WALTER CREEK VALLEY FILL
HEAP LEACH PAD
OPERATIONS & MAINTENANCE MANUAL
REVISION 5

Fairbanks Gold Mining, Inc.
A Subsidiary of Kinross Gold Corporation
P.O. Box 73726
Fairbanks, Alaska 99707-3726

January 2014

Walter Creek Valley Fill
Heap Leach Pad
Operations & Maintenance Manual

Table of Contents

Page

Preface 1-1

Section 1.0 - INTRODUCTION 1-2

1.1 Purpose and Objective 1-2
1.2 Scope 1-2
1.3 Overview of the Heap Leach Pad 1-2
1.4 Operator Training Program 1-3
1.5 Assignment of Responsibilities and Procedures 1-3

Section 2.0 - DESCRIPTION OF THE HEAP LEACH PAD 2-1

2.1 General 2-1
2.2 Ore Heap 2-1
2.3 Solution Collection and Composite Geomembrane Liner Systems Including the LCRS 2-4
2.3.1 Solution Collection System Pipeworks and Overliner 2-4
2.3.2 In–Heap Pond Liner System and LCRS 2-8
2.3.3 Liner System above In-Heap Pond 2-9
2.4 In-heap Storage Pond Embankment, Base Platform Random Fill, Underdrain Random Fill, and Random Fill Drain 2-9
2.5 Internal In-Heap Storage Pond 2-12
2.5.1 General 2-12
2.5.2 Full Scale Leaching Operations 2-12
2.5.3 Solution Collection Wells 2-14
2.5.4 Solution Level Monitoring 2-15
2.6 Process Control Monitoring System (PCMS) 2-15
2.7 Underdrain Collection System and Monitoring Wells 2-18
2.8 Pregnant and Barren Pipeline Corridor 2-18
2.8.1 Carbon in Column One 2-18
2.8.2 Carbon in Column Two 2-19
2.9 Surface Water Control System 2-21

Section 3.0 - OPERATION AND MAINTENANCE PROCEDURES 3-1

3.1 General 3-1
3.2 Ore Heap 3-1
3.2.1 Operation and Maintenance - Ore Heap 3-1
3.2.2 Inspections and Monitoring - Ore Heap 3-2
3.3 In-Heap Storage Pond 3-2
3.3.1 Operation and Maintenance - Internal In-heap Storage Pond 3-2
3.3.2 Inspections and Monitoring - Internal In-heap Storage Pond 3-7
3.4 Solution Collection System, Solution Monitoring and Composite Geomembrane Liner Systems including LCRS 3-7
3.4.1 Operation and Maintenance - Solution Collection System 3-7
3.4.2 Inspections and Monitoring - Solution Collection System 3-8
3.4.3 Operation and Maintenance - Composite Geomembrane Liner System 3-9

3.4.4 Inspections and Monitoring - Composite Liner System 3-9
3.5 Leachate Collection and Recovery System (LCRS) 3-10
3.5.1 Operation and Maintenance- LCRS 3-10
3.5.2 Inspections and Monitoring - LCRS 3-10
3.6 Embankment Underdrain Collection System and Monitoring Wells 3-11
3.6.1 Operation and Maintenance - Embankment 3-11
3.6.2 Inspections and Monitoring - Embankment 3-11
3.6.3 Operation and Maintenance - Underdrain Collection System and Monitoring Wells 3-13
3.6.4 Inspections and Monitoring - Underdrain Collection System and Monitoring Wells 3-14
3.7 Process Control Monitoring System (PCMS) 3-15
3.7.1 Operation and Maintenance - PCMS 3-15
3.7.2 Inspections and Monitoring – PCMS 3-17
3.8 Pregnant and Barren Pipeline Corridor 3-17
3.8.1 Operation and Maintenance - Pregnant and Barren Pipeline Corridor 3-17
3.8.2 Inspections and Monitoring - Pregnant and Barren Pipeline Corridor 3-17
3.9 Surface Water Control System 3-17
3.9.1 Operation and Maintenance – Surface Water Control System 3-17
3.9.2 Inspections and Monitoring – Surface Water Control System 3-17
3.10 Photographs 3-18
3.11 Data Interpretation 3-18
3.11.1 Data Interpretation 3-18
3.11.2 Internal and External Reviews 3-19

Section 4.0 - Emergency Action Plan 4-1

4.1 General Emergency Response Procedures 4-1
4.2 Emergency Communication Procedures 4-1
4.2.1 Internal Communications 4-1
4.2.2 Communication with Government Agencies and Media 4-2
4.3 Emergency Detection, Evaluation and Classification 4-5
4.3.1 Event Detection 4-5
4.3.2 Emergency Level Determination 4-5
Level I Notification and Emergency Action Procedures 4-5
Level II Notification and Emergency Action Procedures 4-6
Level III Notification and Emergency Action Procedures 4-6

Section 5.0 - REFERENCES 5-1

Section 6.0 - LIST OF REVISIONS 6-1

Section 7.0 - Acronyms and Abbreviations 7-1

Tables

Table 1.1 – HLP O&M Responsibilities 1-3
Table 3-1 - Transient Heap Draindown Volumes and Times 3-4
Table 3-2 - Stage Storage Components 3-5
Table 3-3 - Monitoring Requirements 3-11
Table 3-4 - Monitoring Parameters for Underdrains 3-14
Table 3.4 - Inspection Schedule for the Walter Creek HLP Surface Water Controls 3-18
Table 3.5 - Surface Water Controls - Observation and Response 3-18
Table 4-1 Emergency Level 4-5
Table 4-2 - Guidance for Determining the Emergency Level 4-7

Figures

Figure 1.1 - Heap Leach General Layout....1-5
Figure 1.2- FGMI Organization Chart 1-5
Figure 2.1 - General Layout 2-2
Figure 2.2 - Well Configuration 2-3
Figure 2.3 - Composite Liner Cross Section 2-4
Figure 2.4 - Solution Collection System....2-6
Figure 2.5 Stage 3 Pipework Modification 2-7
Figure 2.6 - LCRS Details 2-8
Figure 2.7 - In-Heap Storage Embankment....2-9
Figure 2.8 - Spillway Redesign 2-11
Figure 2.9 - In-Heap Storage Pond....2-12
Figure 2.10 – PCMS Channel Detail....2-16
Figure 2.11 PCMS and Underdrain System....2-17
Figure 2.12 - Pipeline Corridor Detail 1....2-19
Figure 2.13 - Pipeline Corridor Detail 2....2-20
Figure 2.14 - Pipeline Corridor Detail 3....2-20
Figure 2.15 - Pipeline Corridor Detail 4....2-21
Figure 2.16 - Ultimate Heap Watershed Plan 2-23
Figure 3.1 - Stage Operating Elevation Ranges 3-6
Figure 3.2 - Maximum Allowable Draindown 3-6
Figure 3.3 - Stage 7 Filling Curve 3-7
Figure 3.4 - Vibrating Piezometer Locations and Instrumentation Room 3-9
Figure 3.5 - Survey Monuments....3-12
Figure 3.6 - Survey Monuments Details....3-13
Figure 3.7 - PCMS Outlet Locations 3-16
Figure 4.1 Level 1 Notification 4-2
Figure 4.2 Level 2 Notification 4-3
Figure 4.3 Level 3 Notification 4-4

Appendices

Appendix A Project Data Sheets
Appendix B Heap Leach Pad – Inspection Forms
Appendix C Analytical Profile Chemistry
Appendix D Emergency Action Plan

Walter Creek Valley Fill
Heap Leach Pad
Operations & Maintenance Manual

Preface

This document is the Operation & Maintenance Manual (O&M Manual) for the Fairbanks Gold Mining, Inc. (FGMI) Walter Creek Valley Fill Heap Leach Pad (HLP) located near Fairbanks, Alaska in the North Star Borough. This O&M Manual has been prepared to facilitate effective and efficient operation, maintenance, and surveillance, as well as documentation for the facility. It is for the use of FGMI operating and maintenance personnel and contains information and instructions that will assist these individuals in performing their duties. Additionally, this O&M Manual will be used in training operators and maintenance personnel in recommended procedures. The O&M manual includes an organization chart showing the key personnel with operating and maintenance responsibilities. It also includes a remedial action contingency plan including general emergency response procedures and emergency communication procedures.

The facility descriptions presented in this manual are summary descriptions designed to serve as a basis for presenting the O&M and monitoring procedures. The manual user should refer to the more detailed descriptions presented in the design and record of construction reports described below as situations warrant.

Proper O&M is crucial for the HLP to operate safely and efficiently and this O&M manual is an essential component of the O&M program. Owing to the lengthy and cold winters at the site the HLP contains an in heap solution storage pond behind an embankment dam at the toe of the heap. This manual presents procedures for operating the pond under normal and extreme pond levels and flow conditions. It provides technical guidance and procedures for monitoring, inspection, and long-term maintenance programs. It also contains descriptions of unusual conditions that are most likely to occur at the dam and the operating procedures that should occur under those conditions, including extraordinary inspections.

As with any structure of this complexity the operations manual may not foresee each and every potential problem. However, with a well conducted training program and careful observations and inspections unusual circumstances will be identified and brought to management's attention so they can be appropriately dealt with.

Monitoring equipment, procedures, and instrumentation are required to accomplish the following:

- Confirm that the structure is performing in accordance with the design
- Determine if a problem exists that may require remediation
- Provide timely notice of an adverse change in the state of the dam or in heap storage pond

It must be noted that for the majority of the time over the life of the HLP, the inspection and monitoring program will be routine with no surprises. However, due attention and diligence must be maintained to provide early identification of any potential problem so that it may be remediated prior to it becoming significant. This can only be achieved through the commitment of operating personnel and management at all levels of the operation.

Many of the figures included in this O&M Manual have been copied in part from the drawing set accompanying the "Fairbanks Gold Mining, Inc. Walter Creek Valley Fill Heap Leach Pad Design Report", Revision 2, March 27, 2007 (Design Report), and "Fairbanks Gold Mining, Inc. Walter Creek Valley Fill Heap Leach Expansion Pre-Feasibility Study Revision 0", dated December 7, 2011 prepared by Knight Piésold and Co. of Denver, Colorado, and construction related Addendums and the latest edition of the Record of Construction Report (ROC).The figures in his manual are provided to aid in the understanding of the HLP related to the operation and maintenance of the facility.

Section 1.0 - **INTRODUCTION**

1.1 Purpose and Objective

The purpose and objective of this O&M Manual is provide a description of the HLP and descriptions of the methods and procedures that will help to ensure that each facility component of the Walter Creek Valley Fill HLP is performing as designed and constructed. In addition, it will help to provide for early detection of component damage, degeneration and/or performance outside the limits of the design intent so that appropriate remedial measures and actions can be implemented.

1.2 Scope

This O&M Manual describes management practices that will be used for the operation and maintenance and routine inspection and monitoring of the HLP, as well as extraordinary inspections. It also presents procedures, roles and responsibilities. It addresses the in-heap storage embankment, the composite liner system, the foundation underdrain, the process component monitoring system (PCMS), the leachate collection and recovery system (LCRS), monitoring systems, surface water controls and related facilities. An emergency response plan outlining responses to emergency situations has also been incorporated in this O&M Manual.

1.3 Overview of the Heap Leach Pad

The Walter Creek Valley Fill Heap Leach Pad (HLP) is a gold heap leach pad located in the upper end of the Walter Creek drainage immediately upstream from the Fort Knox tailing impoundment facility. Run-of-mine ore from the Fort Knox pit and material from low grade stockpiles is stacked in the lined containment area located behind and above the in-heap storage embankment constructed in the upper reaches of the Walter Creek drainage. The design capacity of the HLP is approximately 307 million tons. Ore is loaded on the pad in incremental lifts at an average rate of 72,000 tons per day. Figure 1.1 shows a general arrangement of the HLP as well as the in-heap storage impoundment. The pad is to be constructed in five stages as illustrated on Figure 1.1. A Project Data Sheet presenting key statistics for the HLP is presented in Appendix A.

For the long term operations, the leachate or barren solution is applied to the surface of the HLP through a network of solution drip emitters for the removal of gold. These are placed on the ore or buried during cold weather months. The leachate is a dilute alkaline cyanide solution that percolates through the heap and is intercepted by a solution collection system placed in the 36-inch thick overliner drain at the base of the heap. In addition to acting as a drain, the overliner is designed to protect the underlying liner system during ore placement. To initiate gold recovery a vat leach operation was utilized in the winter of 2009/2010 in conjunction with a drip leach winter test pad.

The HLP itself is comprised of two distinct areas consisting of the in-heap storage pond located behind the in-heap storage pond embankment and the basin area above the level of the in-heap storage pond. The composite liner system beneath the in-heap storage pond is double-lined consisting of, from bottom to top, a 12-inch-thick low permeability prepared sub base overlain by an 80-mil double-side textured Linear Low Density Polyethylene (LLDPE) secondary geomembrane liner, then a leachate collection recovery system (LCRS), a primary 80-mil double-side textured LLDPE primary geomembrane and finally a 3-foot-thick overliner with solution collection pipe works designed to promote solution collection and flow to the solution collection wells located just upstream of the in-heap embankment. The LCRS is composed of a geocomposite drain on the slopes and in the flatter valley bottom a 3-foot thick layer of LCRS drain aggregate overlain by an 8- to 14-inch thick low permeability layer. A more detailed description of the liner systems and LCRS is presented in Section 2.3.

The composite liner in the basin, above the in-heap pond, consists of a 12-inch-thick low permeability prepared sub base overlain by an 80-mil double-side textured LLDPE primary geomembrane liner. Then the overliner with solution collection pipes as a direct extension of the overliner in the in-heap storage pond. Along with promoting leachate drainage, the overliner and the solution collection pipework will maintain a low head, designed to be less than 1 foot on average, on the 80-mil double-side textured

LLDPE geomembrane liner above the in-heap storage pond. The solution collection pipe work carries the leachate, now the pregnant solution, to the in-heap storage pond located behind the in-heap pond embankment

For the remainder of the HLP operation, the pregnant solution is removed from the in-heap storage pond with five vertical solution collection wells located at the lowest portion of the in-heap storage pond just upstream of the upstream toe of the in-heap storage pond embankment. The solution is pumped directly to a Carbon-in-Column (CIC) recovery system located adjacent to the existing mill. After the recovery of gold, the barren solution from the CIC plants is returned to the HLP. Solution is moved to and from the HLP in pipes within the lined solution collection corridor.

Extensive inspection and monitoring systems are included in the HLP to assess the ongoing performance of the facility. Liner integrity is monitored with three separate systems. First, a process control monitoring system (PCMS) has been installed in each of three drainage areas on the west side of the heap leach pad where concentrated flows are anticipated. The PCMS has been designed to monitor for leaks through the liner beneath the solution collections headers located in these drainages above the limits of the in-heap storage pond. Second, the LCRS pump back system has been designed to collect and return any solution passing through the primary liner to the in-heap storage pond. Third, an underdrain system has been installed beneath the lined base of the HLP in the valley bottom to capture and transport flow from seeps and springs under the pad. Solution depths in the in-heap pond will be monitored by a series of vibrating wire piezometers located in the overliner within the pond. Solution levels on the primary liner above the in-heap pond are monitored by a series of vibrating wire piezometers in the overliner above the pond. Vibrating wire piezometers have also been located in the LCRS and LCRS sump to monitor fluid levels. Movement monuments in the form of survey points are located on the in-heap embankment crest, pipeline bench road, and crest of the base platform bench and on the top ends of the solution collection wells. A visual inspection and report program is included, as well as more extensive inspections by FGMI, the Engineer of Record and State of Alaska Dam Safety Engineer. The inspections by the Engineer of Record and State Engineer are not covered in this O&M Manual, but they will include a review of the monitoring information collected and analyzed as part of this O&M program. The Alaska Department of Natural Resources (ADNR) and the Alaska Department of Environmental Conservation (ADEC) will perform inspections on a non-routine basis, as they deem necessary.

1.4 Operator Training Program

An operator training program was conducted at the initiation of operations and will be continued annually after to provide employees responsible for the implementation of the O&M procedures with the expertise that will enable them to perform their respective duties. More frequent training sessions may be held to train employees newly assigned to O&M responsibilities.

1.5 Assignment of Responsibilities and Procedures

A list of key personnel with operating and maintenance responsibilities relating to the HLP is shown in Table 1.1. A partial organization chart outlining relationships between those personnel is shown in Figure 1.2.

Table 1.1 – HLP O&M Responsibilities

TITLE	RESPONSIBILITY
General Manager	Overall Responsibility for Project
Environmental Manager	Environmental Compliance and Permitting
Operations Manager	HLP Management
Ore Processing Manager	HLP Operation
Mill Operators / Mechanics	Routine Maintenance Work
Mill Operators, Mechanics, & Env. Dept.	Reading and Recording Monitoring Data
FGMI and Consultants as Needed	Reduction and Interpretation of Data
Mill Operators	Daily Inspections
Environmental Dept.	Environmental Inspections
FGMI and Consultants as Needed	Annual Inspections

The Heap Leach operators are responsible for conducting the daily inspections and monitoring of the general operations of the Heap Leach facility. The Mine Operations foremen are responsible for conducting daily inspections and monitoring of the placement of the ore on the Heap Leach Pad. The Environmental Department will review the daily inspections on a Quarterly basis and conduct a monthly inspection using the Inspection Form. The Inspection Forms are located in Appendix B. The data collected will be filed electronically and maintained to facilitate reporting of the HLP facility as required. The data will be presented in a fashion as required by the receiving agency.

Any variances from the design basis or higher than design water levels, cyanide in the monitoring systems, signs of instability, improper ore placement or other things that could adversely affect facility performance shall be reported daily to the Mill Superintendent, Operations Manager, and Environmental Manager so corrective actions can be taken. The Mill Superintendent, Operations Manager, and/or Environmental Manager shall advise the General Manager of any deviations and corrective actions.

Emergency situations and responses are described in Section 4.0. Figure 4.1 shows the Emergency Notification Procedures. In general the Level 1 notifications will be for deviations from the design basis that do not affect the overall safety and integrity of the HLP or be anticipated to lead to the release of solutions from the HLP or present a threat to the health and safety of workers or persons offsite. If emergency situations arise that could affect the overall safety and integrity of the HLP or be anticipated to lead to the release of solutions from the HLP or present a threat to the health and safety of workers or persons offsite the General Manager and/or Environmental Manager or acting site manager shall be informed to initiate Level 2 and 3 notifications and initiate corrective actions. They will initiate the emergency response plan, as appropriate.

