GENERAL PLAN OF OPERATIONS

APPENDIX 11

WASTE ROCK MANAGEMENT PLAN

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ACRONYMS

AAC	Alaska Administrative Code
ABA	Acid-Base Accounting
ADEC	Alaska Department of Environmental Conservation
ADNR	Alaska Department of Natural Resources
APDES	Alaska Pollutant Discharge Elimination System
ARD	acid rock drainage
EA	Environmental Assessment
FEIS	Final Environmental Impact Statement
GPO	General Plan of Operations
HGCMC	Hecla Greens Creek Mining Company
KGCMC	Kennecott Greens Creek Mining Company
IMP	Integrated Monitoring Plan
KCB	Klohn Crippen Berger, Ltd.
MSHA	Mine Safety and Health Administration
NEPA	National Environmental Policy Act
NNP	Net Neutralization Potential
QA	quality assurance
QC	quality control
SOP	Standard Operating Procedure
TDF	Tailings Disposal Facility
USDA	United States Department of Agriculture
USFS	United States Forest Service
WMP	Waste Management Permit

1.0 INTRODUCTION

Operation of the Greens Creek Mine is carried out by Hecla Greens Creek Mining Company (HGCMC) in accordance with the General Plan of Operations (GPO) approved by the United States Forest Service (USFS), hereafter referred to as the Forest Service. The GPO describes the management activities which are conducted at Greens Creek Mine, the location and timing of those activities, and how the environment and resources in the area are protected through compliance with federal and state requirements. This document, GPO Appendix 11 Waste Rock Management, defines management objectives and provides general information on the background, operations, maintenance, and monitoring for Greens Creek Mine waste rock sites.

Table 1. RECORD OF CHANGES AND AMENDMENTS

Date	Section(s) Changed or Amended
August 2000	Submittal by Kennecott Greens Creek Mining Company
February 2014	Submittal by Hecla Greens Creek Mining Company. Revisions associated with specifying separate operating procedures for active and inactive waste sites, including waste rock removal efforts, and incorporation of ADEC solid waste permit requirements (2003 and 2008). Also updated for stability monitoring requirements associated with active waste rock disposal site, Site 23.
November 2014	Submittal by Hecla Greens Creek Mining Company. Revisions to incorporate reference to ADEC Waste Management Permit 2014DB0003, issued August 11, 2014.
April 2019	Reviewed plan prior to submittal to the ADEC as part of the Waste Management Permit renewal.

Certain areas of the mine's operation are also subject to federal and state permits and approvals issued by other federal and state agencies. State of Alaska Department of Environmental Conservation (ADEC) regulates mill tailings and waste rock disposal facilities at the Greens Creek mine as well as other aspects of the operation primarily through Title 18 of the Alaska Administrative Code (AAC), Chapters 50, 60, 70, 72 and 80. The Waste Management Permit, issued by the ADEC, authorizes tailings and waste rock disposal and prescribes monitoring, reporting, closure, post-closure and

financial responsibility requirements. The Forest Service has issued special use permits and leases for various aspects of the operations.

Closure requirements for the Greens Creek Mine, including temporary and permanent closure, are described in more detail in GPO Appendix 14. The Alaska Department of Natural Resources (ADNR) is the lead state agency (Alaska Statute 27.05.010) and regulates the reclamation, by issuing the Reclamation Plan approval for the entire site, including the tailings and waste rock disposal sites Title 11 AAC 97.310. The Forest Service also sets requirements for reclamation. Permits and authorizations are further discussed in Section 2.1.

Management objectives associated with waste rock sites consider acid rock drainage (ARD) and metals leaching, which can potentially create adverse environmental conditions. These risks are evaluated with respect to local hydrology, climate and geochemistry to ensure the employment of practices best matched to site-specific conditions while providing the operational flexibility to incorporate systems improvement. Specific aspects of the practices used to achieve management objectives outlined in this document are presented in the standard operating procedure (SOP) for waste rock provided in Attachment A. The SOP format allows flexibility for regular updates as site conditions and needs change. Modifications to the SOP are summarized in the annual report. This appendix is updated through coordination with the USFS, the ADEC, and the ADNR. If there is a conflict between the terms established in the GPO, applicable regulations, or the WMP, then the terms with the most recent written approval from the ADEC, the USFS, and the ADNR govern.

2.1 BACKGROUND

This section summarizes permits and authorizations, waste rock characterization and weathering characteristics, and active and inactive waste rock sites. The understanding of the Greens Creek Mine waste rock geochemistry and potential influences on water quality has developed over the life of the project.

2.2 Permits and Authorizations

The Forest Service and the ADEC regulate waste rock placement, monitoring, and reclamation. The ADNR Mining Section also regulates the reclamation and closure of the waste rock facilities. For a complete summary of federal, state, and local agencies involved in the permitting approval processes for Greens Creek Mine, refer to the 2013 Final Environmental Impact Statement (FEIS) (USFS 2013).

Regulatory references pertaining to site-specific waste rock management are included in the 1983 FEIS (USFS 1983), 1988 Environmental Assessment (EA) for *Proposed Changes to the General Plan of Operation for the Development and Operation of the Greens Creek Mine*. (USFS 1988), and 1992 *EA for Additional Waste Rock Disposal Capacity at Greens Creek Mine* (USFS 1992).

