1968 Public Law 90-542, 82 Stat. 906	Volume II Section 3.8 and Appendices
2p	Dwellings and other buildings for human occupancy all or part of year	Volume II Section 3.9 and Appendices
2q	Existing and proposed infrastructure and utilities	Volume II Section 3.10 and Appendices
2r	Public recreation areas	Volume II Section 3.11 and Appendices
2s	Natural areas, per R 324.35101	Volume II Section 3.11 and Appendices
2t	State Wilderness Areas, per MCL 324.35101	Volume II Section 3.11 and Appendices
2u	Federal Wilderness Areas, per 78 Stat. 890, 16 U.S.C. 1131	Volume II Section 3.11 and Appendices
2v	Wild areas, per MCL 324.35101	Volume II Section 3.11 and Appendices
2w	Research natural areas, per CFR Title 36, Section 251.23	Volume II Section 3.11 and Appendices
2x	Land uses, access, size/shape, current and historic trends	Volume II Section 3.12 and Appendices
2y	Aquatic and terrestrial flora/fauna species, variations (2 yrs of information)	Volume II Section 3.13, 3.14 and Appendices
2z	Fish and wildlife habitats	Volume II Section 3.13, 3.14 and Appendices
2aa	T & E species, per Act 365, per 1973 Act, and per Public Law 93-205, 87 Stat. 884	Volume II Section 3.15 and Appendices
2bb	Special concern species, per US Forest Service Region 9	Volume II Section 3.15 and Appendices
2cc	Non-native or invasive plants and animals	Volume II Section 3.16 and Appendices
2dd	Ecological systems recognized in sources published	Volume II Section 3.13, 3.14 and Appendices
2ee	Cultural, historical archaeological resources	Volume II Section 3.17 and Appendices
2ff	Air quality	Volume II Section 3.18 and Appendices
2gg	Meteorology, and predicted seasonal and long-term variations	Volume II Section 3.18 and Appendices
2hh	Visual resources	Volume II Section 3.19 and Appendices
2ii	Noise	Volume II Section 3.19 and Appendices
2jj	Light	Volume II Section 3.19 and Appendices
2kk	Seismisity	Volume II Section 3.19 and Appendices
3	For (d) groundwater, (e) surface water, (g) water quality, and (gg) meteorology, 2 yrs data and statistical analysis	Volume II Section 3 and Appendices
4	Description of Public involvement	Volume II Section 1.5
5	Information required by other parts of the Act may be used in the EIA	NA