Figure 1.1 - Heap Leach General Layout

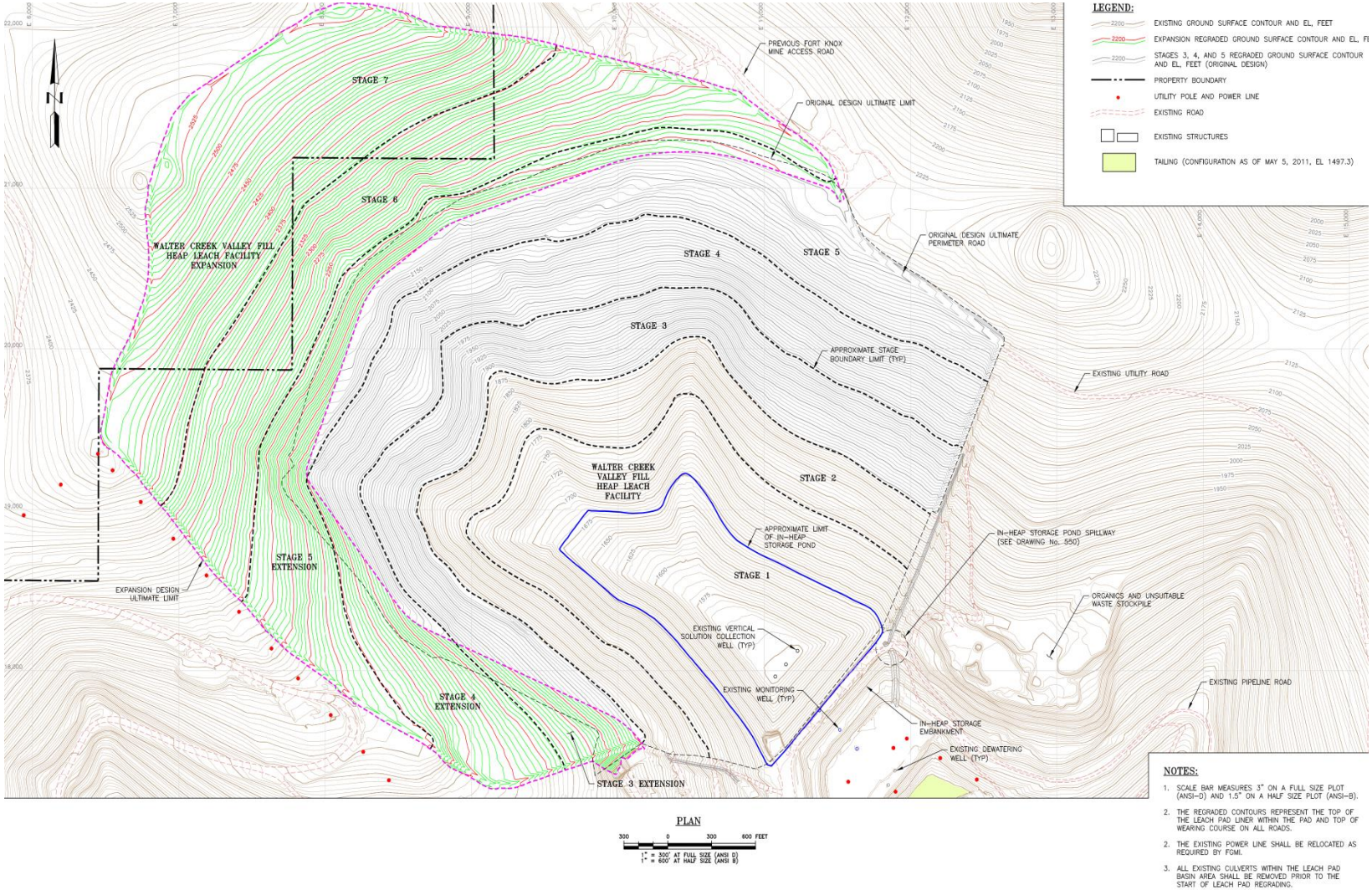
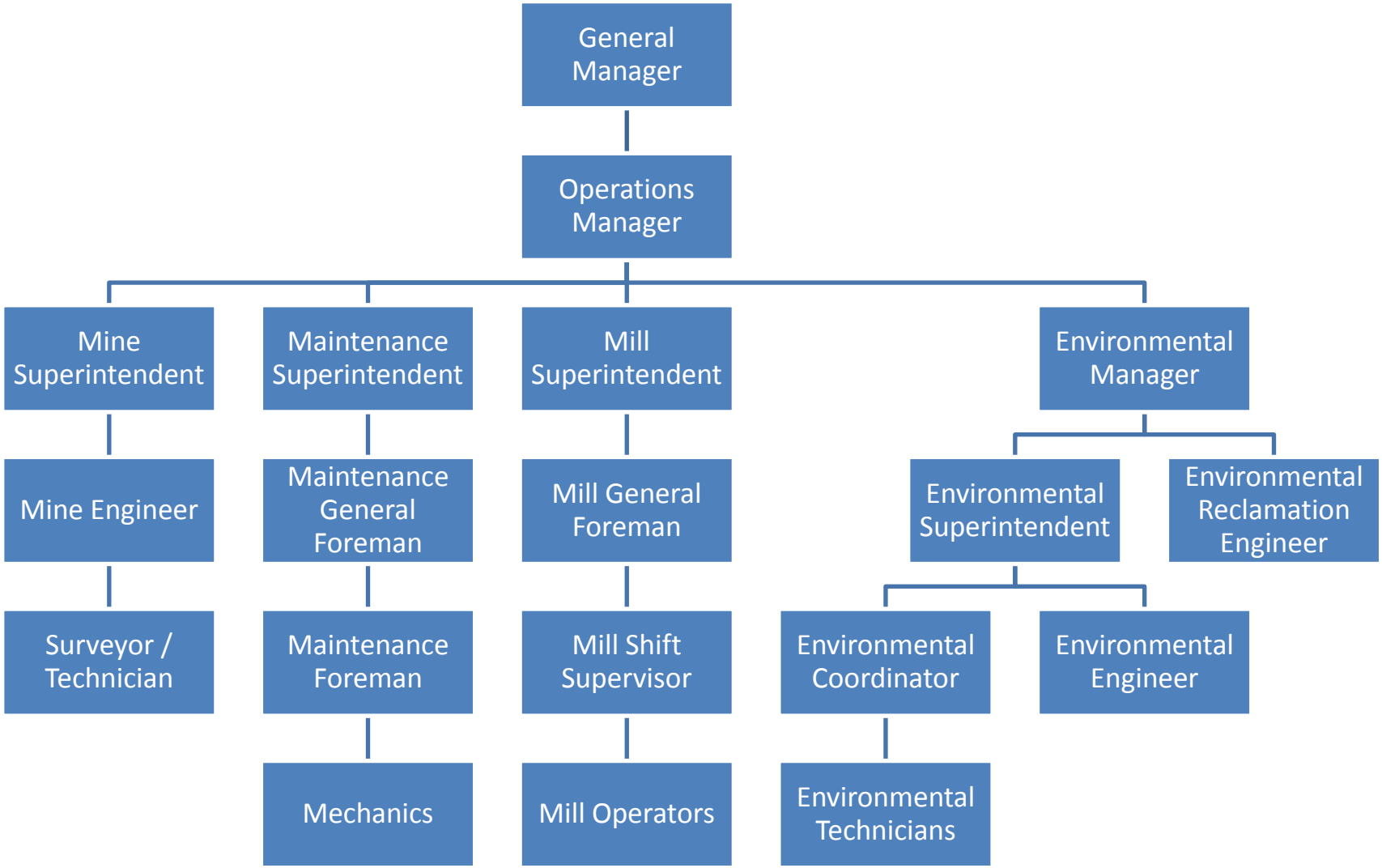


Figure 1.2- FGMI Organization Chart



Section 2.0 - **DESCRIPTION OF THE HEAP LEACH PAD**

2.1 General

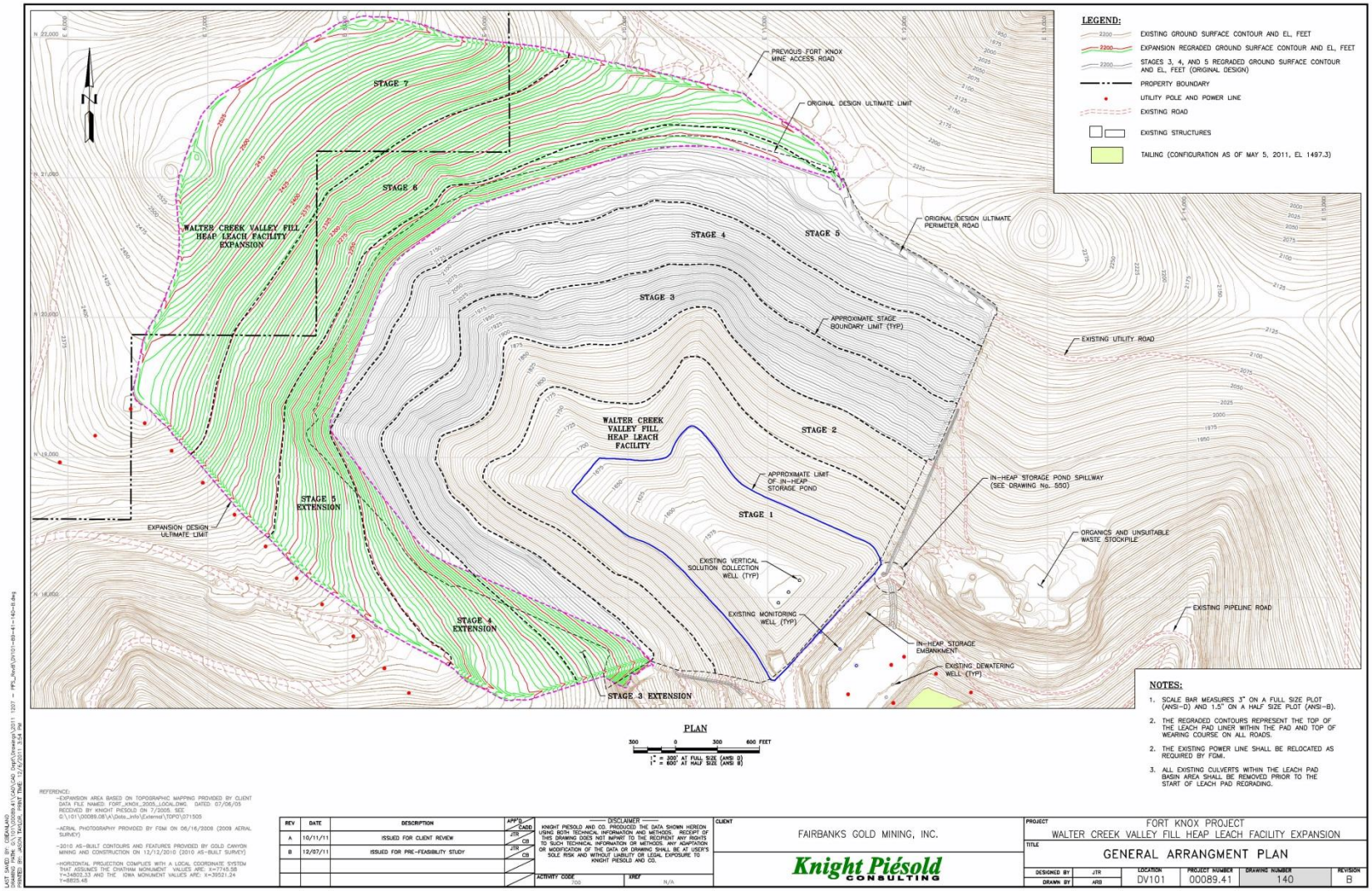
Major components of the HLP consist of the ore heap, the composite geomembrane liner and solution collection system, the in-heap storage embankment, the internal in-heap storage pond, the leachate collection and removal system (LCRS), the process component monitoring system (PCMS), the underdrain collection system, the process solution handling system including the vertical solution collection wells, and the surface water controls. The following sections provide descriptions of these components to help understand the necessary operation and maintenance requirements.

2.2 Ore Heap

Run-of-mine ore from the Fort Knox pit and low grade stockpiles is stacked in the lined containment area located behind an in-heap storage embankment constructed in the Walter Creek basin. Loading of the ore occurs over eight months or 244 days per year. Generally, ore is loaded on the pad in incremental lifts Stages one, two and part of three at a rate of 50,000 to 100,000 tons per day; the remaining lifts will be stacked at an average rate of 72,000 tons per day Leaching is conducted on a rotational basis that includes placing a lift of ore to be leached, ripping the surface of the placed ore that has been compacted by the haul truck traffic, installing the drip tubes, leaching, and then preparing the top of the leached lift for receipt of the next ore lift. Year-round leaching and eight to ten months of stacking is planned.

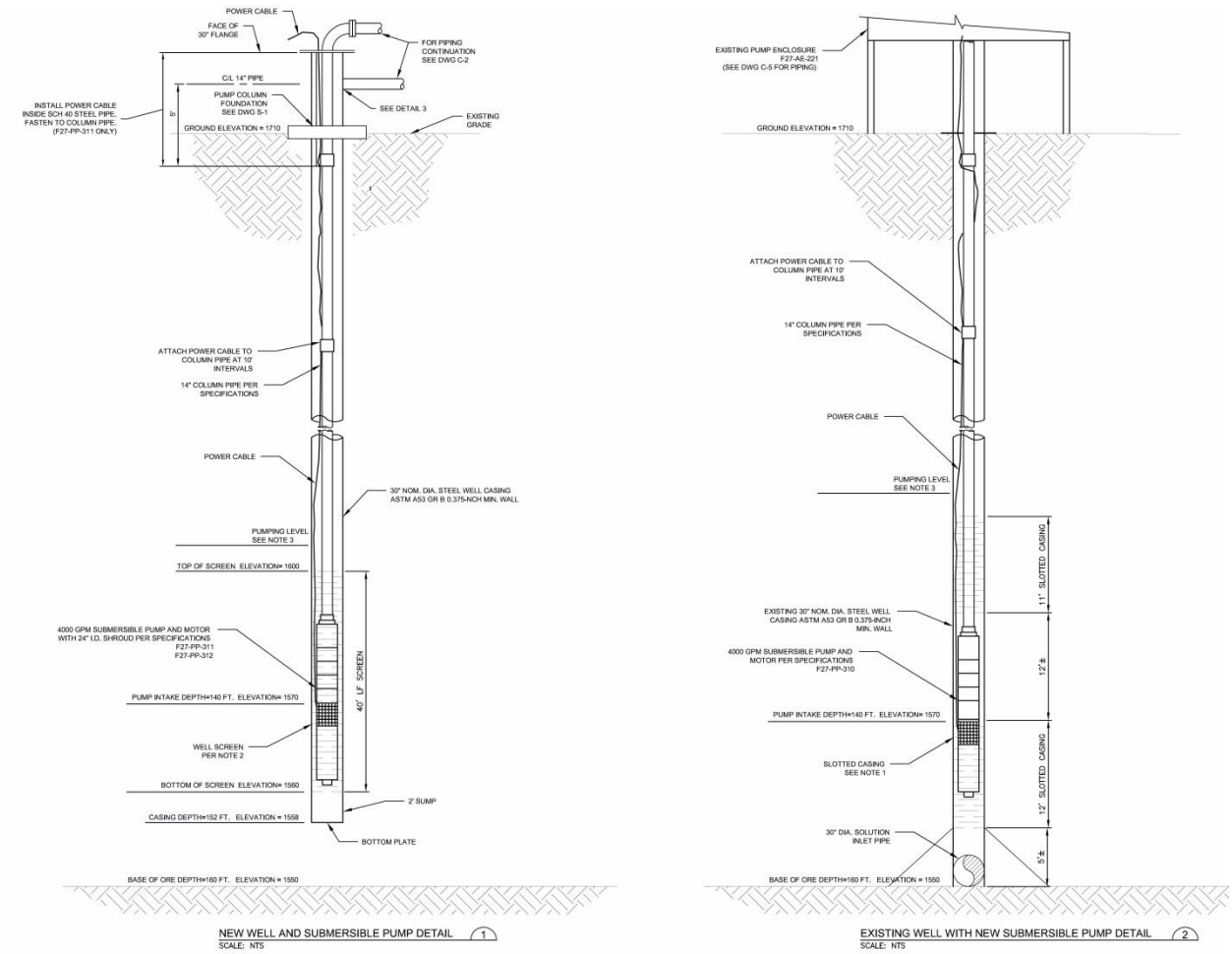
A general plan of the facilities is illustrated in Figure 2.1 of the following page

Figure 2.1 - General Layout



For the long term operation, the pregnant solution will be removed from the in-heap storage pond with the five vertical solution collection wells. The original three are located at the lowest portion of the in-heap storage pond during initial construction and are connected directly to the solution collection header pipes. The two wells constructed in 2012 are within the in-heap storage pond thus not directly connected to the solution collection header pipes. Each of the wells has a pumping capacity of 4,000 gpm. Generally, four wells will be pumped at any one time to remove the solution being applied at a rate of 16,000 gpm, reference Figure 2-2 for well configuration details.

Figure 2.2 - Well Configuration



The pregnant solution is pumped directly to two Carbon-in-Column (CIC) recovery systems located adjacent to the existing mill. After the recovery of gold, the barren solution from the two CIC plants is returned to the pad. All solution is conveyed to and from the HLP in pipes situated within a lined channel which is sloped from the CIC plants to the HLP. In the event of a leak in any of the conveyance pipes, solution will report in the lined channel, backfilled with pervious gravel, and will flow directly into the lined HLP. The end of the channel is exposed at the HLP for observation of flow in the channel that could indicate leaks in the pipes.

Subsequent lifts are placed with approximately a 1.3H: 1V (horizontal: vertical) angle of repose slope. Benches will be included between each successive lift of ore placed on the heap such that an overall exterior slope of the embankment will be 3H:1V or with local variations as described in the Design Report.

Leachate also known as barren solution is applied to the surface of the HLP through a network of solution drip emitters. These are placed on the ore or buried during cold weather months. The leachate is a dilute

alkaline cyanide solution that percolates through the heap and is intercepted by the composite liner system and the solution collection piping in the overliner covering the base of the heap.

A haul ramp is utilized for placement of ore on the pad. It has been designed with a 100-foot running width, a safety berm on the downstream side of the road, and a maximum uphill haulage grade of 8.0 percent.

2.3 Solution Collection and Composite Geomembrane Liner Systems Including the LCRS

2.3.1 Solution Collection System Pipeworks and Overliner

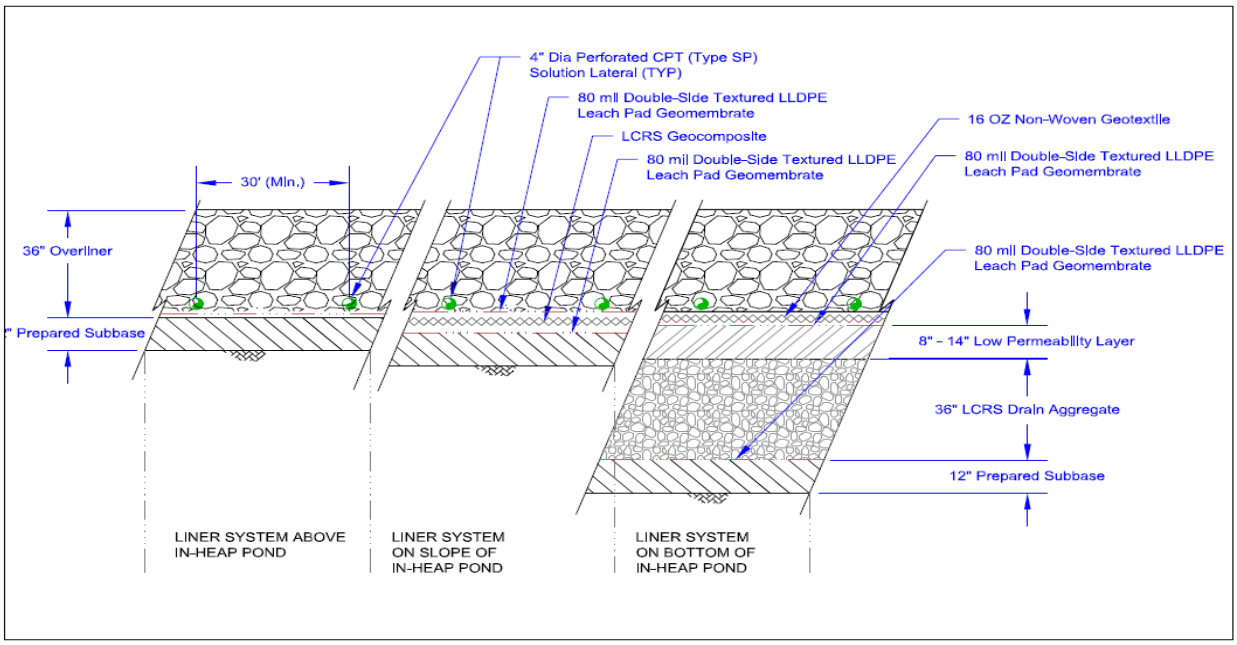
The solution collection system underlies the ore under the entire pad. It includes the 3-foot-thick overliner constructed of overliner drainage aggregate and contains a series of small diameter slotted solution collection pipes reference Figure 2-4. The overliner was designed to serve three primary functions including:

1) Reduce head pressure on liner

2) Protect the liner from damage during ore placement

3) Increase the level and rate of recovery of the process solution

Figure 2.3 - Composite Liner Cross Section



The solution collection pipework in the overliner consist of a series of 4-inch diameter slotted smooth interior Corrugated Polyethylene Tubing (CPT) solution collection lateral pipes to collect and transport pregnant solution to the solution collection pipes. The 4-inch laterals are installed in a herringbone pattern between the larger diameter solution collection pipes and are spaced at intervals varying from 30 to 90 feet, depending on the slope on which they are installed. The solution collection pipes consist of a series of 6-inch to 24-inch diameter solution collection headers installed in the low areas of the recontoured leach pad basin including the expansion area.