The 1992 EA Decision Notice approved the use of ten acres in addition to the 43 acres approved by the 1983 FEIS Record of Decision for waste rock disposal. The Decision Notice incorporates all aspects of the operations and maintenance, required improvements, mitigation, monitoring and reclamation components identified in the Components Common to all Alternatives section of the EA.

The EA concluded that the potential for short or long-term generation of acid drainage from waste rock was small and required an ongoing assessment of field conditions to verify these conclusions from laboratory studies. The EA Decision Notice required that mitigation measures defined from the ongoing assessment be incorporated into the General Plan of Operations, if necessary. Subsequent findings during these assessments indicate that there is a potential for acid rock drainage development and/or metal(oid)s leaching from Greens Creek waste rock.

Mining wastes are categorically exempt from regulation under the ADEC Solid Waste Program unless they pose a potential "welfare threat or environmental problem associated with the management of the waste". The ADEC made the determination that waste rock placed in Site 23, the only active production waste rock site at Greens Creek Mine, is subject to Chapter 60 solid waste requirements, which include the need to acquire a permit. Mining waste is regulated under the monofill standards 18 AAC 60.455 which allows the department discretion to incorporate applicable provisions of 18 AAC 60 into the waste management permit. Waste Management Permit (WMP #0211-BA001) was issued to Kennecott Greens Creek Mining Company in November 2003 (ADEC 2003). Refer to GPO 3 for further discussion of ADEC WMP requirements associated with waste disposal sites.

In 2004, correspondence between the ADEC and KGCMC, ADEC and the Forest Service authorized modification to WMP #0211-BA001 and GPO Appendix 11 for Site 23 waste rock placement methodology and changes to final cover design. Modification to the Site 23 placement design was with regards to details of the rock type (no longer segregating class 2 and class 3 waste rock) and shell thickness. The Waste Rock Management SOP provided in Attachment A incorporates these modifications.

There were further permit modifications approved for Site 23 in 2008 (ADEC 2008) to include authorized construction of a temporary lined storage pad at Site 23 to be used for interim waste storage (waste rock relocation) from inactive waste rock sites pending transport to underground (ADEC 2008). This interim facility was removed after all the waste rock was moved into the underground.

In 2009, the *Site E Removal and Waste Rock\ Tailings Co-Disposal Plan* (HGCMC 2009) was approved by agencies for co-disposal of waste rock at the TDF. Co-disposal refers to the placement of a mixture of waste rock and tailings. The primary purpose of co-disposal is to reduce pyrite oxidation and metal leaching from waste rock by surrounding it with a matrix of fine-grained material (tailings). The geotechnical, geochemical and operational aspects of co-disposal have been studied, and the results demonstrate that co-disposal of waste rock and tailings will significantly improve the drainage quality at uncontained

inactive waste rock sites by relocating this material to the TDF, without negatively impacting tailings drainage compositions, and can be done in a manner that minimizes effects on the environment.

Procedures for waste rock co-disposal with tailings at the tailings disposal facility (TDF) are also included in the SOP provided in Attachment A.

The Waste Management Permit (WMP #2014DB0003) issued to Hecla Greens Creek Mining Company was renewed in August 2014. The renewed permit incorporates the previous permit revisions approved in 2004, 2008 and 2009.

2.3 Waste Rock Characterization

The geochemical characterization programs for the Greens Creek Mine waste rock are well established. Classification and segregation of waste rock provides the basis for ongoing management at active and inactive sites. Waste rock at Greens Creek has two general conditions; fresh waste rock from the mine and weathered waste rock from inactive waste rock sites.

The objective of waste rock characterization is to define the materials and determine how they behave under weathering conditions. Limiting metal(oid)s mobility and the potential for development of acid rock drainage are primary objectives.

Waste rock from the mine generally consists of two varieties, argillite and phyllite. Argillite consists primarily of near-equal amounts of quartz and dolomite with minor pyrite and graphite, which gives it a dark grey to black color. Argillite exhibits both slatey and massive textures, with the slatey variety having concentrations of pyrite and graphite along slatey cleavage planes. Argillite is not acid generating but does pose a metal(oid)s and sulfate leaching risk despite producing neutral to alkaline drainage.

Phyllite consists primarily of quartz, sericite, dolomite, pyrite and chlorite. Sericite and chlorite give phyllites their grey and green coloration, respectively. The carbonate content in phyllite is lower than argillite (typically 10 to 20 wt% versus 30 to 50 wt% for argillite) and

pyrite content is typically higher. Phyllites are well-foliated and pyrite often occurs along foliation planes, making it readily available to exposure as the rock weathers. Most of the phyllite produced by the mine is potentially acid generating and poses a metal(oid)s and sulfate leaching risk.

Further description of the mineralogy and weathering characteristics of Greens Creek Mine rock types are provided in several assessment reports (Vos 1993, Vos 1994, KGCMC 1995, SMI 2000) and annual reports from 1995 to present.