The original solution collection system and pipes were designed to maintain maximum average head of 1 foot on the primary liner above the limits of the in-heap pond and to carry 8,000 gpm, each pipe's capacity is based on a 0 to 50 percent reduced flow area due to pipe deflection based on ore-induced pipe loading.

During the prefeasibility design analysis it was determined the existing and future solution collection pipe network and drainage layer will continue to accommodate 16,000 gmp. However, small localized lengths of existing solution collection headers were identified as being unable to convey the required flow. Additional dispersion pipework was designed and installed during Stage 3 construction.

The analysis of the solution collection system, demonstrates that the calculated head applied to the pad liner system under the increased flow regime will remain low, at less than 1.0 foot (ft) on average, for the area under leach. Some small areas are predicted to have localized heads higher than 1.0 ft, the high-quality liner and solution monitoring systems installed in the WCHLF, as well as the hydraulic containment provided by the valley site that results in all drainage reporting to the tailing storage facility and then being consumed in the mill process, provides for a very high level of environmental protection.

Figure 2.4 for the general layout of the solution collection system and Figure 2.5 for the Stage 3 additional dispersion pipework.

Figure 2.4 - Solution Collection System

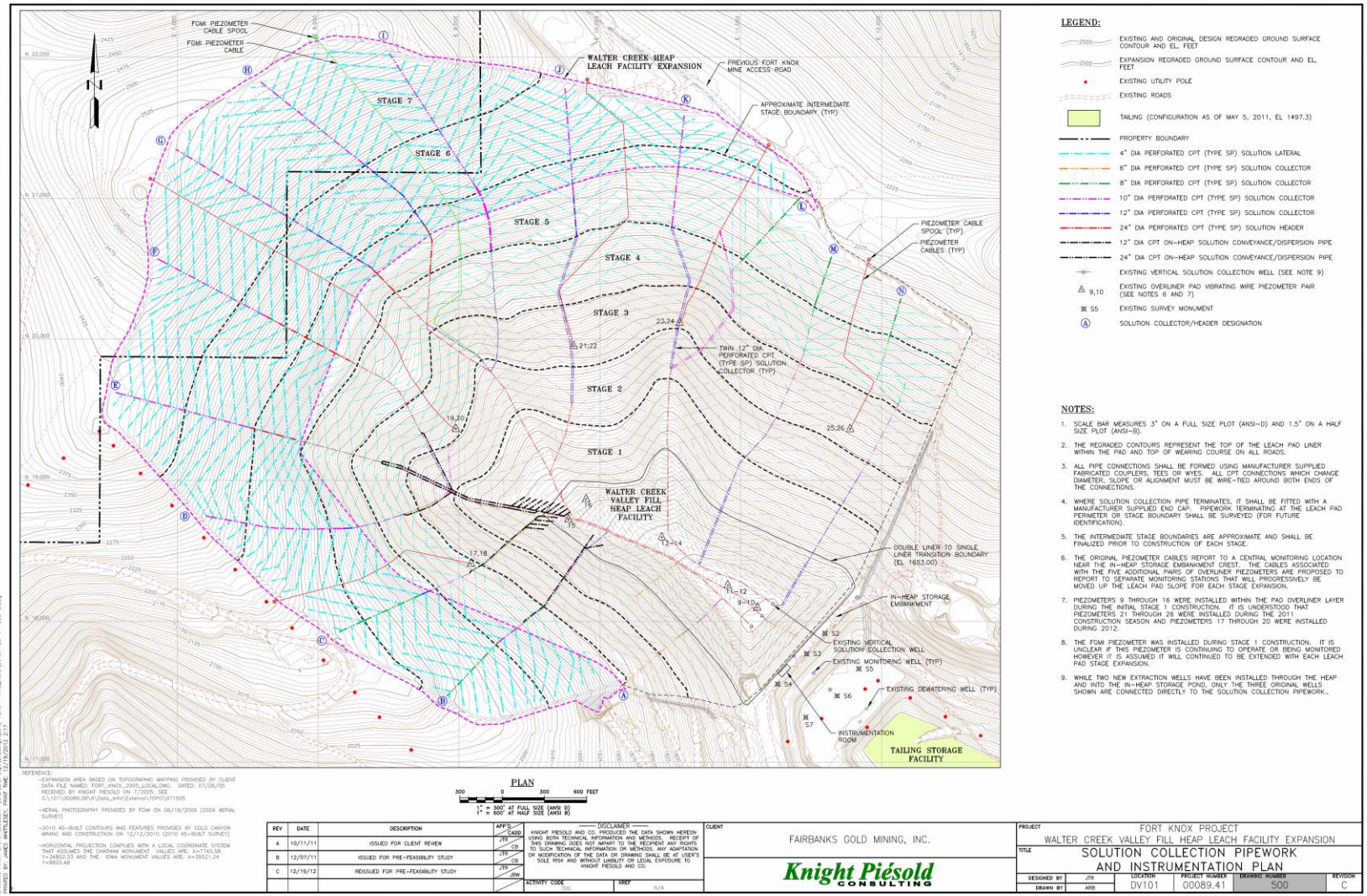
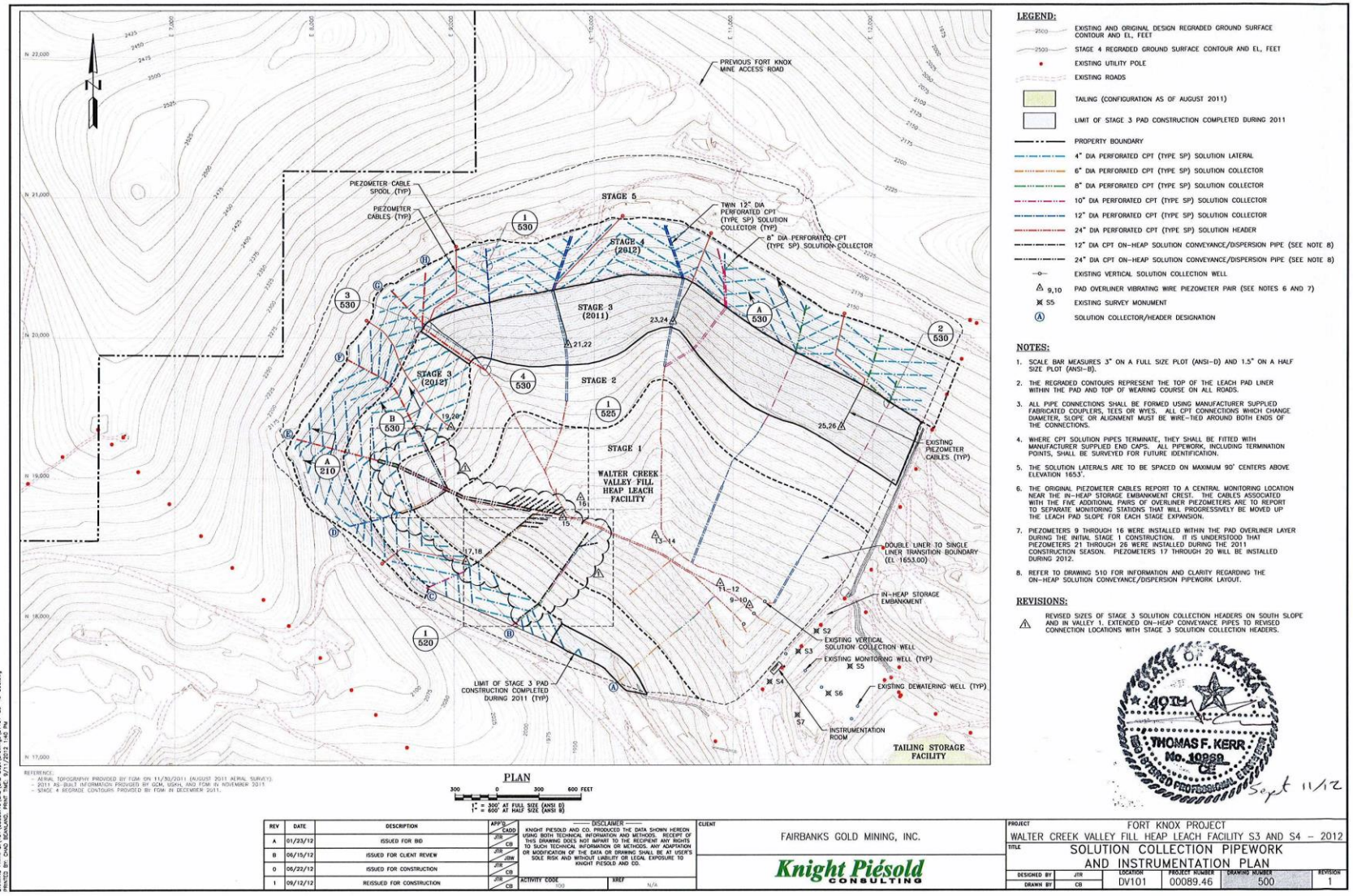


Figure 2.5 Stage 3 Pipework Modification



2.3.2 In–Heap Pond Liner System and LCRS

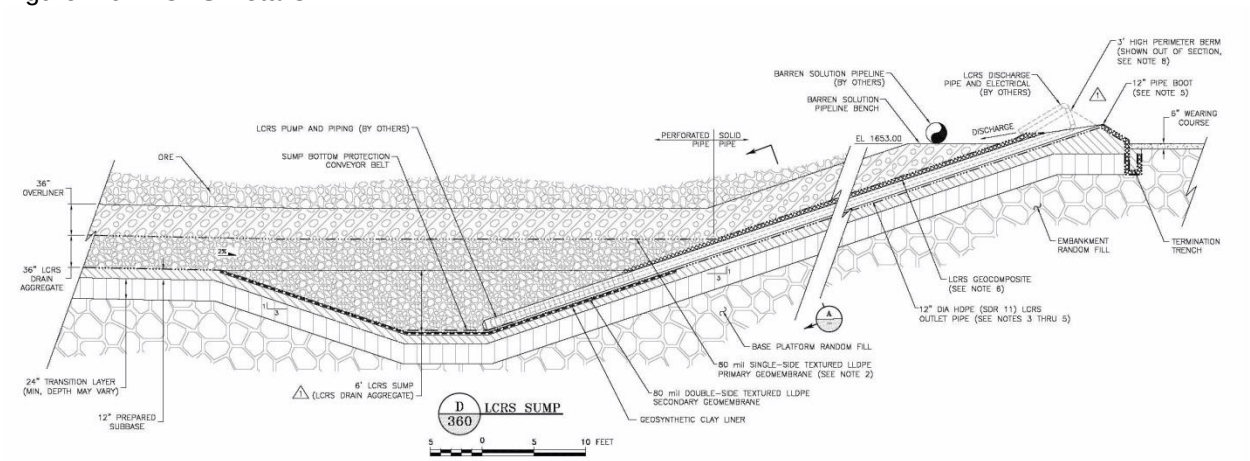
The composite liner system is modified in the area of the in-heap storage pond behind the embankment below elevation 1653 feet, the embankment crest elevation. In this area, the liner is fully double lined consisting of, from bottom to top, a 12-inch-thick low permeability prepared sub base overlain by an 80-mil double-side textured secondary LLDPE geomembrane liner, an LCRS consisting of a geocomposite on the side slopes of the in-heap pond and an LCRS drain aggregate layer on the pond bottom where the slopes are less than 10-percent, an 80-mil double-side textured primary LLDPE geomembrane liner, and finally a 3-foot-thick overliner. There is an approximately 8- to 14-inch thick low permeability layer between the LCRS drain gravel and primary LLDPE geomembrane to provide a smooth bedding layer for the geomembrane and facilitate LLDPE placement and also reduce flow through any imperfection in the liner reporting to the LCRS. In addition, there is a 16-ounce non-woven geo-fabric between the primary LLDPE geomembrane and overliner where the primary geomembrane overlies the “footprint” of the LCRS drain aggregate.

The LCRS serves as a monitoring and collection system for any process solution passing through the primary liner; it also provides a hydraulic break between the two liners – the primary and secondary 80-mil double-side textured geomembrane liner. Thus, although the head acting on the primary liner is the full depth of process solution during the normal operating conditions for each stage of the in-heap storage pond, the head acting on the secondary liner beneath the in-heap pond is designed to have a maximum average head of one foot.

The geocomposite comprising the LCRS on the side slopes of the in-heap pond is comprised of a geonet sandwiched between layers of non-woven geotextile that are heat bonded to the geonet.

Within the flatter areas (areas with slopes less than or equal to 10 percent) of the in-heap storage pond area, the secondary liner is overlain by 36 inches of LCRS drain aggregate material which serves as high permeability medium for leachate transport for the LCRS into solution collection pipes that will capture flows through the primary liner and convey them to the LCRS sump at the south end of the upstream toe of the embankment. The LCRS sump consists of an approximately 40 square-feet by 6-feet-deep sump filled with LCRS drain aggregate. Monitoring and return of any collected solutions within the sump is accomplished using two submersible pumps each located in one of the two 18-inch diameter carbon steel pipes between the primary and secondary geomembranes. The pipes are inclined up the interior face of the in-heap storage embankment, extending from the bottom of the LCRS sump to the embankment crest. The portions of the pipes within the sump are slotted with the slot sizing designed to avoid migration of the LCRS drain aggregate into the pipes. The bottom of the LCRS sump has been protected from damage from the outlet pipes with the placement of conveyor belting. A layer of geosynthetic clay liner was installed below the LCRS sump, between the 12-inch-thick prepared sub base and the secondary liner, to further limit the potential for leakage. Reference Figure 2.6 for LCRS details

Figure 2.6 - LCRS Details



A monitoring station and access to the LCRS sump is located on the in-heap embankment crest. The LCRS was initially monitored daily for flow establishing a baseline. Currently the LCRS is visually inspected daily and pumped on a weekly basis.

2.3.3 Liner System above In-Heap Pond

The composite liner system above the in-heap pond is composed of a 12-inch-thick layer of prepared sub base, an 80-mil double-side textured LLDPE geomembrane liner and a 3-foot-thick overliner, as shown earlier in Figure 2.3. The overliner layer facilitates flows to the solution collection pipework encapsulated within the layer and in conveying the flows to the in-heap storage pond.

The prepared sub base is a 12-inch-thick soil layer with a permeability of less than 1×10-5 cm/sec. The prepared sub base is overlain by an LLDPE geomembrane liner which is an 80-mil double-side textured geomembrane liner. Above the geomembrane liner, there is an overliner constructed of 3 feet of crushed mill reject material, less than two inch in size, containing the network of solution collection pipe work to promote rapid solution removal.

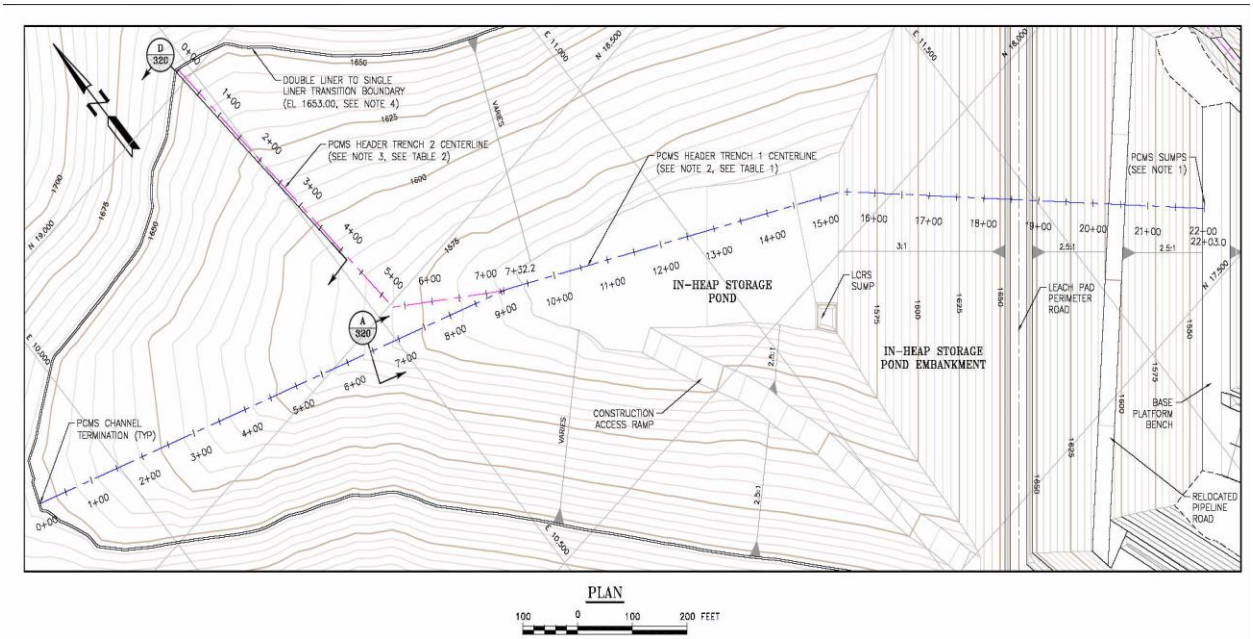
2.4 In-heap Storage Pond Embankment, Base Platform Random Fill, Underdrain Random Fill, and Random Fill Drain

The in-heap storage pond embankment has been designed to provide containment for process solution including “normal” precipitation and snowmelt, and to provide containment for the 100-year/24-hour design storm. The base platform random fill and underdrain random fill have been designed to provide sufficient level surface area for ore placement to begin leaching and replace unsuitable soils such as organic soils and loose wet silts excavated from the foundation area. The base platform fill and underdrain random fill are founded on dense sands and gravels except under the “footprint” of the in-heap pond embankment where the base platform fill is founded on the schist bedrock. Above the level of the base platform fill the abutments of the in-heap pond embankment are also founded on the schist bedrock. The random fill drain is a 24-foot wide by 4-feet thick, drain backfilled with 2- to 3-inch rock with no fines. It is founded in the low area of the excavations for the base platform fill and underdrain random fill and extends from the downstream toe of the base platform fill to near the upstream end of the underdrain random fill. Its purpose is to provide additional capacity to remove flows from springs and seeps and other flows from beneath the HLP to the downstream toe of the base platform fill.

To provide a foundation suitable for support of the in-heap pond embankment, the alluvium and extremely weathered bedrock were removed beneath the embankment footprint to expose hard to very hard schist. As per the “State of Alaska, Department of Natural Resources, Certificate of Approval to Construct a Dam, Attachment B - Special Condition No. 6”, dated July 3, 2007, a geologic map containing bedrock types, fractures, faults, and other pertinent information, was compiled by FGMI geologists for the exposed embankment footprint bedrock. Mine waste random fill was placed in 4-feet-thick lifts in the base platform random fill, underdrain random fill, and in-heap pond embankment. The mine waste was placed and compacted by truck and loaded traffic from the downstream toe of the base platform to approximately 800 feet upstream covering the footprint of the base platform/underdrain random fill footprint. Random fill placement commenced as areas of competent soils or rock were exposed for the base platform and underdrain random fills and competent bedrock under the in-heap pond embankment footprint.

The completed in-heap storage embankment has a crest width of 50 feet at Elevation 1653 feet, and the downstream toe is at approximately Elevation 1540 feet. Thus, the overall height for the in-heap storage embankment is 113 feet. On the upstream side of the in-heap storage embankment from the upstream toe to the crest, the in-heap storage embankment has a height of 100 feet. The exterior slope of the in-heap storage embankment is 2.5:1 minimum slope, and the interior slope is 3:1 slope. A plan view of the in-heap storage embankment is shown on Figure 2.7.