2.4 Weathering Characteristics and Acid Rock Drainage

When rock is disturbed, it undergoes physical and chemical changes in response to its new environment. The particle size decrease, and surface area increase that result from rock extraction exposes some minerals to chemical and physical conditions under which they may not be stable. The unstable minerals break apart, dissolve and/or alter to form other minerals in response to the new conditions. Exposure and weathering of unstable forms of base metal- bearing minerals can liberate elements such as copper, lead and zinc, which are carried away in dissolved form or re-precipitated as more stable mineral species.

Several variables, including pH, control the solubility (stability) of minerals under weathering conditions. In general, minerals are more soluble under acidic (low pH) conditions. As a result, drainage from acidic environments tends to carry a considerably larger dissolved load than drainage from neutral to alkaline environments. However, some metals, such as zinc, may be released under neutral pH conditions. Some sulfide minerals, predominantly pyrite (FeS_2), react with oxygen and water in the weathering environment to produce sulfuric acid. If the acid is not neutralized by dissolution of neutralizing minerals within the rock, acid rock drainage (ARD) can result.

Because of its acidity, ARD is able to dissolve minerals with which it is in contact. Although this tends to neutralize the acidity, it also depletes the rock of neutralizing potential and liberates dissolved metals.

The relative amounts of oxygen, water and pyrite that can chemically interact dictate the rate and volume of ARD production. ARD unchecked may increase exponentially. Therefore, limiting the supply of any one of these variables will help to decrease the severity of ARD.

Given the above considerations, it is clear that interaction between many complex variables influences water quality associated with waste rock removal and storage. Knowledge of the dynamics is important to meet water quality objectives. Timely evaluation of significant variables at existing locations is necessary for effective planning and action.

Static tests (acid-base accounting [ABA]) and past kinetic tests (column or humidity cells) allow identification of the potential for acid generation and determination of how materials behave under controlled weathering conditions. These tests are then used in conjunction with physical and mineralogical characterization to determine best management practices for waste rock disposal.

In 1994 GCMC drilled and sampled several inactive waste rock sites to better define site specific material composition and weathering characteristics (KGCMC 1994). The results indicate a moderate net acid generation potential of surface materials sampled. Distribution of potentially acid generating material was not homogeneous and there was a considerable range in net neutralization potential (NNP) values for each site. Local waste rock acidification was encountered in areas where significant surface water infiltration into potentially acid generating material had occurred. The amount of readily soluble metals in surface samples was determined via shake flask extraction tests. The results indicated that samples that had undergone acidification produce metals, sulfate, and acidity significantly higher than samples that have not undergone acidification.

Monitoring of Site 23 and older, inactive waste rock sites can be viewed as simplified field kinetic tests. Results of drainage monitoring and visual observations during removal of several inactive sites supports the findings of the laboratory test work. The historic piles were comprised of a mixture of rock types, and highly pyritic phyllite placed near the surface had begun to locally generate acidic drainage (15-20 years of exposure). Most of the waste

rock below a depth of five feet retains its grey/green color and has not depleted its available carbonate. Drainage from the larger, historic piles and Site 23 remains near neutral and produces sulfate, zinc and other metals at elevated levels. Lower sulfide contents and smaller surface areas yield a lower flux of oxidation products from quarries compared to waste rock sites. Refer to annual reports for a summary of the latest monitoring and interpretations for the sites.

Characterization of Greens Creek Mine argillite and phyllite using ABA and other field observations indicate that argillite is clearly not acid generating and that most samples of phyllite are potentially acid generating. Due to these characteristics, management objectives have been established for management of waste rock materials and monitoring and control of water quality effluent from waste rock disposal sites.

Specific assessment of material weathering characteristics, classification of acid generating and/or neutralization potential of waste rock, and test methods and sampling frequency are discussed in GPO Appendix 1, Integrated Monitoring Plan (IMP).

2.5 Active and Inactive Waste Rock Sites

HGCMC currently operates one active production waste rock site, identified as Site 23. The rest of the waste rock sites used in the past are termed inactive, used to refer to not receiving further waste rock from on-going mine production. Table 2 summarizes inactive production waste rock sites and a borrow area associated with Greens Creek Mine (refer to Attachment B). The borrow area is because it has been utilized as a storage sites for waste rock materials.

Table 2. INACTIVE WASTE ROCK AREAS AND BORROW AREAS

Site	Description
Site E (4.7B Road)	Site E is located at mile marker 4.6 along the B Road, about halfway between the port facility and the mine service area. Waste placement began during 1988 and continued through 1994. During placement activities a total of approximately 365,000 cubic yards of material were placed over an area of about 9 acres. Concurrent reclamation to relocate this material to the TDF initiated in 2009 and is on-going. Removal activity from Site E slowed while the TDF was being expanded. This is an estimated 220,000 cubic yards of waste rock needing to be reclaimed.
Site D (8.0 B Road)	Waste rock Disposal Site D is located downslope from the B Road between mile markers 8.0 and 8.2. Site D was approved for active waste rock placement during 1987. Waste placement, on an intermittent basis, began during October of 1987 and continued through 1989. During placement activities a total of 300,000 cubic yards of material were placed over approximately 7 acres.
Site C/920 Area	Waste rock and fill were placed in the 920 portal, mill site, and Site C from 1987 to 1989 as part of mine site construction. During mill development, a large amount of clayey till was removed for geotechnical reasons and was placed in the lower portion of Site E (prior to waste rock placement at that site), with a smaller amount placed in Site D. Approximately 48.500 cubic yards of waste rock and fill have been placed in Site C over a combined area of 2 acres. Some of this waste rock was relocated to Site 23 initially in 2006 and more recently in 2011 as part of storm water management pond modifications.
960 Area	A small quantity of waste rock from the 920 portal was placed along the 1350 access road just uphill from the portal. Approximately 10,000 cubic yards of rock have been placed in the 960, which covers about 1 acre. A majority of this waste rock (excluding 1350 access road prism/subgrade) was removed as part of concurrent reclamation activities in 2005.
Site 1350	Site 1350 is located approximately 1.5 road miles above the main (920) mine entrance. Waste was placed intermittently between 1978 and 1985. Approximately 100,000 cubic yards were placed over an area of 5 acres. Concurrent reclamation removal activities initiated in 2005 and are periodically on-going. Waste rock was relocated to the Site 23 temporary storage pad for pending eventual transport to underground. Most of the waste rock has been removed from Site 1350, an estimated 9,000-10,000 cubic yards remains near the 1350 Portal. This material will be removed during final reclamation of the mine site.
Pit 405 (7.6B Road)	Borrow area located on the B road near Site 23. This former borrow area has been backfilled with waste rock and the upper level received till materials from the main mine site excavation. The till materials will be used as part of reclamation and the waste rock will eventually be relocated.

3.0 WASTE ROCK MANAGEMENT

HGCMC Surface Operations department manages the active waste rock facility, with delivery of the rock conducted by the Mine Department. The Surface Operations Department also manages removal of waste rock from inactive waste sites as part of concurrent reclamation efforts. Management responsibility will transfer to the Environmental Department upon completion of closure activities.

Management of waste rock from active mining applies to waste rock placement at Site 23, the TDF, and underground workings, where appropriate. Management of inactive waste rock sites that are independent of other mine infrastructure require ensuring integrity of the sites are maintained until materials can be removed and consolidated at the TDF, underground, or Site 23.

3.1 Management Objectives

HGCMC manages its waste rock facilities to safely receive material during production, maintain pile stability, reduce impacts to the receiving environment and ultimately return the land to natural use. Practices consistent with industry standard are employed to achieve management objectives. Objectives applicable to surface waste rock site management include the following;

- Segregate waste rock for disposal based on the Greens Creek Mine defined classification scheme (e.g., class 1 – 4).
- Maintain surface water controls by using best management practices.
- Reduce potential for water quality issues caused by air and water entry into the waste rock mass.
- Place and maintain interim argillite cover over the disposal site.
- Construct and maintain waste rock sites in a manner that ensures operational stability.

3.2 Underground Waste Rock Classification

Management and routing of waste rock initiates in the underground mine. Waste rock classification is based on rock type and pyrite content. Interpretation of development and exploration drilling information allows mine geologists and engineers to estimate the quantities of argillite and phyllite anticipated during mining. Where practical the mine plan tries to minimize development in high pyritic rock, although mining potentially acid generating rock is unavoidable. Production geologists visually inspect the active mining face and muck piles to determine the waste rock lithology and pyrite content, estimate the NNP value and assign the heading a class. The classification system was not based on the distribution of NNP values or specific geochemical groups. Despite this, it is well-integrated in the mining process and sufficient to meet management objectives. It is as follows:

Class 1 - NNP greater than 100 tons $CaCO_3$/kt (surplus of approximately 10% carbonate)

Class 2 - NNP between 100 and -100 tons $CaCO_3$/kt

Class 3 - NNP between -100 and -300 tons $CaCO_3$/kt

Class 4 - NNP less than -300 tons $CaCO_3$/kt (deficit of approximately 30% carbonate)

Production geologists communicate the class of the heading to the mine department as conditions change and it is posted in the mine office/dry to notify truck drivers. Verbal communication and paint markings in the workings are also used. Class 4 waste rock is retained underground. Class 1, Class 2 and Class 3 waste rock is brought to the surface if not needed underground for backfill. Tonnage estimates are calculated from a polygonal estimate made from a surveyed plan as-built and these tonnage estimates are reconciled with hauled tonnages. Tonnage records are maintained by the Mine Department and reported in annual reports.

Chip samples of the headings are collected and sent to a laboratory for ABA analysis. The ABA results help document the types of material produced and validates the visual classification system.

3.3 Surface Operations

Surface operations for active and inactive waste rock site management are in this subsection.

Active Waste Rock Site Management (Site 23)

Per the 2003 WMP, a minimum slope of 3H:1V shall be used to ensure slopes are stable and do not erode or slough. This requirement is waived for the slope at Site 23 during construction. The slope is designed and constructed to a 2.85(H):1(V).

Waste rock is brought to the active waste rock site (Site 23) by underground haul trucks and placed in stockpiles, which are signed according to their waste rock class (Class 1 or Class 2/3). Some waste rock is hauled from the stockpiles to the TDF to armor slopes and construct access roads on the tailings pile.