Figure 2.7 - In-Heap Storage Embankment

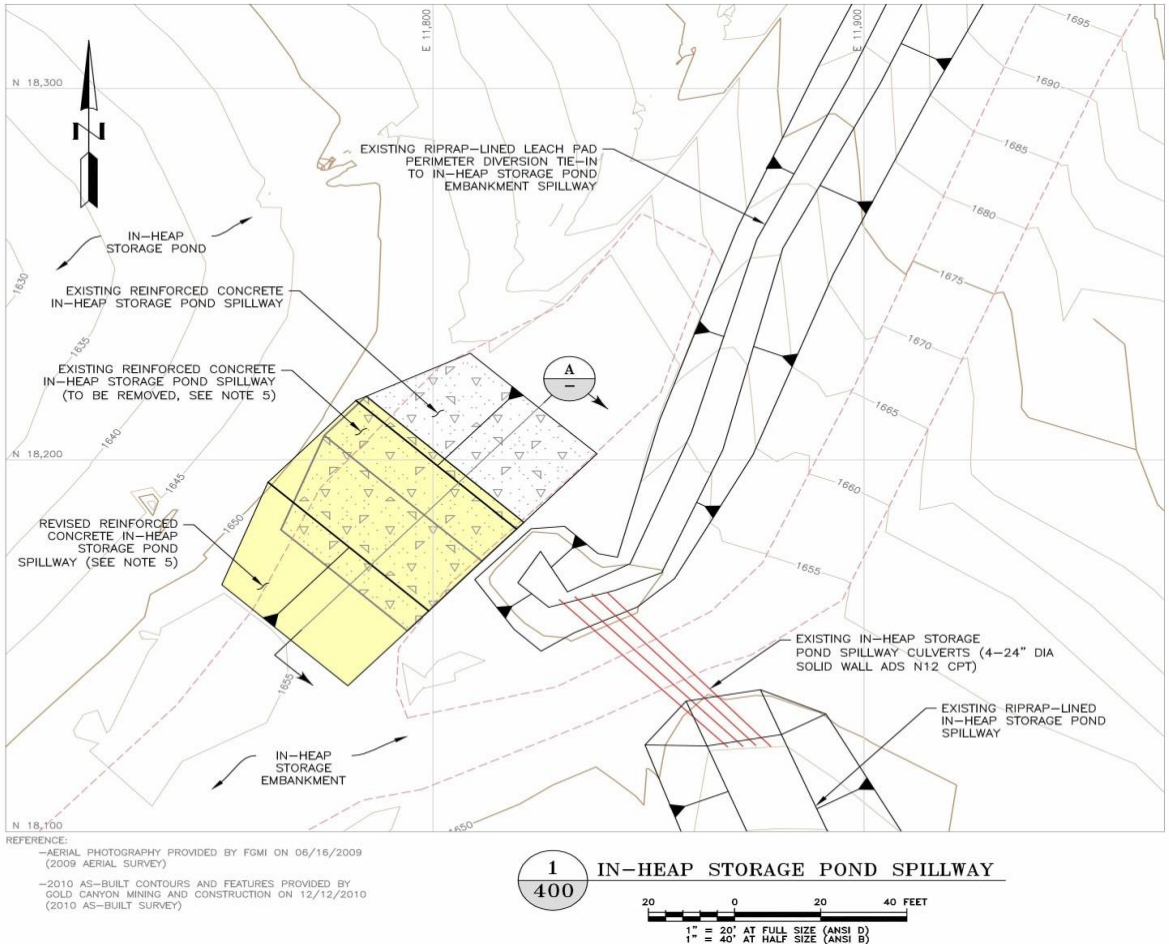


On the downstream face of the embankment, a 30-foot-wide pipeline bench was constructed from approximately Elevation 1610 feet along the southwest abutment to approximately Elevation 1590 feet along the northwest abutment. The bench carries the rerouted existing pipeline and access road across the Walter Creek valley. Additionally, the in-heap embankment was constructed such that the toe of the embankment is set back approximately 50 feet from the crest of the base platform random fill. This 50-foot-wide bench will provide access along the top level of the base platform and to one of the underdrain monitoring wells.

It must be noted that some embankment settlements and movements are anticipated and normal for embankments of this size and type. It is common to see some cracking parallel to the dam crest associated with settlements. This type of cracking is normal. However, it must be noted and reviewed by the Engineer of Record to see that it is within normal and anticipated limits. It must be noted on the Daily Visual Inspection form and photographs taken to document the extent and amount of movement.

A spillway was constructed on the north side of the in-heap storage embankment to accommodate emergency overflow from within the facility. The spillways original design passed the peak flow from the 100-year/24-hour storm event (220 cubic feet per second [cfs]) with 1 foot of freeboard. The spillway invert was constructed 2.5 feet below the embankment design crest at elevation 1651.5 feet. The spillway invert was constructed at the design elevation, although the actual dam crest was constructed 1 foot higher than the design elevation at 1654 feet. The spillway section through the embankment crest was constructed with reinforced concrete and has a 15-foot bottom width with 10:1 side-slopes to allow drive-through traffic across the crest. The spillway has been re-designed to pass the peak flow of 392 cfs as a result of the expansion. The bottom of the spillway will be lowered .25 ft to an elevation of 1650.25 or 2.75 feet below the crest of the in-heap storage embankment to accommodate 1.75 feet of flow depth within the spillway. The spillway section through the embankment crest will be constructed with reinforced concrete and expanded to a 30 foot bottom width while maintaining a 10:1V side slopes to allow continued drive through traffic see Figure 2.8.

Figure 2.8 - Spillway Redesign



The spillway will direct any overflows to the downstream TSF via the riprap-lined spillway channel. Downstream of the reinforced concrete spillway section, the spillway channel continues with a 15-foot-wide bottom while the depth varies from 2.5 to 3.2 feet; the channel side-slope transitions to a 2:1 slope for the remainder of the channel. The channel was constructed on grades ranging from a minimum of 10 percent to a maximum of 44.5 percent directly downstream of the reinforced concrete drive-through spillway section. Approximately 350 feet down the embankment emergency spillway channel, it transitions into three 36-inch-diameter solid CPT (Type S) culverts placed beneath the pipeline access road. Below the pipeline access road, the spillway channel was restored to the same shape as above the road, where it conveys the flows to the surface of the TSF located near the valley floor.

The spillway, spillway channel, tie-in channel, and spillway culvert crossing have been sized to pass the peak flow from the 100-year/24-hour storm event; riprap erosion protection has been installed within the channels.

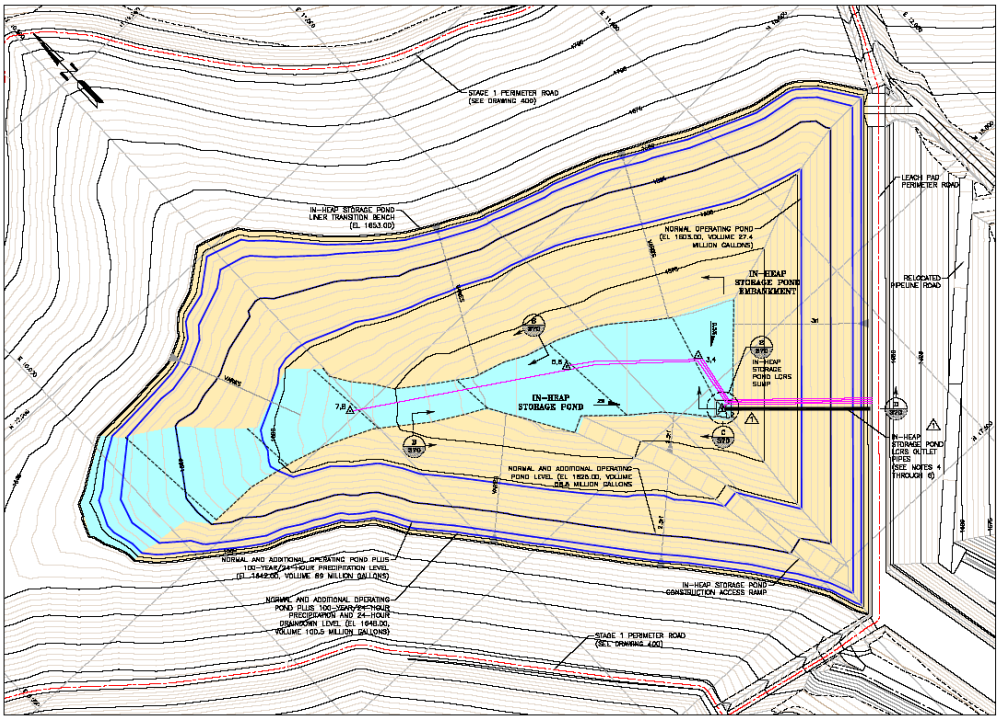
If the in-heap storage capacity is exceeded during an extreme storm event, any excess water will flow over the emergency spillway. The “V” swale located between the downstream face of the heap and the exposed upstream face of the in-heap storage embankment is available to temporarily store storm water runoff that flows to it from around the heap toe. This is a contingency situation since the flow is expected to enter the pervious ore in the heap. The estimated as-built storage volume of the swale is approximately 6.2 million gallons. Since the heap is pervious, it is expected that any flows entering the swale will infiltrate directly into the in- heap pond. In the unlikely event that the surface of the swale is completely frozen, the calculated runoff volume of 53.2 million gallons from the 100-year/24-hour design storm event could be conveyed through the emergency spillway.

2.5 Internal In-Heap Storage Pond

2.5.1 General

The in-heap embankment creates an internal in-heap storage pond for collection of pregnant solution. The in-heap pond was selected to avoid freezing the pond in the winter months. A plan view of the in-heap storage pond is shown below in Figure 2.9.

Figure 2.9 - In-Heap Storage Pond



Full scale operations drip leaching will be used at a solution application rate of up to 16,000 gpm. The design is based on the ore being pervious so that it has capacity to store solution and allow it to flow laterally to the collection wells. In addition, the solution collection pipe works will collect leachate throughout the heap leach pad and carry it to the in-heap storage pond and then to the solution collection wells.

Following are descriptions of the planned leaching operations, operating solution levels and the solution collection wells.

2.5.2 Full Scale Leaching Operations

Full scale heap leaching using drippers were initiated in early 2010 ramping up to a design solution application rate to 16,000 gpm in 2012.

The design volume for the in-heap storage pond, for full scale leaching operations of each stage, includes provision for storage of:

A. Maximum normal operating level
B. The 24-hour draindown
C. The 100-year/24-hour storm event
D. Freeboard

The recent increase in solution flow to 16,000 gpm and the planned expansion beyond Stage 5 required a revision to the volumetric components for the solution levels in the in-heap pond. The expansion of the

WCHLF will increase the lined area and thus add more precipitation water to the in-heap pond, which will increase the required storm water storage component. The increase in solution flow will change the required 24-hr emergency draindown component. The storm water diversion component has been sized to accommodate the volume of precipitation from a 100-yr/24-hr storm event above the lined area of the WCHLF. The emergency draindown component had been previously calculated as the volume associated with 24 hours of flow at the solution application rate of 8,000 gpm and then 16,000 gpm, but this has since been revised downward on the basis of a more realistic transient analysis that includes for a reduction in the flow rate to the pond over time as the draindown progresses. The in-heap pond capacity provided for this occurrence is for the first 24 hours of draindown on the basis that normal operations will be resumed within 24 hours. The draindown condition would occur if either the power supply is interrupted or a few pumps are temporarily shut down; both of which would result in a loss of pumping capacity from the in-heap pond. FGMI has recently equipped the WCHLF with sufficient backup power and redundant pumps so that in a worst-case condition 8,000 gpm would continue to be extracted from the wells but it would be re-applied to the heap, and no solution would be removed to the gold recovery plant. In this case, the draindown into the pond would be associated with a reduction in the solution application rate on the heap from 16,000 to 8,000 gpm, and this was modeled in the transient analysis.

Since this is an in-heap pond the solution storage is located in the interstitial pore spaces between the ore particles. The available solution storage was estimated considering the settlement and consolidation that has occurred as a result of the heap overlying the ore placed in the in-heap storage pond. Storage for normal operational requirements is the amount of process solution required to operate the pumps considering drawdown of the pool surface due to the operation of the pumps which varies by elevation for each stage.

The volumetric components of the in-heap storage pond are summarized below.

- **100-yr/24-hr Design Storm Event** – The governing 100-yr/24-hr storm is a winter rain-on-snow storm event that is estimated to produce 4.14 inches. The pond storage volume associated with this event varies between 21.5 and 53.2 Million (M) gallons from Stage 3 to Stage 7 of the WCHLF development.

- **Emergency Draindown due to Loss of Power or Pumps** – The 24-hour draindown volume was calculated to be 1.3 M cubic feet (ft^3), or 9.8 M gallons from the transient analyses that includes recirculation of 8000 gpm to the top of the heap, and this has been used to size the emergency draindown volume component for the in-heap pond (note this calculation is independent of the stage of development of the heap because the rate and area of solution application will be the same for all stages. At a solution application rate of 16,000 gpm without recirculation, the 24-hour draindown volume was calculated to be 2.6 M cubic feet (ft^3), or 19.5 M gallons.

- **Freeboard Allowance** – A freeboard allowance of 5 feet has been made below the crest elevation of the in-heap pond dam (1,653 feet), making the maximum allowable solution level 1,648 feet.

The most important findings from the above calculations are the maximum normal operating levels for the in-heap storage pond. These are the stage-by-stage levels that should not be exceeded under normal operating conditions in order that the required storm water, draindown, and freeboard component allowances are always maintained. By way of summary, these maximum normal operating levels are:

With 8,000 gpm recirculation:

- Stage 3 1,634.7 feet
- Stage 4 1,629.8 feet
- Stage 5 1,625.8 feet
- Stage 6 1,620.9 feet
- Stage 7 1,617.3 feet

Without 8,000 gpm recirculation:

- Stage 3 1,629.1 feet
- Stage 4 1,624.2 feet
- Stage 5 1,619.1 feet
- Stage 6 1,614.1 feet
- Stage 7 1,608.6 feet

The pond has been operated at levels well below these elevations to date and is currently being operated at around 1,600 feet elevation.

A water balance in the Walter Creek Heap Leach Expansion Pre-Feasibility Study estimated that water surpluses of up to 2,700 gpm this is in addition to the 16,000 gpm pumping rate that is required extract pregnant solution to the process circuit. The highest pumping rate will most likely occur during the month of breakup, typically May. For most years of operation an excess of water production is projected May through September. For the remaining months October through April when a deficit condition exists, the addition of water will be required.

Surpluses and deficits are possible over the expected operating life of the facility, due to climatic variations and changes in operating conditions. Consideration must be given to removing the water surpluses from the heap leach pad to maintain the design operating levels of the operation of the in-heap storage facility.

2.5.3 Solution Collection Wells

There are five vertical solution collection wells constructed to date. The original three are located near the lowest point along the upstream toe of the in-heap storage pond embankment. The two wells constructed during the summer of 2012 are offset a few feet upstream from the original wells. They are located within the in-heap storage pond; however their completed depth is approximately ten feet above the overliner drain layer.

The purpose of solution collections wells it to remove leachate from the in-heap storage pond. Each well is fitted with a 4,000 gpm turbine pump. The wells are constructed of 30-inch diameter steel pipe with intermittent lengths in the lower portions screened to allow the inflow of solution.

An earlier model of the anticipated drawdown of the original wells was performed to analyze the drawdown effects due to pumping from two of the three original wells at a combined rate of 8,000 gpm. A major feature of that system that was not simulated in the model was the connectivity of the extraction wells with the solution collection headers. Excluding the direct connection with the solution collection headers, the previous modeling predicted a substantial drawdown at the extraction wells; however, FGMI's operating experience indicates that very little drawdown occurred. The previous calculations have therefore proven to be very conservative, and the better-than-expected performance of the extraction wells is attributed to the direct connectivity of the perforated solution collection headers with the bases of the wells.

The design and installation of the 2012 solution extraction wells and the increase in the solution extraction rate to 16,000 gpm required the investigation of a series of pumping scenarios for the estimated drawdown that may be expected to occur in the ore around the wells under each scenario. The scenarios are identified as B and C. Pumping scenario A is not discussed in this document since FGMI does not have plans to implement it at this time, a full description can be found in Section 6.6.2.1 of the Walter Creek Heap Leach Prefeasibility Study Revision 3 (Knight Piésold, 2013).

A. Pumping Scenario B

Primary Pumping Configuration (Prefeasibility Study Rev. 3 and Draindown Analyses Scenario B) – under this configuration 12,000 gpm is extracted from the three pre-2012 wells, while 4,000 gpm is pumped

from one of the two 2012 installed wells. Under the Primary Pumping Configuration, the in-heap storage pond operating level was modeled which suggested the in-heap storage pond operating level would need to be maintained above 1,612.3 feet amsl to provide 24 feet of pump submergence. However, based on actual field operating performance, observations showed negligible drawdown of the in-heap storage pond while operating at levels as low as elevation 1605 ft amsl and therefore the modeled lower level limit is not considered to be applicable. This configuration is currently being used and is considered the preferred method of operation.

B. Pumping Scenario C

Standby Pumping Configuration (Prefeasibility Study Rev. 3 and Draindown Analyses Scenario C) – under this configuration 8,000 gpm will be extracted from two of the three pre-2012 wells, while 8,000 gpm will be pumped from the two 2012 installed wells. Under the Standby Pumping Configuration, when the pumps in both of the 2012 extraction wells are operated at 4,000 gpm each, for a total of 8,000 gpm, the in-heap storage pond operating level was modeled which suggested that the in-heap storage pond operating level would need to be maintained above 1616.6 feet amsl to provide 24 feet of submergence at the pumps. However, similar to above, based on actual field operating performance of the Standby Pumping Configuration, observations showed negligible drawdown of the in-heap storage pond while operating at levels as low as elevation 1605 ft amsl and therefore the lower level limit is not considered to be applicable.

2.5.4 Solution Level Monitoring

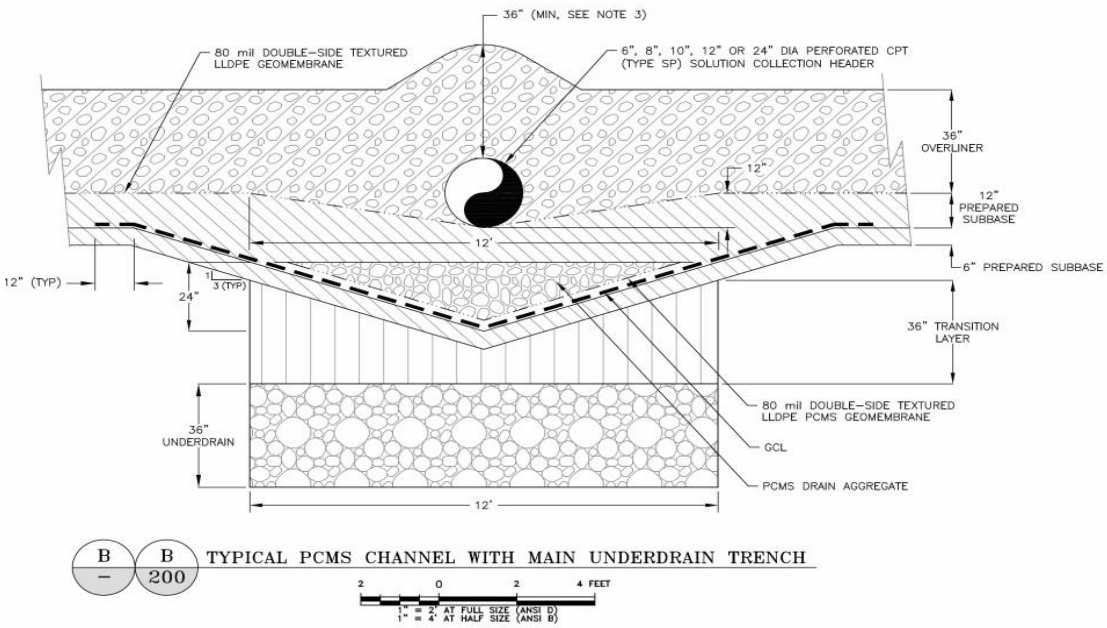
In accordance with the original design three pairs of vibrating wire piezometers are used to monitor solution levels within the in-heap pond. Piezometer locations are shown on Figure 2.3. Piezometer pair 9 and 10 will monitor the solution levels at the upstream toe of the embankment, piezometer pair 11 and 12 about at the middle of the in-heap pond, and piezometer pair 13 and 14 the solution level at the upper end of the pond. Piezometer pairs will be used to determine the pond depth and piezometer pair 9 and 10 the solution depth over the pump intakes. The piezometer pair in the middle of the pond, 11 and 12, will be used to monitor the shape of the pump drawdown curve. Piezometer pair 15 and 16, above the level of the in-heap pond will be used to measure the solution depth on the liner that is designed to have a maximum average head of one foot. The five piezometer pairs 17 through 26 were installed within the Stage 3 overliner to provide further monitoring of the head acting on the pad liner system.