Site 23 is constructed from the bottom-up in less than two-foot, compacted lifts. This minimizes air entry into the pile by preventing size sorting and maximizing compacted density. Minimizing air entry minimizes pyrite oxidation. Bottom-up placement also allows construction at 3H:1V side slope.

Class 1 material is placed on at least the outer two feet of the pile. This provides a barrier between the atmosphere and the potentially acid generating, Class 2 and Class 3 rock. The outer layer of Class 1 rock is also an oxygen sink. Pyrite contained in the Class 1 rock consumes oxygen and the abundance of carbonate neutralizes acidity generated by the pyrite oxidation.

Class 2 and Class 3 rock is placed in sub-horizontal to modestly-inclined, homogeneous lifts at least two feet from outer pile surfaces. Segregation of Class 2 and Class 3 was discontinued in 2004/2005 because it was creating physical discontinuities in the pile, which were promoting water and air entry. The classification system was not changed because it is well integrated into the mine operation and still provides useful production information. The primary objective of waste rock placement is to create a well-compacted, physically homogeneous surface that is buried quickly, minimizing exposure to air and water. The placement practices described above meets this objective. As available, additional

Class 1 rock may be placed within the Site 23 pile along with Class 2/3 rock.

In 2008, construction of a temporary lined storage pad at Site 23 was authorized to be used for interim waste storage (waste rock relocation) from inactive waste rock sites pending transport to underground (ADEC 2008). The lined pad was constructed and used through 2013, with deconstruction initiating late in 2013 upon construction of a second pad at a higher elevation. Once the reclamation work was completed at Site 1350 and the waste rock hauled into the underground the second pad was removed.

Surface water runoff from Site 23 is routed through a network of diversion tubes and ditches to the Site 23 water management pond located near 8-mile B road. Refer to GPO Appendix 10 – Water Operations and Maintenance Manual for more details on water management.

Attachment B, Figure 2 includes the Site 23 as-built for reference; refer to HGCMC annual reports for the most recent facility as-built.

Inactive Waste Rock Site Management

Management of inactive waste rock sites (refer to Section 2.4) includes adhering to BMP's for surface water controls and monitoring for potential adverse impacts. All inactive waste rock sites are vegetated for erosion control either with grasses or small trees that have naturally grown in, with the exception of Site E. Concurrent reclamation of Site E initiated in 2009 with waste rock being relocated to the TDF for co-disposal with tailings. This waste rock removal is on-going over multiple years and dependent on space availability for these materials at the TDF. Active water collection systems exist at both Site E and Site D. Site E surface water runoff is routed to a collection pond which is pumped to the storm water line located along the B Road for routing to the water treatment plan at the TDF; pumping is by manual operation and only during summer months. The Site D collection pond receives water runoff from the B Road and Site D. This collection pond is on automated pump control and pumps water to the Site 23 water management system for eventual routing to the water treatment plant.

3.4 Monitoring and Inspection

All monitoring shall be conducted in accordance with the WMP, 18 AAC 60.820-860 (surface water and groundwater), and GPO Appendix 1, IMP. GPO Appendix 1 contains information regarding water quality compliance monitoring, including monitoring requirements, test procedures, frequency, parameters, field procedures, and QA/QC plans.

Active Waste Rock Site 23

Inspections, survey data and material sampling are used to ensure that construction of the active waste site is according to approved construction plans. Monitoring hub, inclinometer, piezometer and topographic survey data are used in conjunction with engineering assessments to determine site stability. Visual observations and routine maintenance ensure that the water management system is functioning as designed. Routine water quality, flow and level monitoring, material sampling and data collection from site meteorological stations are used to define geochemical and hydrologic processes occurring at the site. This information is evaluated with respect to design expectations, and modifications are made, if necessary, to minimize effects on the receiving environment in the short and long term.

Monthly inspections of the facility will be performed when operations are in process, using an inspection checklist, in addition to any daily or weekly visual inspections made routinely as part of operation for which an inspection checklist is not used. A person who is familiar with the waste management permit requirements shall conduct the monthly inspection. Visual monitoring shall be conducted on routine facility operations, leachate collection and diversion systems, leachate pumping systems, the engineered cover and the facility perimeter. Structural changes or leakage noted during the inspections shall be documented. Inspections shall include but may not be limited to the following:

- signs of damage or potential damage to any component of the facility from settlement, ponding, leakage, thermal instability, frost action, erosion, slip failure, thawing of the waste, or operations that contribute to a problem;
- exceptions to conditions of the waste management permit;
- unauthorized waste disposal;

- damage to the structural integrity of a monitoring device, containment or drain structure; retaining wall, erosion control or diversion structure; and,
- evidence of death or stress to fish, wildlife, or vegetation caused by the facility.

Surface stability monitoring is performed at Site 23. Based on review of regional topography in the mid-2000's, concern arose that the site may have been constructed on an ancient landslide. A vertical inclinometer was installed in the central portion of the pile in 2006. Monitoring of that inclinometer identified a slow creep movement subsurface to the waste rock pile at the interface with the till (less than 3 mm/year at approximately 80-ft bgs). In 2010, three additional inclinometers were installed proximate to the site (north and west of Site 23, and south at the toe of Site D). The movement rate is generally constant at three of the inclinometers, and the fourth inclinometer located at the toe of slope indicates no movement. All associated site stability data was assessed by a geotechnical engineer in 2011 (KCB 2012). As part of this data assessment, procedures were identified to be followed if changes in site movement rates are identified as part of future monitoring. Monitoring is performed and summarized in annual reports.

If any structural change in or damage to the facility, or any exception to the WMP conditions are observed during the visual monitoring program, it shall be reported to the ADEC by the end of the next working day and appropriate action will be taken to correct the exception or damage, prevent the escape of waste or leachate, and clean up any improper waste disposal. The Forest Service will be notified.

HGCMC submits reports on waste rock sites to the ADEC per WMP requirements, and the Forest Service in consideration of the GPO. These reports include:

- an as-built topographic survey (in plan and cross section) of active sites;
- a running total of waste rock placed on active sites and a current remaining volume estimate;
- a summary of piezometer readings;

- a summary of key activities, observations, problems and corrective actions;
- a status report for inactive sites;
- a summary of water and waste rock monitoring, including a description of the geochemical and hydrological processes occurring at the site; and
- a summary of pertinent reclamation/closure activities and studies.

Refer to the reporting requirements section of the WMP for additional details on reporting items.

4.1 REFERENCES

Alaska Department of Environmental Conservation (ADEC) Division of Air and Water Quality, Waste Water Discharge Program. *Waste Management Permit 2014DB0003, Hecla Greens Creek Mining Company.* August 11, 2014.

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ATTACHMENT A

WASTE ROCK MANAGEMENT

STANDARD OPERATING PROCEDURE

Waste Rock Management Standard Operating Procedure

Hecla Greens Creek Mining Company (HGCMC) uses the following operational procedures for waste rock management at active and inactive sites.

GENERAL:

- Waste rock disposal sites are permitted under the Waste Management (WMP); the requirements of that permit must be adhered to.
- Best management practices (BMPs) shall be utilized with regards to storm water and sediment management; refer to GPO Appendix 5, BMPs.
- Site reclamation shall be per approved GPO Appendix 14, Reclamation Plan.

Safety

- Conduct operations per HGCMC and MSHA safety standards. This includes:
  - Install safety berms per MSHA standards.
  - Awareness around highwalls
  - Adequate lighting for night operations.
  - Maintaining site access grade and road surfaces.
  - Radio or visual contact with site operator.
  - Awareness of uneven surfaces, slips trips and falls awareness

Site Access

- Proper signage shall be placed at site entrances for site access authorizations, and as appropriate, traffic patterns and active placement areas.
- Site access may be restricted with locked gates, chains, or cables. Secured accesses shall be maintained, if required by site-specific policy.

Water Management

- Divert surface runoff from undisturbed areas around the site.
- Ensure ditches are in place to prevent surface waters from running into placement or disturbed areas.
- Ensure site runoff is conveyed via designed and properly sized diversion ditches or conveyance tubes to retention ponds or discharge points to minimize erosion and sediment loss.
- Minimize surface water ponding and flow down site access roads.

Fugitive Dust Control

- Apply water as needed, particularly on traffic areas and during screening and crushing.
- Maintain roads properly.
- Hydroseed exposed inactive areas or cover with granular rock or soils.
- Use dust suppression aids where approved/appropriate.

Sediment Control

- Maintain access roads in a manner that minimizes sediment production.
- Construct and maintain rock check dams and settling basins to reduce sediment loading in site drainage.
- Use flocculent aids where approved/appropriate.

WASTE ROCK SITE 23 SPECIFIC:

Ground Preparation

- Remove reclamation materials in accordance with approved site design plans, adhering to lease boundaries.
- Keep useful reclamation materials separated where practical.
- Place overburden in approved stockpile areas with appropriate drainage control.
- Avoid creating stockpiles with mixed organic material and oxide soil horizons (these generate iron and manganese water quality issues); drainage containment may be necessary.
- Burn large woody debris per Forest Service guidelines.
- Leave excavated ground in stable condition.
- Prepare foundation and install foundation drainage per design plans.

Water Management

- Maintain water controls as designed and constructed.
- Protect the installed foundation drain system which discharges via pipe to the ditch along the upgradient side of the B Road. This includes monitoring and repair of any erosion at discharge points from piping.

Waste Rock Placement

- A slope of 3H:1V is generally used to ensure slopes are stable and do not erode or slough. Constructed slope during operations is established for some pile areas at a 2.85(H):1(V).

- Place waste rock in sub-horizontal to modestly inclined, less than 2-foot lifts.
- Spread with bulldozer and compact with four passes of the vibratory roller.
- Place Class 2/Class 3 at least two feet from outer pile surfaces.
- Avoid physical discontinuities in lifts that would allow water and air entry.
- Place Class 1 on at least two feet of outer final slopes to encapsulate Class 2/Class 3 rock.
- Encapsulate foundation drains with at least two feet of Class 1 rock.
- Place lifts in a manner that minimizes exposure of Class 2/Class 3 rock (continual burial).
- Avoid constructing access roads in valleys or depressions.