2.6 Process Control Monitoring System (PCMS)

The PCMS serves to monitor the performance of the lining system beneath the solution collection headers placed in the three drainages, designated Valleys 1, 2 and 3, of the heap leach pad where concentrated flow is anticipated. The PCMS monitors for leaks through the liner beneath the solution collection headers where they are outside the limits of the in-heap storage pond. It is anticipated that solution flow will occur in the headers most of the time, as opposed to intermittently for the remaining majority of the system, corresponding to periods when and where active leaching is occurring on the heap surface. If leakage occurs through the liner beneath the solution collection headers it will be collected in the PCMS channel and conveyed by header pipes to the monitoring and discharge points. The routing of the PCMS header pipes runs above the north/northeast side of the in-heap storage pond beyond the eastern toe of the heap. The discharge and monitoring points are constructed in a single location above the northeast corner of the in-heap storage pond allowing separate analysis points. From the monitoring points the PCMS discharges directly to the double- lined in-heap storage pond.

In the three drainages, the PCMS consists of a lined “V” channel filled with pervious PCMS drain aggregate. The design width of the top of the PCMS channel is 12 feet, and the depth is 2 feet. The composite liner for the channel includes a geosynthetic clay liner (GCL) overlain by an 80-mil double-side textured LLDPE geomembrane. The GCL was used in lieu of the prepared sub base to simplify construction. The GCL that used to line the trench beneath the LLDPE geomembrane extends about a foot outside the edges of the PCMS trench. The LLDPE geomembrane has both sides textured. Figure 2.10 illustrates this arrangement.

Figure 2.10 – PCMS Channel Detail

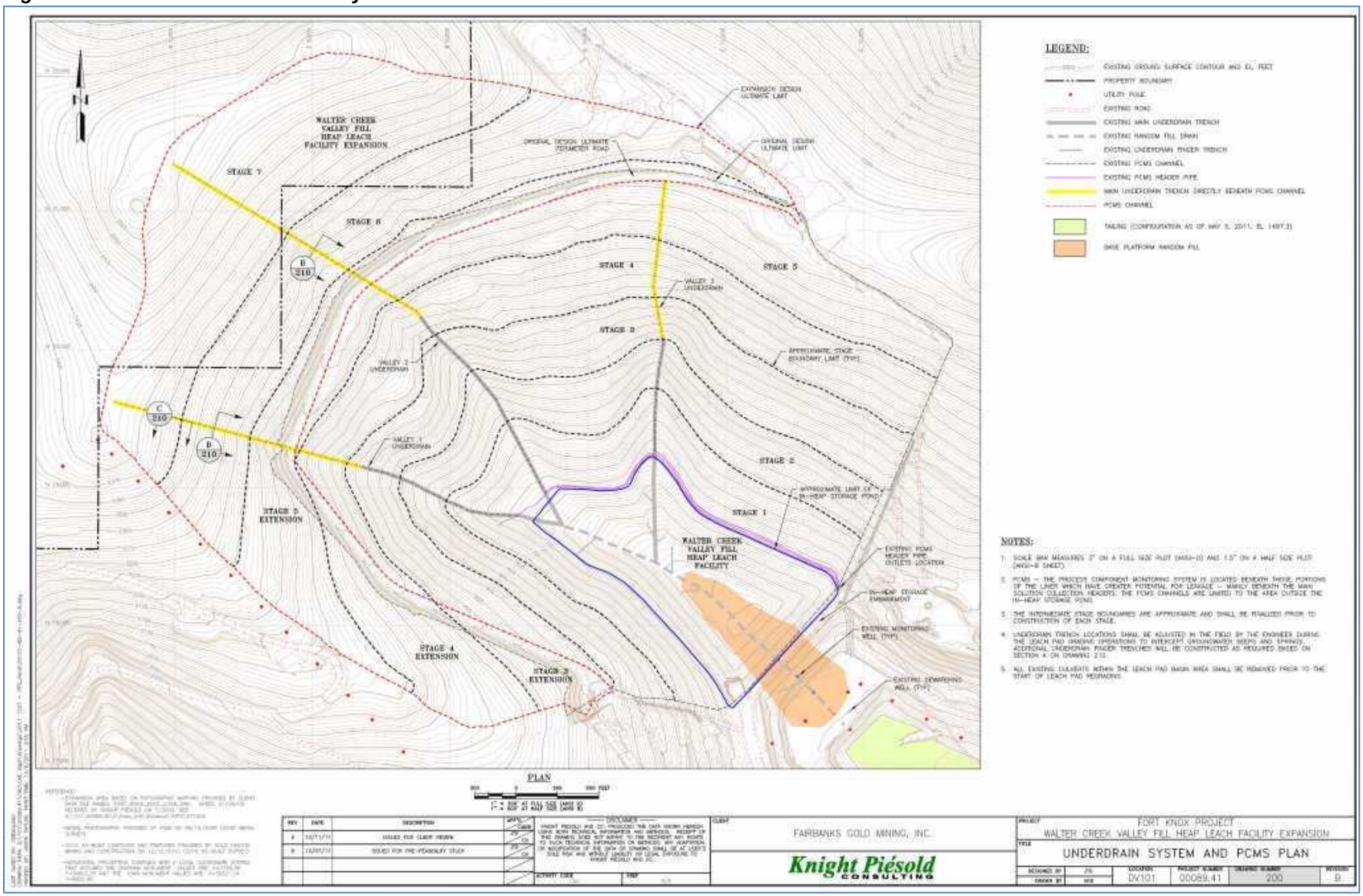


Just above the level of the in-heap storage pond any flows in the “V” ditches will be transferred into the three 4-inch-diameter PCMS header pipes that are routed along an alignment just above the north side of the in-heap pond. The pipes follow a 1 percent down gradient slope to the outlet monitoring points so they operate by gravity flow. The outlet monitoring point is in the northeast corner of the in-heap storage pond at a location downstream of the ore pile but upstream of the in-heap storage pond embankment. The outlet monitoring points are exposed and therefore easily accessible to field monitoring personnel and will discharge any flows directly onto the double lined pond area. The pipes penetrate the single geosynthetic liner in a reinforced concrete block with the geomembrane connected to the concrete block by embedment strips. This penetration is just above the transition boundary from the double lined in heap pond (below) to the single liner (above). The pipes extend into the in-heap storage pond to discharge out onto the double lined area. The last 50 feet of the pipes are heat traced to prevent icing of the outlets in winter. The PCMS plan is shown on Figure 2.11.

For the heap leach expansion the PCMS channels will be of the same geometry extend up the Walter Creek drainage basin and continue to be constructed beneath the leach pad liner system. They will follow the orientation of the main solution collection headers. The top portions of each channel will extend approximately five feet on either side of the largest solution collection header which is deemed sufficient to meet the design intent of monitoring potential leakage.

The PCMS will be monitored daily for flow. If flow is present a sample will be analyzed for WAD CN and pH upon discovery and weekly thereafter until the source can be determined.

Figure 2.11 PCMS and Underdrain System



2.7 Underdrain Collection System and Monitoring Wells

A number of springs, seeps, and wet areas, as well as, Walter Creek flow in the valley bottom. An underdrain system including trench drains, the underdrain random fill, the base platform random fill and random fill drain collect these flows and route them to a sump downstream of the base platform fill. The stream flows and surface water outside of the active leach pad, including the flows from springs and seeps from the area above the active leach pad, are being transported around the pad in diversion channels. This will reduce the flow required to pass beneath the leach pad as well as reduce the recharge to the seeps and springs whose flow will be conveyed by the underdrains.

The underdrains on the valley side slopes consist of trench drains excavated with a backhoe. The trenches are 3 feet deep by 12 feet wide and are backfilled with pervious underdrain trench drain aggregate. These connect directly to the underdrain random fill and base platform fill that are designed to act as drains beneath the HLP. They also serve as a “global” means to monitor for leaks in the liner system since flows beneath the liner system report to the base platform fill at the toe of the HLP where they will be monitored by the monitoring wells.

Monitoring wells are installed in the following locations: the base platform, the pipe bench of the in-heap storage pond embankment, and the crest of the in-heap storage pond embankment. They extend to the bottom or below the bottom of the base platform random fill. The bottom section is slotted to facilitate water sampling. The wells will be used for water quality sampling and to measure water levels.

The observations that are normally made on the monitoring wells provide a good indication of potential changes in seepage rates at the HLP. If an increase in seepage is detected, the flow will be examined by the Environmental Department to see if it is cloudy or clear and an investigation of the reason for the increase in seepage will be initiated.

2.8 Pregnant and Barren Pipeline Corridor

2.8.1 Carbon in Column One

The 2781-foot-long (including 125-feet of pipe rack) pregnant and barren pipelines has been constructed from the CIC1 plant at elevation 1684 feet to the valve enclosure at the heap leach pad at elevation 1660 feet. The pipe rack supports the pipes above ground for the first 125 feet after which they enter the geomembrane-lined trench at the elevation 1684 feet at the mill parking lot and then continue to the in-heap pad. The trench was filled with overliner drain aggregate, consisting of minus 2-inch-size material with less than 5 percent passing the No. 200 sieve (fines) to protect and cover the pipes. The Mill Reject (overliner drain aggregate) is permeable and will pass any small flows from leaks in the pipes to the heap leach pad where they will be detected so that the pipeline can be repaired.

The pregnant and barren pipeline corridor consist of trench sections and cover including: (1) the buried lined trench under the mill parking lot and mine access road and (2) the lined trench adjacent to the pipeline perimeter road. The detail designs of these sections take into account the loads associated with traffic moving over the buried pipelines within the trench.

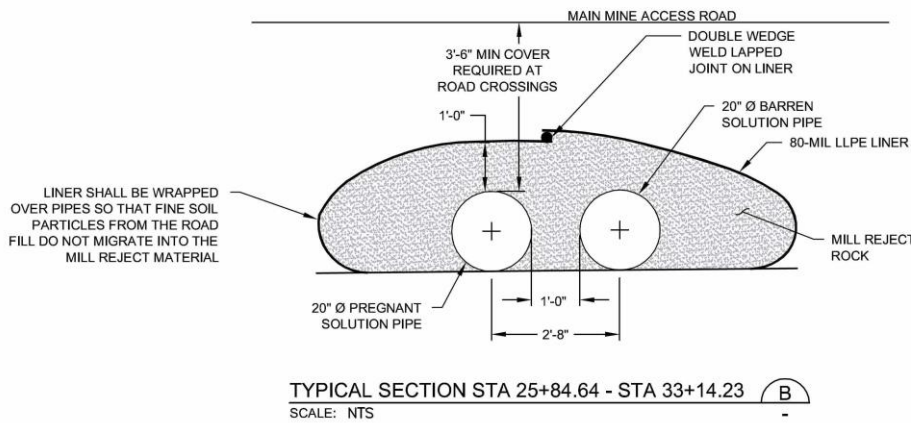
The slope of the trench bottom varies from 0.6 to 0.9 percent sloping from the mill to the heap leach pad. As discussed above, the pipeline corridor trench was backfilled with minus 2-inch overliner drain aggregate over the entire length. The overliner drain aggregate will allow an estimated capacity of 25 GPM flow to the leach pad to pass minor leaks. A series of 4-inch PVC and steel pipes with an atrium grating at the bottom were placed inside the trench at designated locations along the corridor alignment to detect the approximate location of the leakage and avoid excessive excavation to repair the pipe. The pipe was placed on the side of the trench which is adjacent to the access road for easy access and monitoring.

Also located in the trench are 2-inch conduit for a communication line and 4-inch conduit for a power cable for lime silo.

2.8.2 Carbon in Column Two

The pipeline corridor conveying the pregnant and barren lines from the 2012 solution collection wells to the CIC 2 plant is designed with the same standards and criteria as CIC 1 pipeline corridor. There will be minimal disturbance of the CIC 1 pipeline corridor to maintain its integrity. The new pipeline corridor will be approximately 2,500 feet in length. Starting from the trestle bridge the pregnant and barren lines enter the corridor trench located next to the mill parking lot. The pipes are placed on 80 mill LLDPE liner then backfilled with mill reject material. The liner is then folded so the sides overlap top and center then welded, see Figure 2.12. This portion of the corridor does not interact with CIC 1 corridor.

Figure 2.12 - Pipeline Corridor Detail 1



After the CIC 2 pipeline corridor crosses under the mine access road the, the CIC 1 corridor trench is carefully excavated to expose the trench liner which is then prepped for connection to CIC 2 corridor liner. Once the extrusion welds were completed the barren and pregnant pipes were installed. Mill reject material was used as backfill, as Figure 2.13 indicates. To increase the flow capacity of the lined trench there is also a perforated, corrugated polyethylene pipe that was installed. Inspection ports will have similar spacing and installed between the CIC 1 corridor ports. This construction method is used between the mine access road and the valve house enclosure except for a small section that is constructed using the design detail in Figure 2.13.

Figure 2.13 - Pipeline Corridor Detail 2

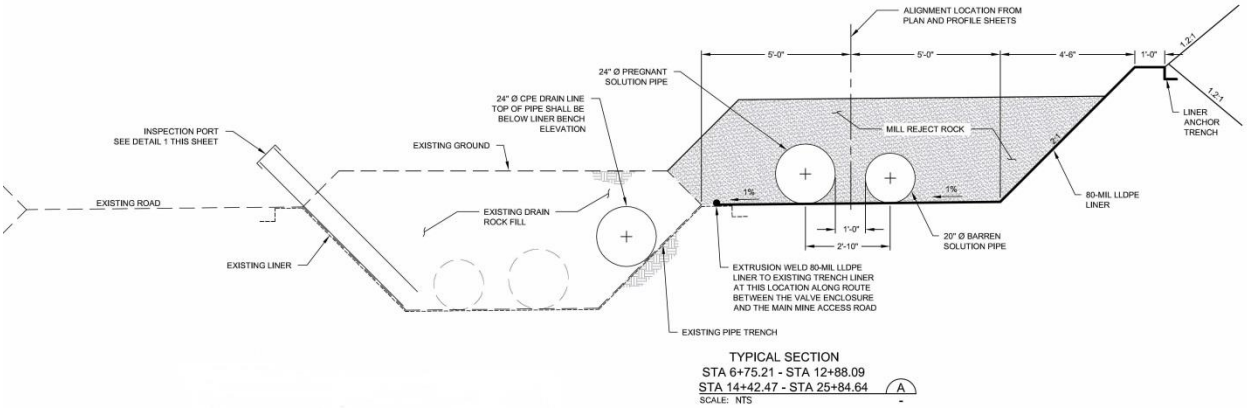
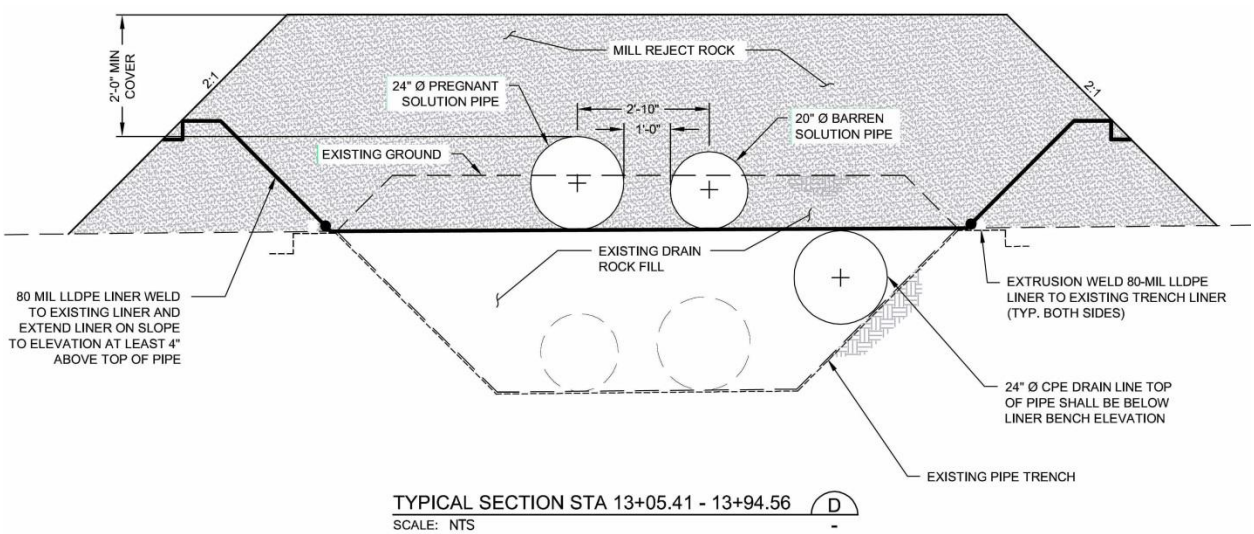
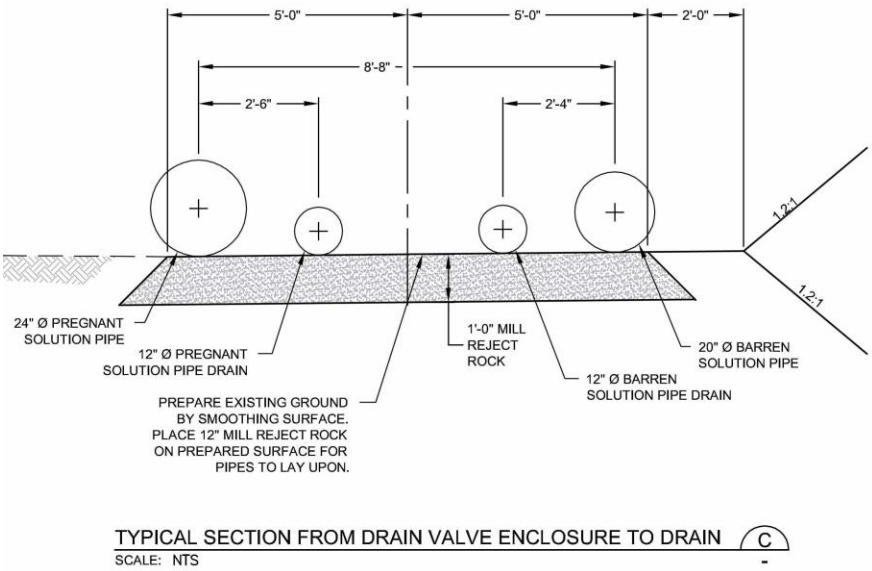


Figure 2.14 - Pipeline Corridor Detail 3



The remaining run will be installed per design detail in Figure 2.15

Figure 2.15 - Pipeline Corridor Detail 4



2.9 Surface Water Control System

A surface water management plan was developed as part of the original design (Knight Piésold, 2007) for controlling and safely directing runoff generated from up-gradient watersheds around the heap leach facility. The surface water management plan also accounted for containment and conveyance of precipitation directly incident on the pad. As part of the WCHLF expansion, modifications and additions to the original surface water management design included the following:

A. Update of the Stages 3 and 4 perimeter diversion channels to account for extensions to each stage,
B. Update of the Stage 5 perimeter diversions to account for realignment of the of the pad perimeter,
C. Addition of the Stage 6 perimeter diversion channel,
D. Addition of the on-heap haul road culvert crossing 3 (located where the proposed future haul road will enter the Stage 4 leach pad southwest corner to provide loading access through the end of the facility),
E. Update of the in-heap storage pond emergency spillway weir section.

Precipitation falling directly on the pad will infiltrate the heap and be conveyed to the in-heap storage pond, which has the capacity to contain the 100-year/24-hour storm volume, the 24-hour draindown volume, and storage of the maximum normal operating pond levels. Runoff from the storm event would flow into the heap or, via the perimeter offsets around the toe of the heap, to the swale between the upstream slope of the in-heap storage embankment and the front face of the heap. This swale has a capacity of about .8 million cubic feet, or 6.2 million gallons. Since the heap is pervious, any flows entering the swale will infiltrate directly into the heap. In the very unlikely event that the swale is frozen, the spillway constructed on the left abutment of the in-heap embankment will accommodate any overflow and direct it to the TSF via the riprap-lined spillway. The spillway will direct any overflows to the downstream TSF via the riprap-lined spillway channel. Downstream of the reinforced concrete spillway section, the spillway channel will be modified from a 15-foot-wide bottom to a 30-foot wide while the depths vary from 2.5 to 3.2 feet; the channel side-slope transition to a 2:1 slope for the remainder of the channel. The channel was constructed on grades ranging from a minimum of 10 percent to a maximum of 44.5 percent directly downstream of the reinforced concrete drive-through spillway section. Approximately 350 feet down the embankment emergency spillway channel, it transitions into four 24-inch-diameter solid CPT (Type S) culverts placed beneath the pipeline access road. Below the pipeline

access road, the spillway channel restores to the same shape as above the road, where it will convey the flows to the surface of the TSF located near the valley floor.

The stormwater diversion ditch slope road for each stage is designed to pass the 100-year/24-hour storm event around the pad, so there is no storage volume needed in the in-heap storage pond related to this drainage area. Diversion ditches will be constructed for each subsequent stage.

During construction, surface water diversion around the all stages of the leach pads will be accomplished by the construction of temporary diversion channels cut into the basin slope. The diversion is designed to pass runoff from the upstream watersheds for the 100-year/24-hour storm event. The leach pad perimeter access roads are located adjacent to the diversion channel for each stage of the leach pad. The leach pad perimeter roads are used as a construction access road for the leach pad construction, and for maintenance and operation of the heap leach pad operation.

No perimeter diversions were deemed necessary for the ultimate Stage 7 leach pad configuration based on the limited contributing watershed area. The ultimate heap configuration watershed map, created to model runoff for sizing of the on-heap culvert crossings and the in-heap storage pond emergency spillway, is presented on Figure 3.5.

Figure 2.16 - Ultimate Heap Watershed Plan

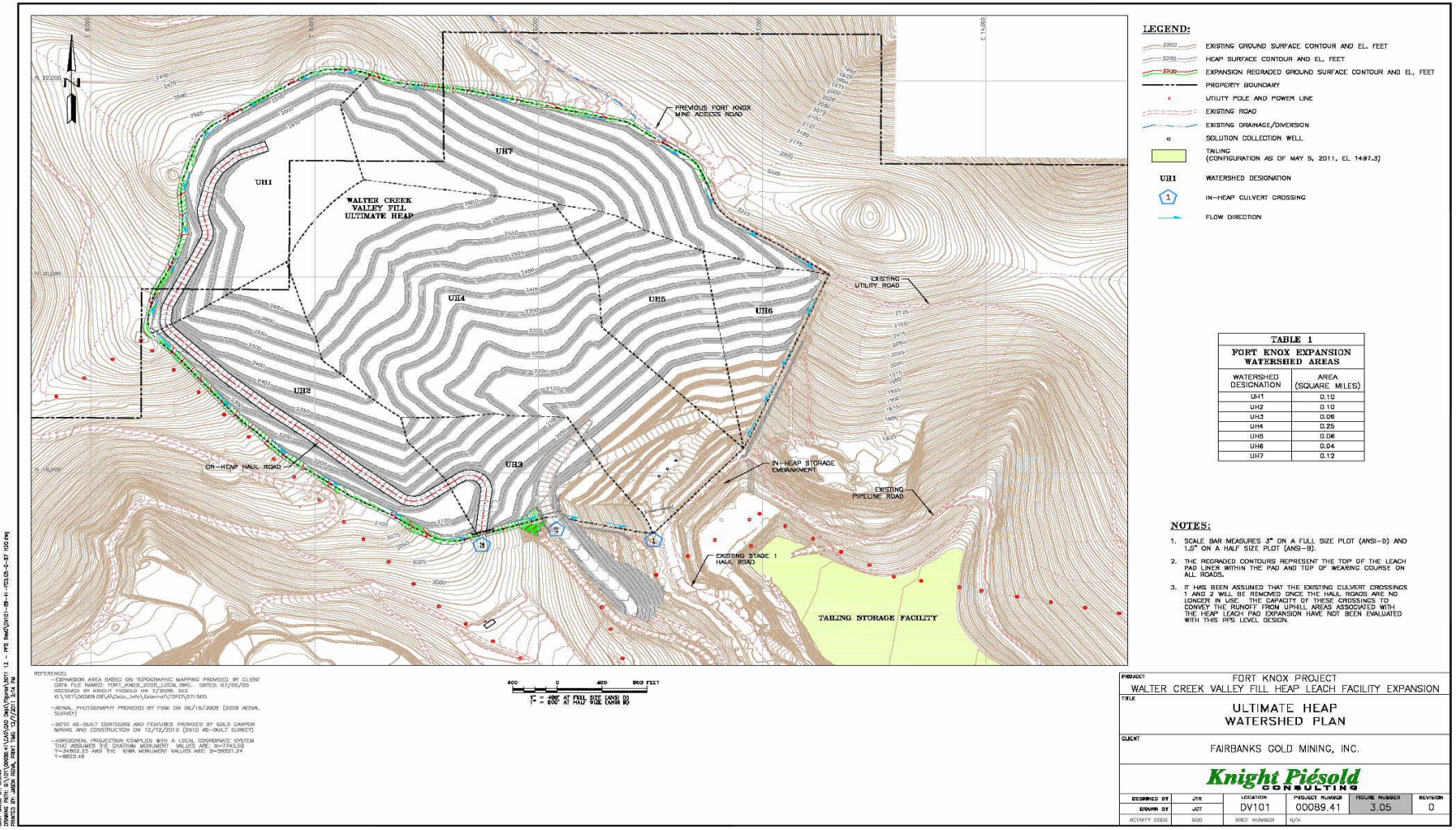


TABLE 1
FORT KNOX EXPANSION WATERSHED AREAS

WATERSHED DESIGNATION	AREA (SQUARE MILES)
UH1	0.10
UH2	0.10
UH3	0.06
UH4	0.25
UH5	0.06
UH6	0.04
UH7	0.12

Section 3.0 - **OPERATION AND MAINTENANCE PROCEDURES**

3.1 General

The O&M program includes a description of the parameters by which the HLP is to be operated and a monitoring program conducted by FGMI to confirm that the heap leach pad, embankment, and in-heap pond and related systems are performing in accordance with the design. The monitoring program will include both informal routine inspections by operations personnel and formal inspection monitoring for the ultimate operation of the HLP.

As discussed in Section 2.0, major components of the HLP consist of the ore heap, a solution collection system, a composite geomembrane liner system, embankment, internal in-heap storage pond, a leachate collection and recovery system (LCRS), a process component monitoring system (PCMS), an underdrain collection system, process solution handling system, and surface water controls. This section outlines the operation and maintenance procedures and corresponding monitoring requirements for each of these components.

3.2 Ore Heap

3.2.1 Operation and Maintenance - Ore Heap

The operation of the heap leach pad involves loading the pad at a rate 72,000 tons per day with a 50 ft. bench height and distributing leach solution at a rate of 16,000 gpm or a unit rate of 0.005 gpm/ft^2. At any one time there can be up to 3.2M ft2 of ore being leached.

Each lift will form a level platform for the placement of the subsequent lift. While a lift is being loaded, the surface of the active leach area will consist partly of the previous lift and partly of the new lift. From the initial placement of ore, the active leach area gradually increased from zero to 3.2 million square feet near the early part of Lift 3, after which the leach area remains constant through remaining lifts

The exterior slopes of each lift have been modeled with a 1.3H:1V angle of repose. Bench widths of 85 ft have generally been included between each successive 50 ft lift of ore placed on the heap, with a 76.5 ft transition bench width between the 40 and 50ft lift, such that an overall 3H:1V maximum heap slope results. The maximum vertical ore thickness is approximately 500 ft.

During the summer months, barren solution will be applied to the heap with drip emitters laid on top of the run of mine (ROM) material. During the cold winter months, the solution will be applied with drip emitters buried under 3 to 5 feet of mill reject.

Slope maintenance will include any activities required to maintain the slope of the ore and preserve the integrity of structure along the toe of the slope.

To aid in the placement of ore and delineate permit limits, FGMI has implemented the following controls:

- A row of lathing will be installed delineating the approved overliner limit
- A second lath line will be installed delineating the run of mine ore fill boundary
- A no-rip zone will be identified by a row of lathing placed 18 vertical feet from the as-built geomembrane liner surface. In other words ripping will only occur over areas that are at least 18 feet thick.

3.2.2 Inspections and Monitoring - Ore Heap

Visual observations and inspections of the ore heap will be conducted by operations personnel for evidence of heap instability, including surface cracks, slides, sloughs, subsidence, and/or unusual settlements, integrity of the overliner, damage to the overliner caused by dumping ore and solution exiting on the face of the stacked ore.

Mine Operations and Heap Leach personnel will monitor and check the following:

- Ore is not placed outside limits of the mine plan or approved limits of liner and overliner
- Ore loading will always occurs in an up-slope direction where possible
- Any indications of slope instability such as slipping, movement, cracking or bulging of the slope or similar movements at the toe of the slope or above the level of the stacked ore
- Overall heap slopes are equal to or flatter than the design slopes shown in the Design Report. The maximum slope must not exceed the general design slope of the middle section of the heap of 3:1 as indicated in the design report section 9.8.1.1. However note that the slope is variable and the details are described in the Design Report
- Any indications of erosion, sloughing or other movements of the overliner
- Ore placement on the overliner is not damaging the overliner or underlying solution collection pipework or liner system
- Ore being placed generally meets the gradation limits for the ore used as a basis for design
- New ore is not placed on snow with accumulations of greater than 4 inches in thickness
- Alkalinity of the leachate solution will be maintained at about 10.2 pH
- Solution distribution lines are working properly
- There is no or minimal ponding of leach solution on the heap surface
- If wildlife has entered the site and if there has been wildlife mortality

Appendix B includes the Inspection Form for the HLP

3.3 In-Heap Storage Pond

3.3.1 Operation and Maintenance - Internal In-heap Storage Pond

The in-heap storage pond is contained in the heap itself behind the embankment to avoid the freezing potential associated with an exposed pond. The available water storage capacity is located in the interstitial pore spaces between the individual ore particles of the ore in the heap contained behind the embankment and bounded on the sides by the ridges forming the valley.

The planned expansion of the WCHLF and the increase in solution flow to 16,000 gpm required a revision to the volumetric components for the solution levels in the in-heap storage pond as follows:

A. The maximum normal operating levels for the in-heap pond.

These are the stage by stage levels that should not be exceeded under normal operations in order that the required storm water, draindown and freeboard component allowances are always maintained. By way of summary these levels are:

- Stage 3 – 1634.7 ft amsl
- Stage 4 – 1629.8 ft amsl
- Stage 5 – 1625.8 ft amsl
- Stage 6 – 1620.9 ft amsl
- Stage 7 – 1617.3 ft amsl

B. 100-yr/24-hr Design Storm Event

The storm water component has been sized to accommodate the volume of precipitation from a 100 year 24 hour storm above the lined area. The updated analysis indicates the governing 100-yr/24-hr storm is a winter rain-on-snow storm event that is estimated to produce 4.14 inches. The pond storage volume associated with this design storm event varies between 21.5 and 53.2 M gallons from Stage 3 to Stage 7 of WCHLF development.

C. Emergency Draindown due to Loss of Power or Pumps

The emergency draindown component had been previously calculated as the volume associated with 24 hours of flow at the solution application rate of 8,000 gpm and then16,000 gpm, but this has since been revised downward on the basis of a more realistic transient analysis that includes for a decay in the flow rate to the pond with time as the draindown progresses. An emergency draindown condition could occur if either the power supply is interrupted or a few pumps are temporarily shut down; both of which would result in a loss of pumping capacity from the in-heap pond. FGMI has recently equipped the heap with sufficient back-up power and redundant pumps so that in a worst case draindown condition 8,000 gpm would continue to be extracted from the wells but it would be re-applied to the heap, and no solution would be removed to the gold recovery plant. The resulting 24 hour volume was calculated to be 1.3 M ft3 or 9.8 M gallons and this has been used to size the emergency draindown volume component for the in-heap pond.

Recirculation of solution under emergency power (to the top of the WCHLF to keep some solution volume in storage in the leach ore above the pond) is an effective means of extending fill durations to the point of encroaching into storm volume or even to the point of approaching the spillway elevation. Recirculating 50 percent of the solution flow, i.e., 8,000 gpm out of 16,000 gpm, will at least double fill durations and, in some cases, may extend fill durations by more than a factor of two because of the non-linear nature of the draindown flow rates.

A transient seepage analyses provided an adequate representation of the draindown expected from the ultimate heap from the PFS design of the WCHLF expansion (Table 3-1).

Table 3-1 - Transient Heap Draindown Volumes and Times

	Prefeasibility Study Design Spillway (Invert at Elevation 1650.25')		
	Pumping Scenario A	**Pumping Scenario B**	**Pumping Scenario C**
Total Pond Volume	113,157,013 gallons	113,157,013 gallons	113,157,013 gallons
Minimum Operating Volume	28,743,988 gallons	30,981,069 gallons	30,981,069 gallons
100-yr/24-hr Storm Volume	53,233,575 gallons	53,233,575 gallons	53,233,575 gallons
Available Volume (without encroaching into storm volume)	31,179,450 gallons	28,942,370 gallons	28,942,370 gallons
Fill Duration (No Recirculation)	1.6 days	1.5 days	1.5 days
Fill Duration (8,000 gpm Recirculation)	3.2 days	3.0 days	3.0 days
Available Volume (to spillway invert)	84,413,025 gallons	82,175,944 gallons	82,175,944 gallons
Fill Duration (No Recirculation)	4.4 days	4.3 days	4.3 days
Fill Duration (8,000 gpm Recirculation)	11.1 days	10.5 days	10.5 days

Notes:

1. The volumes presented are only for the ultimate build-out of the WCHLF through Stage 7.
2. Total pond volume is calculated below the spillway invert elevation
3. Minimum operating volume is based on required solution depth over pumps for different operational scenarios.
4. Scenarios defined as follows: Pumping Scenario A - 16,000 gpm from original wells 0 gpm from additional wells (minimum pond elevation 1603.0')
   Pumping Scenario B - 12,000 gpm from original wells 4,000 gpm from additional wells (minimum pond elevation 1605.0')
   Pumping Scenario C - 8,000 gpm from original wells 8,000 gpm from additional wells (minimum pond elevation 1605.0')
7. Available volume (to spillway invert) is calculated as the total pond volume less the minimum operating volume.
8. Fill durations were evaluated for conditions with and without 50 percent solution recycle (8,000 gpm) onto the heap.

D. Freeboard Allowance

The freeboard allowance below the crest of the in-heap pond dam is 5 ft. The 5 foot of freeboard volume is calculated to be 12 M gallons.

The figures following Table 3.1 are graphical representations of Table 3.1

Table 3-2 - Stage Storage Components

Stage	**Stage 3**		**Stage 4**		**Stage 5**		**Stage 6**		**Stage 7**	
Pad Area (1)	8.32 M ft^2		11.59 M ft^2		14.89 M ft^2		17.69 M ft^2		20.63 M ft^2	
Storage Component	**Elev (ft amsl)**	**Storage (M gal)**	**Elev (ft amsl)**	**Storage (M gal)**	**Elev (ft amsl)**	**Storage (M gal)**	**Elev (ft amsl)**	**Storage (M gal)**	**Elev (ft amsl)**	**Storage (M gal)**
Maximum Normal Operating Level (2,3)	1634.7	76.5	1629.8	68.1	1625.8	59.6	1620.9	52.4	1617.3	44.8
24 Hour Draindown **(4)**	1634.7 – 1638.9	9.8	1629.8 – 1634.7	9.8	1625.8 – 1630.5	9.8	1620.9 – 1626.4	9.8	1617.3 1622.0	9.8
100-yr/24-hr Storm Event (3)	1638.9 1648.0	21.5	1634.7 1648.0	29.9	1630.5 1648.0	38.4	1626.4 1648.0	45.6	1622.0 1648.0	53.2
Freeboard	1648.0 1653.0	12.0	1648.0 1653.0	12.0	1648.0 1653.0	12.0	1648.0 1653.0	12.0	1648.0 1653.0	12.0
Total		119.8		119.8		119.8		119.8		119.8

Notes:

1. The pad areas shown represent the cumulative 2-diminsional areas through each stage pad development, including both the original and expansion design footprints.
2. The Maximum Normal Operating Level represents the maximum elevation that the pond should be operated at any stage of the WCHLF development to maintain the necessary capacity above it for accommodating the 100-yr/24-hr Storm Event, the 24-hour Draindown component and 5 ft of freeboard below the crest of the in-heap pond dam. The storage volumes presented for the Maximum Normal Operating Level are the total volumes from the bottom of the in-heap storage pond (elevation 1550 ft amsl) to the elevations shown.
3. While pond storage allowances associated with the Draindown and Freeboard components are assumed to remain constant throughout the life of the facility, the storage allowances associated with the Maximum Normal Operating Level and the 100-yr/24-hr Storm Event are inversely related to each other. As the pad area grows with each stage of development, the 100-yr/24-hr Storm Event component increases and this reduces the Maximum Normal Operating Pond Level. It is expected that with on-going operational experience, FGMI will be able to readily adapt to this reducing level.
4. The 24-hr Draindown component provides storage for a condition where the power supply is interrupted or a few pumps are temporarily shut down; both of which would result in a loss of pumping capacity from the in-heap pond and its subsequent filling. FGMI has recently equipped the heap with sufficient back-up power and redundant pumps so that the worst case condition is one where 8,000 gpm would continue to be extracted from the wells but it would be re-applied to the heap, and no solution would be removed to the gold recovery plant. In this case, the draindown into the in-heap pond would be associated with a change of the solution application on the heap from 16,000 to 8,000 gpm, and this was modeled in the transient analysis. The storage component listed above is for the first 24 hours of volume from this analysis