Temporary Storage Pad

- Temporary storage pads for interim concurrent reclamation waste rock storage shall be designed and constructed with adequate containment and drainage controls, per ADEC approval requirements.
- Protect containment liner.
- Maintain surface runoff drainage collection piping which routes surface water runoff from the waste pile to a retention swale and is then piped to the Site 23 water management pond degrit basin.
- Only store approved waste rock materials on the pad.
- If required by the source area, blend with lime for temporary geochemical stabilization until waste rock can be transported to underground or another approved disposal area.

Burn Pile

- Burn pile shall be located, operated, and maintained at adequate distance from surface water routing piping and environmental monitoring instrumentation.

Snow Removal

- Do not place waste rock on snow.
- Remove snow to outer slope of pile or stockpile it away from active placement zones.
- Avoid mixing waste rock with snow during snow removal.

INTERIM RECLAMATION:

- Conform to stipulations in the ADEC waste management permit.
- Conduct operations in a manner that minimizes closure/reclamation liability.
- Manage materials to maximize availability for reclamation use.

EMERGENCY ACTION PLAN:

- Issues identified during inspections shall be addressed in a timely manner before an emergency arises. In the event of unforeseen facility slope movement and/or water control issues, the following procedure will be followed:
  - Remove non-critical personnel from the area and mark off the area with flagging.
  - For slope movement issues, assess the site condition with input from a geotechnical engineer. Prepare an action plan as appropriate for the identified site condition and proceed with implementation.
  - For water control issues, work with the surface operations and/or water treatment personnel to prepare an action plan appropriate for the identified site condition and proceed with implementation.

MONITORING:

Monitoring includes visual inspections, environmental, and water quality monitoring. Inspections and environmental monitoring shall be performed per the current *Integrated Monitoring Plan* (IMP) (refer to GPO Appendix 1). This includes the following activities:

- Inspections
- Surface water, groundwater, drains, and lysimeter water quality monitoring
- Lysimeters sampled for field parameters, major ions and trace elements
- Acid base accounting and geochemical analysis
- Water levels (wells and piezometers)
- Geo-technical stability (survey hubs and inclinometers)
- Meteorological conditions

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ATTACHMENT B

FIGURES

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Figure 1, Mine Site Location Map