Figure 3.1 - Stage Operating Elevation Ranges

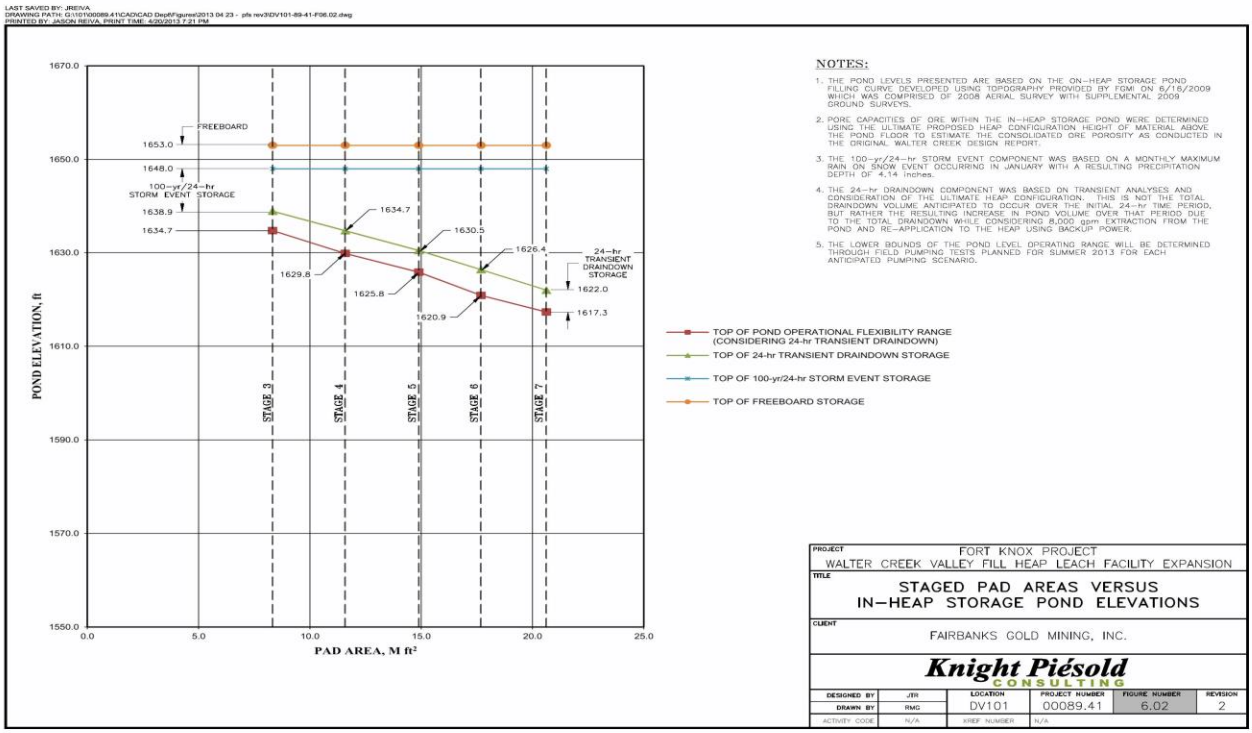
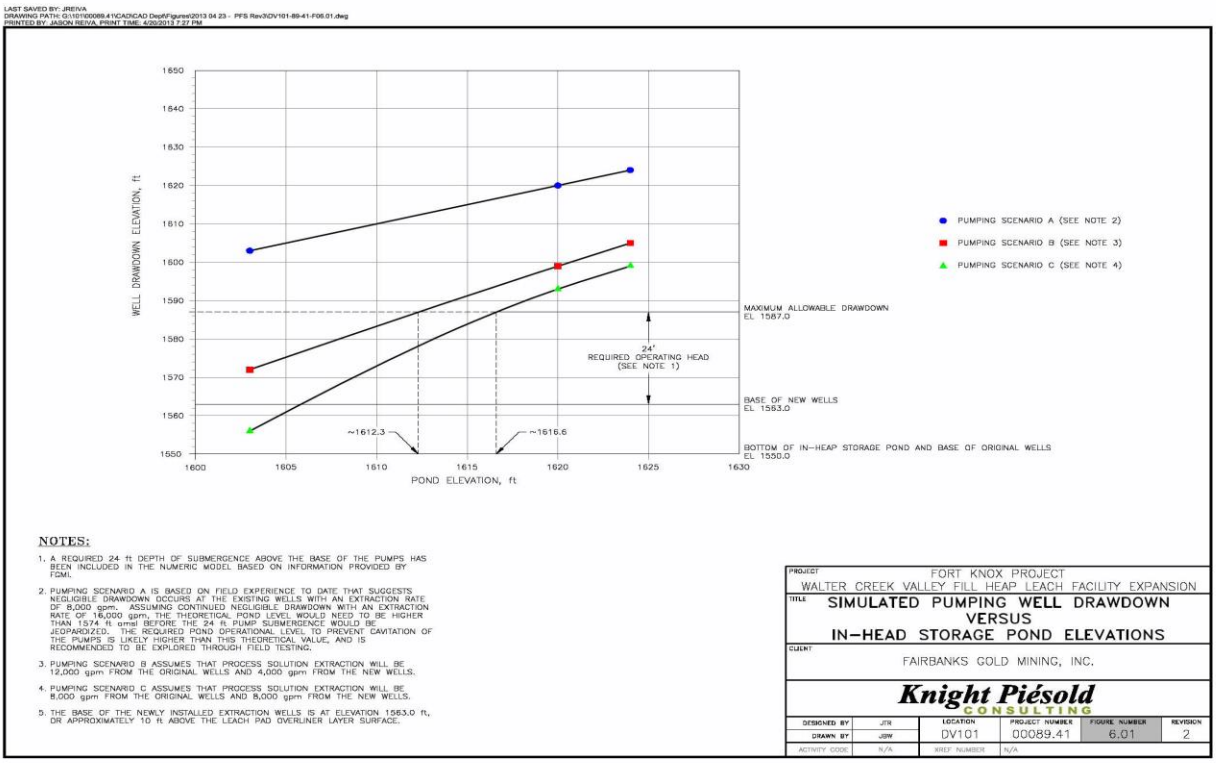
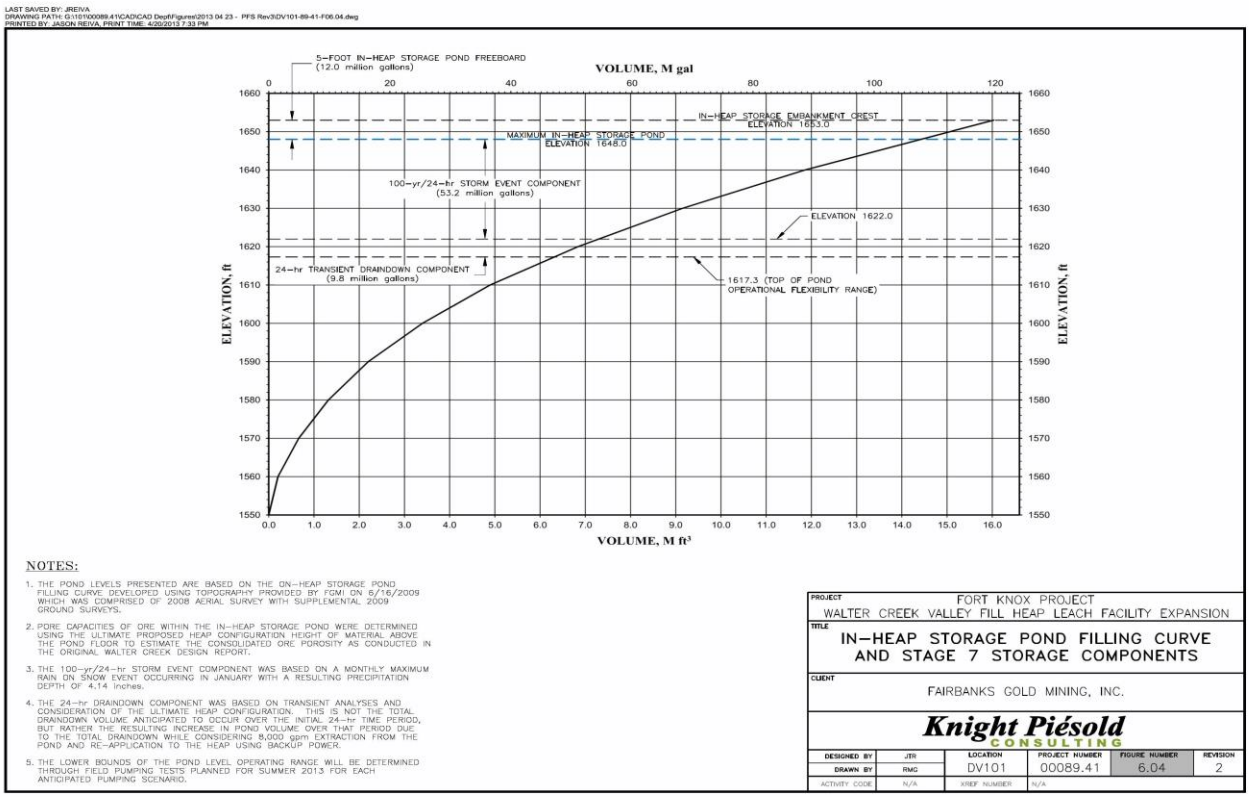


Figure 3.2 - Maximum Allowable Draindown



Under long term operations of Stage 7 a filling curve with the elevations of the storage components are provide in Figure 3.3. During all stages the water levels will be reported to the DCS and will be adjusted as required.

Figure 3.3 - Stage 7 Filling Curve



3.3.2 Inspections and Monitoring - Internal In-heap Storage Pond

Inspection and monitoring of the In-heap Storage Pond will consist of checking the pumps and piping associated with collection wells. Measuring the solution levels in the In-heap Storage Pond will be done with the use of the vibrating wire piezometers in the overliner. Monitoring for the pumps within the solution collection wells will include flow measurements and water depths at the pumps. The results of this monitoring will be reported on the Heap Leach Inspection Form presented in Appendix B.

Monitoring the performance of the facility includes taking weekly readings of the vibrating wire piezometers discussed in Section 3.4.2 and a daily check of the PCMS and LCRS for any evidence of solution indicating leaks in the liner system. The ends of the PCMS are exposed, a visual inspection is performed. The LCRS is continually monitored through the DCS system, and it is pumped weekly. This will provide information on the possible elevation of the leaks and their size relative to flow through the liner system.

3.4 Solution Collection System, Solution Monitoring and Composite Geomembrane Liner Systems including LCRS

3.4.1 Operation and Maintenance - Solution Collection System

As discussed in Section 2.3, the network of 4-inch-diameter lateral collection pipes, covered with overliner (drainage layer) material, will collect leach solution and deliver it to the perforated CPT, Type SP pipes (6- to 24-inch-diameter). These pipes will carry the pregnant solution to the solution collection wells. The system will be buried thus eliminating the potential to perform maintenance.

3.4.2 Inspections and Monitoring - Solution Collection System

The proper function of this system is reflected in the maintenance of a maximum average head of 1 foot or solution depth on the primary liner above the level of the in-heap pond and the volume of the collected flows reporting to the solution collection wells to maintain the desired in-heap pond levels.

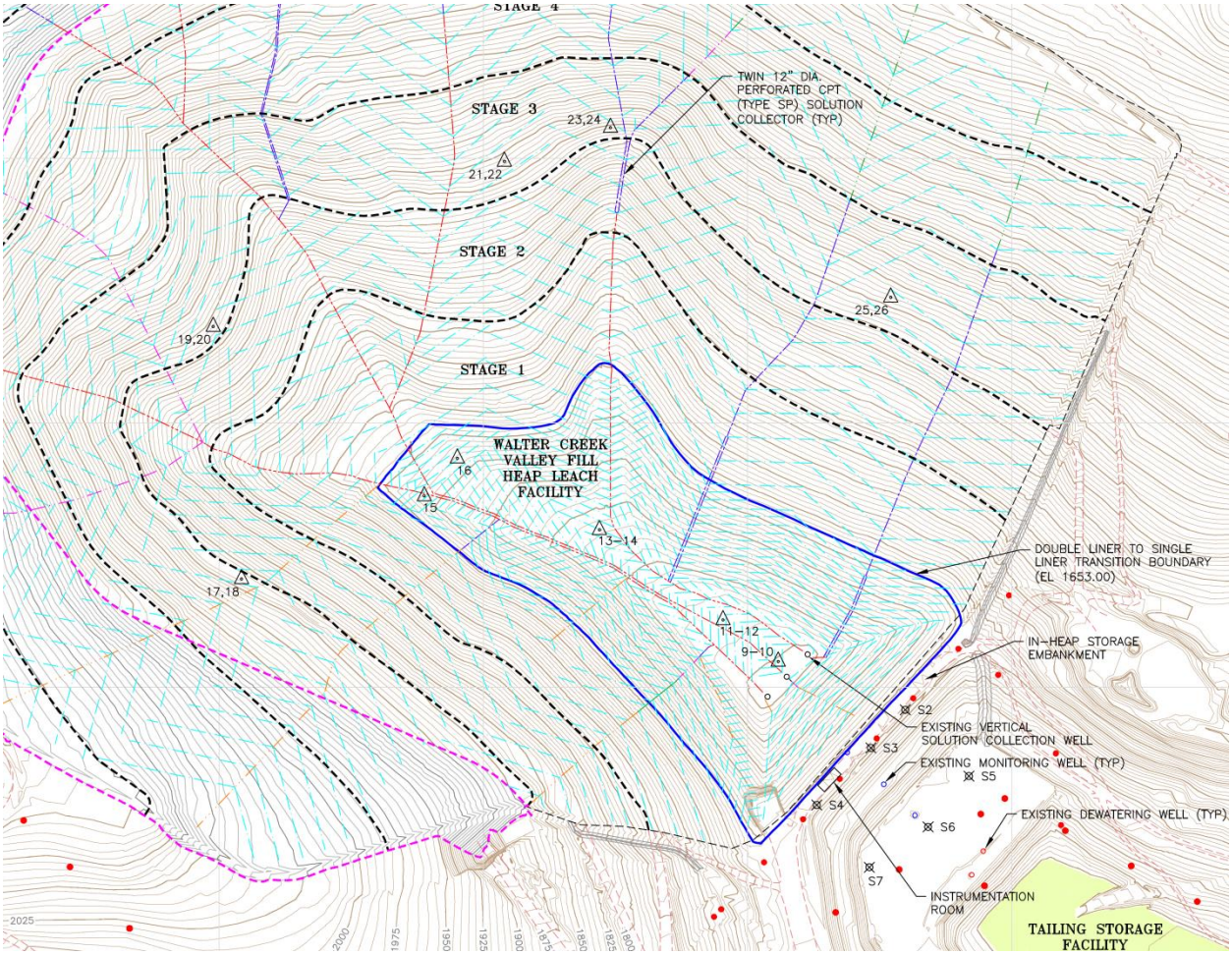
Four pairs of piezometers are installed in the Overliner Drain System in the Stage 1 portion of the WCHLF The piezometers are numbered 9 through 16 and are shown on Figure 3.4. The first three pairs (piezometers 9 through 14) are installed in the in-heap pond area while piezometers 15 and 16 are installed above it.

Five pairs of vibrating wire piezometers are located in the Overliner Drain System in the Stage 3 portion of the facility. These piezometers are numbered 17 through 26 and are shown on Figure 3.4. These piezometers are installed well above the elevation of the in-heap pond. FGMI began taking measurements from these piezometers at the end of July, 2013.

Piezometers 21-26 have recorded piezometric elevations that are clearly erroneous. It was discovered that piezometers 21-26 were inadvertently left uncovered in the overliner material through the winter of 2012/2013 after being installed. This likely caused water to freeze in the diaphragm, damaging the piezometers. Readings for these piezometers will continue to be manually read with a data logger on a monthly basis in the event the piezometers start providing valid data.

The leads from vibrating wire piezometers 1-16 are extended to a single monitoring location located on the right abutment of the in-heap storage embankment. The 16 piezometer are also hardwired to the mill and for continuous and instantaneous readings. Figure 3.4 shows locations of the vibrating piezometers and monitoring station (instrumentation room) for Piezometers 1-16. A VW Mini-logger is used weekly to record the frequencies and recorded on the Inspection Form presented in Appendix B.

Figure 3.4 - Vibrating Piezometer Locations and Instrumentation Room



3.4.3 Operation and Maintenance - Composite Geomembrane Liner System

The Composite Geomembrane Liner System is an integral part of the solution collection system and once covered with ore will not be available for maintenance. Where covered by overliner and not ore it will be available for repair should the need arise. Maintenance requirements will be minimized by proper installation. There are no operating criteria for the geocomposite liner system.

From a practical standpoint, maintenance will be limited to the exposed overliner. If the overliner is eroded it must be replaced. If the liner system is damaged it must be repaired.

3.4.4 Inspections and Monitoring - Composite Liner System

The proper function of this system will be evaluated based on the quantity of solution, if any, reporting to the LCRS, PCMS and sump between the base platform random fill and TSF, as well as the quality of water reporting to the Base Platform Random Fill. The detail design descriptions of these components are described in Section 2.3, 2.7 and 2.8. Inspection and monitoring of these is discussed under their respective sections.

Ore placement on the overliner will be monitored to see that the ore placement is not damaging the overliner and related solution collection pipework and liner system. This will be monitored on a daily basis and any damage reported on the Inspection Form in Appendix B.

3.5 Leachate Collection and Recovery System (LCRS)

3.5.1 Operation and Maintenance- LCRS

The LCRS is designed to monitor and collect process solution passing through the primary liner of the in-heap pond. It will be buried beneath the pond so there is no practical way to perform maintenance.

The base of the in-heap pond is sloped to drain to the LCRS sump near the southeast corner of the bottom of the in-heap pond. Thus, solutions collected by the LCRS will report to the sump. Solution collected in the sump will be removed by a submersible pump placed in an 18 inch diameter carbon steel pipe, located between the primary and secondary geomembranes, extending from the bottom of the LCRS sump to the crest of the in-heap storage pond embankment. Collected solutions will be discharged to the HLP. Currently the LCRS is pumped once a week due to the low volumetric flow of solution that is collected in the sump. Operation and maintenance of the piping and pumping systems will be according to the manufacturer's recommendations and FGMI's scheduled maintenance.

3.5.2 Inspections and Monitoring - LCRS

Inspections of the LCRS piping and pumping system will be conducted daily for dam safety related to first filling. Environmental monitoring requirements related to permit compliance are discussed below. An automatic recording device will be used to measure flows pumped from the sump, as well as water levels at the pump – all LCRS flow will be monitored by the Environmental Department. These flows will be compared to the estimated leakage rate presented in the Design Report. The estimated leakage rate at the long term normal operating level is 379 gpm and for a pond level at elevation 1648 feet 520 gpm. Also, monitoring will include sampling and water quality analysis of flows from the LCRS pumping system.

Three pairs of vibrating wire piezometers numbered 3 and 4, 5 and 6, and 7 and 8, are located within the LCRS to monitor the hydraulic head acting on the secondary liner of the in-heap storage pond. The maximum average head of one foot acting on the liner was used as a basis for the design. Additionally, one pair, numbered 1 and 2, is located in the center of the LCRS sump to monitor fluid depths in the sump and the head acting on the liner. These leads from the vibrating wire piezometers extend to the centralized monitoring station located on the in-heap storage embankment, this data is transmitted to the mill through a communication line in the CIC 1 pipe line corridor. The LCRS piezometer locations are shown on Figure 3.4. Monitoring will include continuous measurement and recording of the flows from the LCRS sump, as well as water levels at the pump. The flow rate being pumped from the LCRS sump will be monitored. The flows will be reported on a daily basis in the Inspection Form in Appendix B.

The LCRS is monitored according to the schedule in Table 3.1. If fluid is present, the fluid will be pumped from the sump and records maintained of the quantity of fluid removed versus time.

In addition to the underdrain monitoring wells, there will be three additional monitoring wells installed within stage 6 limits on the north, east and west flanks. These wells will also follow the same sampling cycle as Table 3.2

The following monitoring requirements shall be fulfilled for environmental monitoring.

Table 3-3 - Monitoring Requirements

IDENTIFICATION	PARAMETER	MONITORING FREQUENCY
LCRS	WAD	Weekly
PCMS	WAD CN/pH	Weekly (if there is measurable flow)
Underdrain (HL1, HL2 and HL3)	Profile II	Quarterly
In-Heap Storage Pond	Elevation	Continuous Automatic Monitoring

3.6 Embankment Underdrain Collection System and Monitoring Wells

3.6.1 Operation and Maintenance - Embankment

The HLP embankment primary purpose is a “dam” for the in-heap pond and, as discussed above it generally provides containment for:

A. Maximum normal operating level
B. The 24-hour draindown
C. The 100-year/24-hour storm event
D. Freeboard

Consequently, O&M for the embankment is closely related to the operation of the Internal In-heap Storage Pond. (Section 3.3 provides O&M procedures for the In-heap Storage Pond.)

Once the embankment is constructed it is not “operated” since it is a stationary structure designed primarily for solution retention.

Specific O&M procedures for the embankment primarily include the placement of ore to maintain the swale between the upstream slope of the embankment and the front face of the heap. The estimated as-built swale storage capacity is about .8 million cubic feet (or 6.2 million gallons) and is provided to intercept precipitation runoff that falls directly on the HLP and to facilitate infiltration into the In-heap Storage Pond. It will be necessary to insure that during ore placement the swale is not filled with ore, the swale and the channel remain unobstructed, particularly during extended periods of extremely cold weather.

Embankment maintenance also involves maintaining the crest road and concrete portion of the spillway and repairing any erosion of the slopes. However slopes erosion is anticipated to be minimal since this is a rockfill embankment that is highly resistant to erosion.

3.6.2 Inspections and Monitoring - Embankment

Visual inspections of the embankment will be conducted on a daily basis and recorded on the HL Inspection Form presented in Appendix B. The key areas of observation include:

1) Embankment crest
2) Upstream slope
3) Downstream slope
4) Abutments

The embankment crest should be checked for signs of settlement that would impinge on the freeboard or horizontal displacements in the downstream direction that would indicate instability. In addition, the condition of the crest road and spillway must be noted and repairs made as needed to maintain the structures.