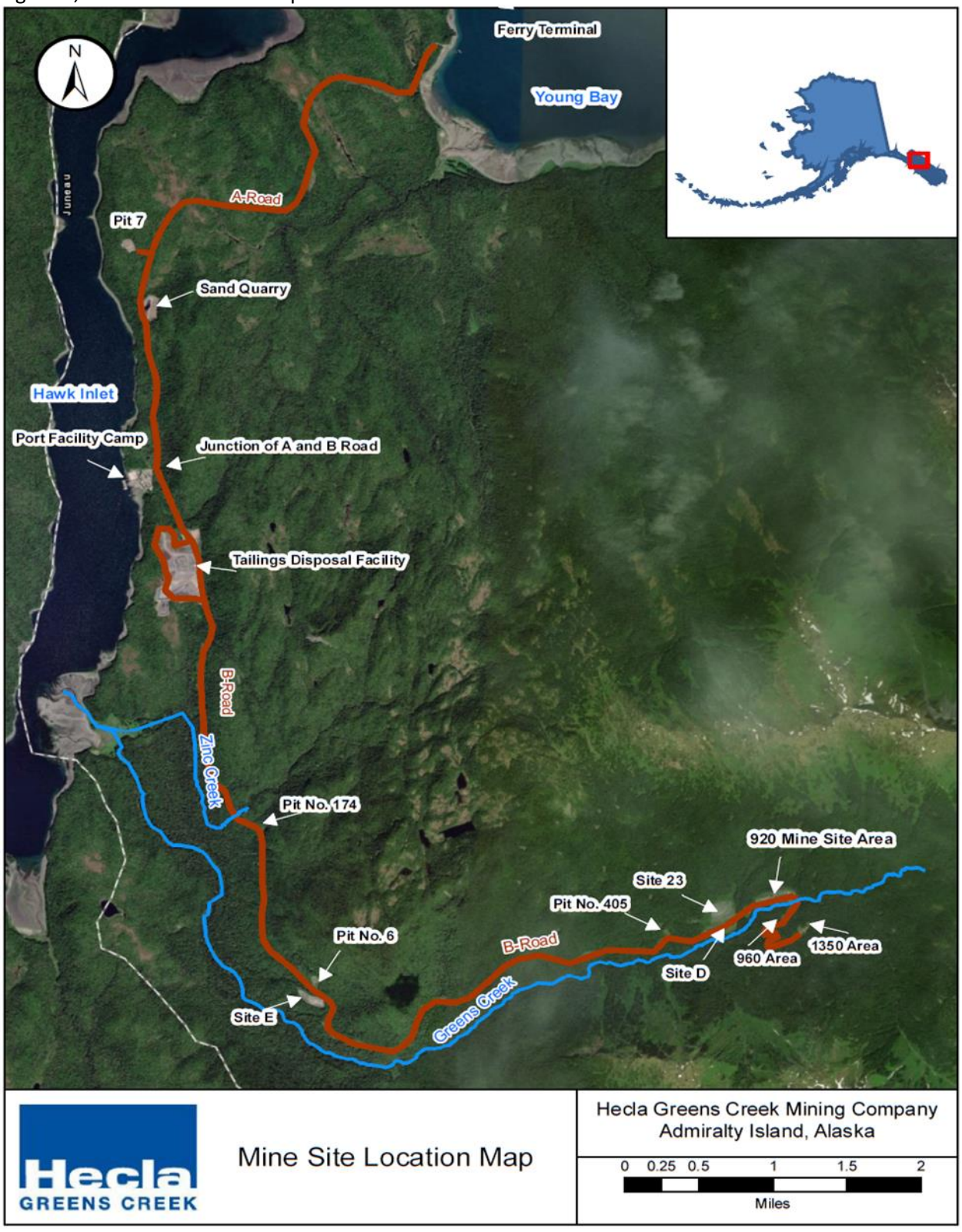

Figure 2, Site 23 As-Built

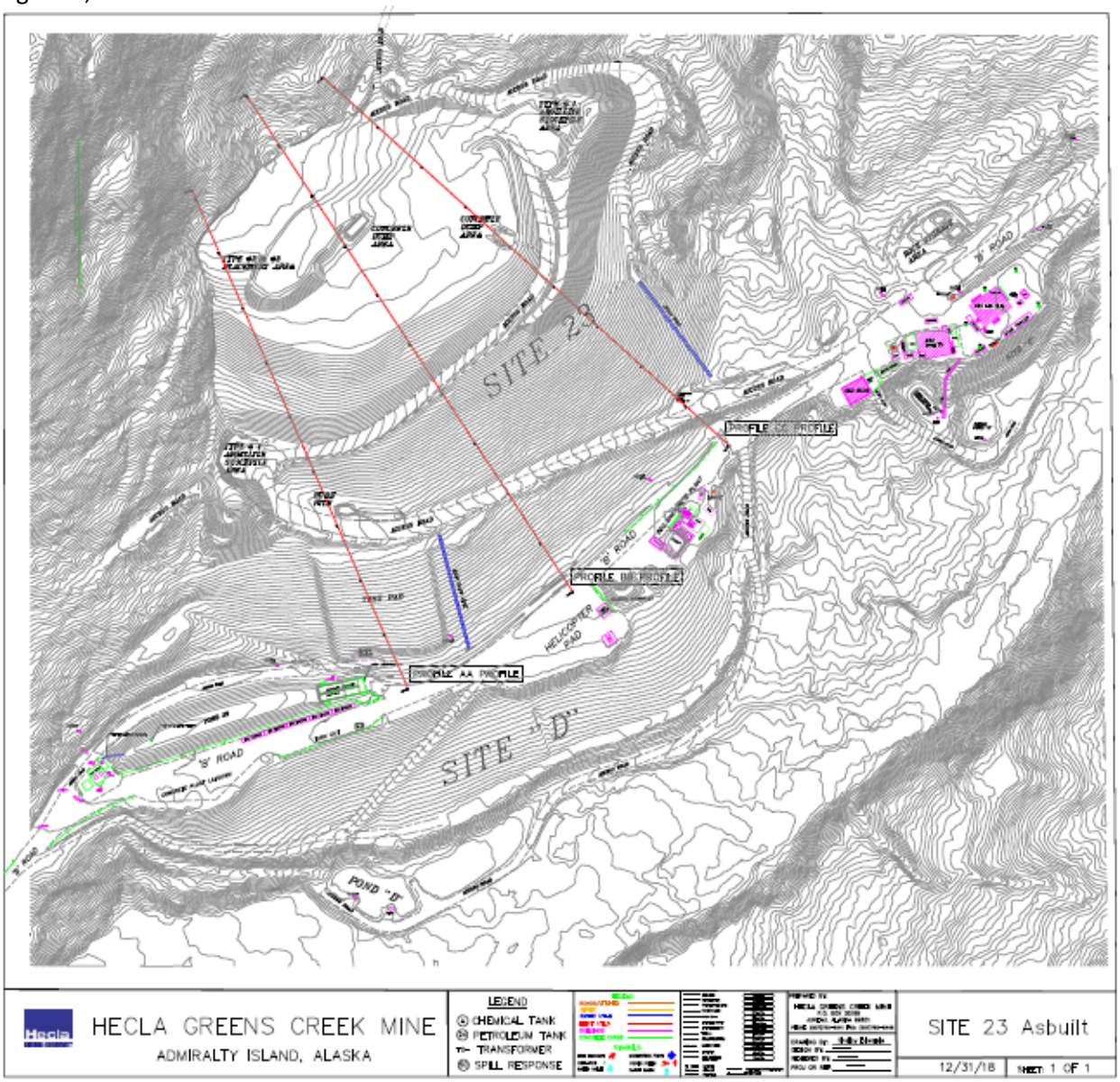

Figure 3, Site 23 As-Built Cross Sections