The upstream slope is covered by the overliner so direct observation of its condition will be somewhat obscured. However, it must be checked to see that the overliner drain aggregate has not eroded from the slope to expose the LLDPE geomembrane primary liner. As the LLDPE geomembrane line is subject to degradation from UV light, any exposed geomembrane must be covered with drain aggregate. Any overliner erosion or slope movements must be noted on the HL Inspection Form in Appendix B.

The downstream slope must be monitored for movements such as slumping, cracking and bulging; signs of seepage; erosion; and deformations along the downstream toe. The location, extent, and size of the slump are to be reported, as well as the pond level and any flow or associated seepage. Likewise the abutments and area downstream of the downstream toe must be observed for signs of instability such as bulging and cracking, as well as signs of seepage.

Seven survey monuments are installed to enable monitoring of embankment movements. Three will be located on the 50-foot-wide bench at the top of the base platform and four on the in-heap embankment crest. See Figures 3.5 and 3.6. Surveying the seven movement monuments, identified as survey monuments S-1 through S-7, will be on a quarterly basis with the first survey being taken prior to first filling and following any significant seismic event. Movement data should be reviewed by the Engineer of Record on an annual basis and more frequently if movements in any direction exceed 0.05 foot from the movements reported in the previous annual inspection. FGMI's survey department records survey data on a spreadsheet which is accessible by the environmental department and sent to Engineer of Record for analysis. The spillway will be inspected weekly or after rainfall of greater than 0.5 inches and documented on the Inspection Form.

Figure 3.5 - Survey Monuments

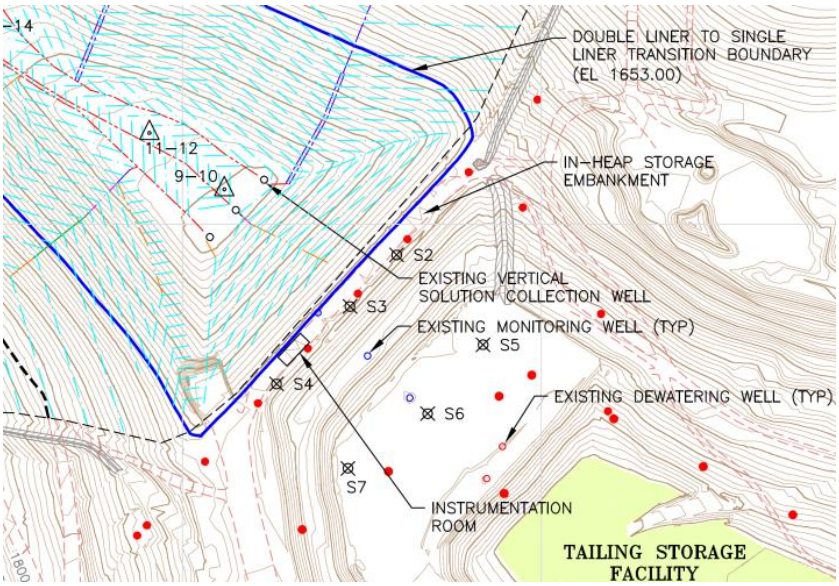
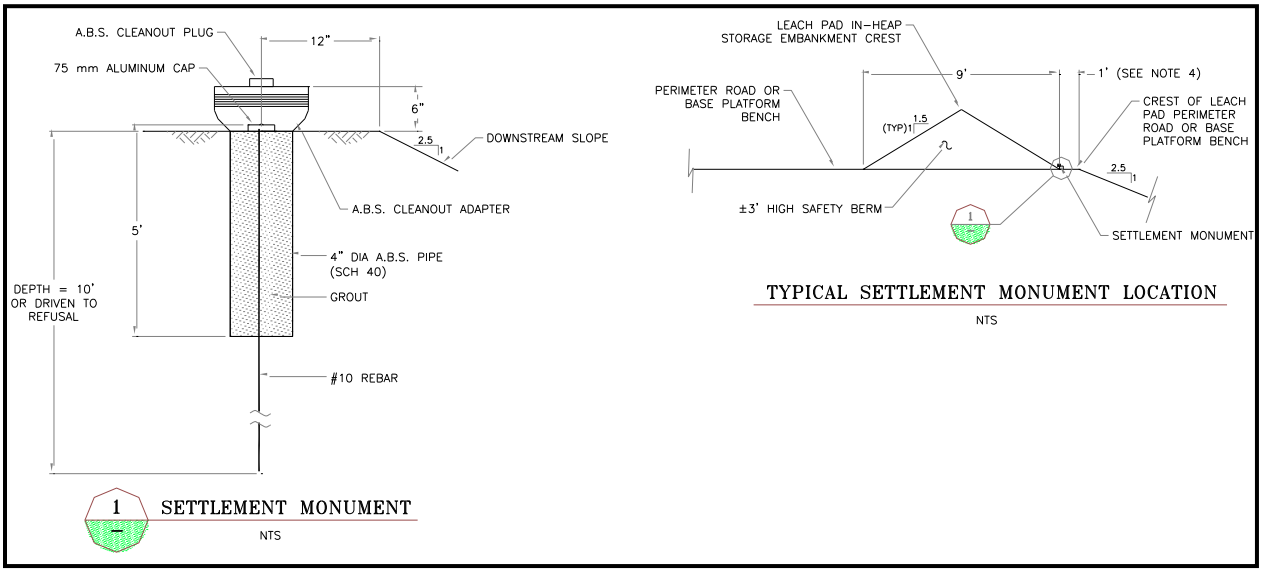


Figure 3.6 - Survey Monuments Details



3.6.3 Operation and Maintenance - Underdrain Collection System and Monitoring Wells

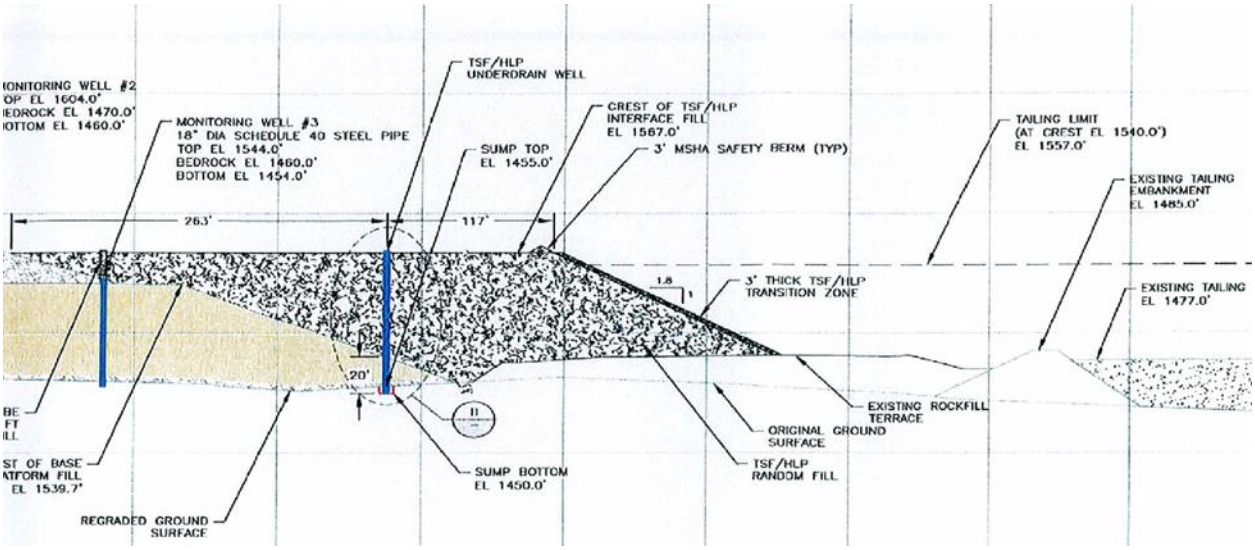
The underdrain system consists of the random fill drain, base platform random fill and underdrain random fill. The underdrain collection system will be buried limiting the amount of maintenance that can actually be performed. Maintenance requirements will be minimized by proper installation. The outlet shall be maintained to provide “free flow” from the downstream end of the underdrain.

The surface around the monitoring wells shall be maintained such that ready access to the monitoring wells is available for reading water levels and sampling the wells. This includes snow management and removal from around the wells so the above ground extensions of the wells are clearly visible to avoid damage to the wells. Monitoring well, HL-1 is an 18-inch diameter pipe; it could be converted to a solution interception well if required.

There are two dewatering wells (underdrain wells) installed at the TSF/HPL interface fill through the heap leach underdrain see Figure 3.7. Their purpose is to capture any backflows prior to tailings restricting the underflow draining into the TSF. When pumping they will effectively reduce pressures developing at the underside of the in-heap storage pond liner system. The pumps need to be operating when water elevations reach 1531amsl which is ten feet below the bottom of elevation of the LCRS sump.

Above ground extensions of the wells must be well marked and painted so the wells are readily visible to avoid damage to the well. Bollards shall be installed, as needed to protect the wells.

Figure 3.7 - Dewatering Wells at the TSF/HPL Interface



3.6.4 Inspections and Monitoring - Underdrain Collection System and Monitoring Wells

The underdrain monitoring wells are provided for obtaining water quality samples, as well as measuring the water level in the drain. Three collinear monitoring wells are installed in the following locations:

1) (HL-1) Crest of the in-heap storage pond embankment
2) (HL-2) Pipe line bench on the downstream slope of the in-heap storage pond embankment
3) (HL-3) Crest of the base platform random fill

These wells will be used to assess the water quality in the base platform fill material that will carry the trench drain discharges. These wells will also be used to monitor the fluid level within the base platform fill. The Environmental Department will measure water levels, collect samples and have them analyzed by a third party quarterly. The monitoring wells will be sampled and water levels measured as indicated on Table 3.3.

Table 3-4 - Monitoring Parameters for Underdrains

IDENTIFICATION	PARAMETER	MONITORING FREQUENCY
Underdrain – HL1, HL2 and HL3	Profile II	Quarterly

If WAD cyanide is detected above a concentration of 0.2 mg/L, the ADEC must be notified within one working day of the discovery. If WAD CN is above the 10 ppm then underflow will need to be returned to the HLP. FGMI must then demonstrate to the ADEC's satisfaction that all underflow reports to the TSF.

If water quality does not meet required water quality standards, existing information demonstrating that the solution is contained in the TSF needs to be submitted to the state. In addition, a pump needs to be installed in HL-1 and operated to lower the groundwater level to form a cone of depression at the toe of the HLP such that the flows can be pumped back to the HLP. A flow measuring device will be installed on the pump to provide a record of flows pumped back to the HLP.

Monitoring well water level readings are recorded in an electronic format. The pump flows shall be recorded on the Inspection Form presented in Appendix B.

3.7 Process Control Monitoring System (PCMS)

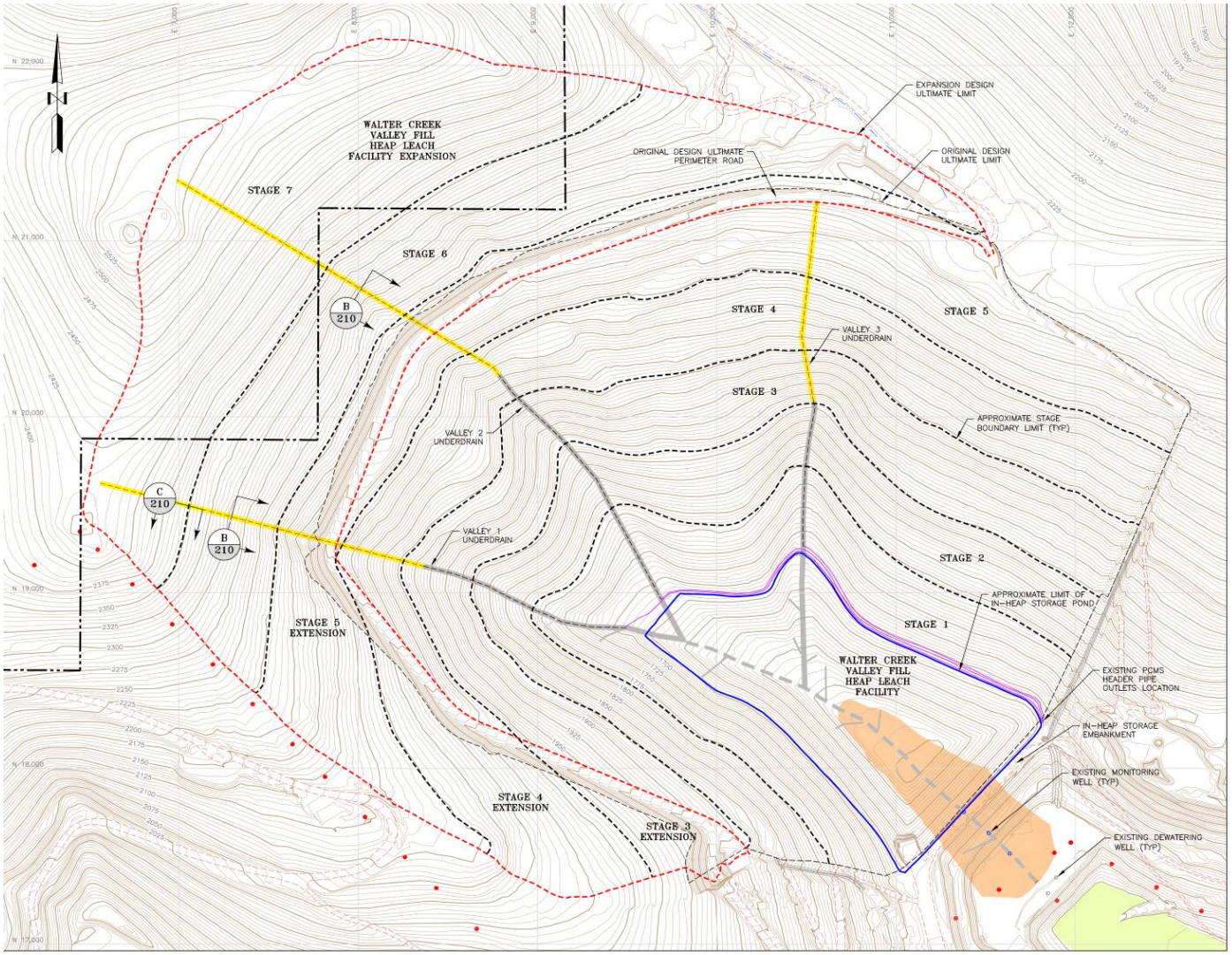
3.7.1 Operation and Maintenance - PCMS

The PCMS is designed to provide an early indication of possible leakage through the liner beneath the three solution collection headers. The system, except for the discharge, will be buried limiting the amount of maintenance that can actually be performed. Maintenance requirements will be minimized by proper installation.

At the limits of the in-heap storage pond, the “V” trenches filled with PCMS drain aggregate transitions to solid 4-inch-diameter, solid-walled HDPE pipe that convey the collected flows to outlet monitoring points. The outlet monitoring points is in the northeast corner of the in-heap storage pond at a location downstream of the ore pile but upstream of the in-heap storage pond embankment. The outlet monitoring points are exposed and therefore easily accessible to field monitoring personnel and will discharge any flows directly onto the double lined pond area. PCMS outlet locations are shown on Figure 3.7.

The PCMS outlets will have heat traces at the outlet ends of the pipes. These will be maintained as part of the routine FGMI maintenance program.

Figure 3.7 - PCMS Outlet Locations



LEGEND:

- 2200 — EXISTING GROUND SURFACE CONTOUR AND EL, FEET
- PROPERTY BOUNDARY
- UTILITY POLE
- EXISTING ROAD
- EXISTING MAIN UNDERDRAIN TRENCH
- EXISTING RANDOM FILL DRAIN
- EXISTING UNDERDRAIN FINGER TRENCH
- EXISTING PCMS CHANNEL
- EXISTING PCMS HEADER PIPE
- MAIN UNDERDRAIN TRENCH DIRECTLY BENEATH PCMS CHANNEL
- PCMS CHANNEL
- TAILING (CONFIGURATION AS OF MAY 5, 2011, EL 1497.3)
- BASE PLATFORM RANDOM FILL

NOTES:

1. SCALE BAR MEASURES 3" ON A FULL SIZE PLOT (ANSI-D) AND 1.5" ON A HALF SIZE PLOT (ANSI-B SHEET).
2. PCMS – THE PROCESS COMPONENT MONITORING SYSTEM IS LOCATED BENEATH THOSE PORTIONS OF THE LINER WHICH HAVE GREATER POTENTIAL FOR LEAKAGE – MAINLY BENEATH THE MAIN SOLUTION COLLECTION HEADERS. THE PCMS CHANNELS ARE LIMITED TO THE AREA OUTSIDE THE IN-HEAP STORAGE POND.
3. THE INTERMEDIATE STAGE BOUNDARIES ARE APPROXIMATE AND SHALL BE FINALIZED PRIOR TO CONSTRUCTION OF EACH STAGE.
4. UNDERDRAIN TRENCH LOCATIONS SHALL BE ADJUSTED IN THE FIELD BY THE ENGINEER DURING THE LEACH PAD GRADING OPERATIONS TO INTERCEPT GROUNDWATER SEEPS AND SPRINGS. ADDITIONAL UNDERDRAIN FINGER TRENCHES WILL BE CONSTRUCTED AS REQUIRED BASED ON SECTION A ON DRAWING 210.
5. ALL EXISTING CULVERTS WITHIN THE LEACH PAD BASIN AREA SHALL BE REMOVED PRIOR TO THE START OF LEACH PAD REGRADING.

3.7.2 Inspections and Monitoring – PCMS

The PCMS will be monitored and inspected on a daily basis. If flow is observed from the PCMS outlets it will be noted on the on the Inspection Form. In addition, the rate of flow will be measured and reported. Initially the flow rate shall be determined by measuring the time it takes to fill a container of known size and calculating the flow rate in gpm. If flows continue automated flow measuring devices may be installed.

Flows from the PCMS must report to the HLP.

PCMS reports must be submitted to the ADEC on a quarterly basis.

Environmental monitoring by the Environmental Department will be done in compliance with the requirements shown on Table 3.2.

3.8 Pregnant and Barren Pipeline Corridor

3.8.1 Operation and Maintenance - Pregnant and Barren Pipeline Corridor

All pipe crossings will be maintained to prevent crushing of the doubled lined pipes or damage to the liner. Piping will be maintained according to the manufacturer's specifications.

3.8.2 Inspections and Monitoring - Pregnant and Barren Pipeline Corridor

The piping corridor will be inspected on a daily basis by the heap leach operators. Inspections will include observation for any surface movements indicating problems with the pipe in the trench or the trench itself, excessive snow load, erosion, or maintenance needed for the corridor. In addition, the discharge end of the pipe trench shall be monitored for flows. It will not be unusual to see flows resulting from rainfall or snowmelt. However, if the flows persist at a near constant or increasing rate water quality samples shall be taken and analyzed to determine if the flows are from leaks in the pipes. If they are from leaks in the pipes the pipes shall be repaired.

3.9 Surface Water Control System

3.9.1 Operation and Maintenance – Surface Water Control System

The diversion channels and spillways will be cleaned out and maintained as needed. Debris and vegetation will be removed when observed. Excessive sedimentation which could affect the capacity of the channels and external ponds will be removed, as needed. Channel riprap will be repaired, as needed and new riprap will be placed in areas of the channels that are eroding significantly. Any required maintenance will be reported on the HL Inspection Form in Appendix B.

3.9.2 Inspections and Monitoring – Surface Water Control System

The condition of the surface water diversion channels and culverts will be inspected weekly or after rainfall of greater than 0.5 inches. FGMI personnel will monitor the condition of the surface water diversions and sediment retention structures as a part of normal operating procedures.

The minimum formal diversion channel inspection schedule is summarized in Table 3.4. The response criteria are provided in Table 3.5. Inspections will include observations of erosion, any plugging or deterioration of the culverts, and accumulation of debris, ice jams, and impairment to diversions. Observations and the need to maintain the diversion ditches shall be reported on the HL Inspection Form.

Table 3.4 - Inspection Schedule for the Walter Creek HLP Surface Water Controls

ACTIVITY	INSPECTION FREQUENCY
Excessive Erosion / Repair	Weekly [1]
Debris Removal	Weekly [1]
Diversion Berms	Weekly [1]
Integrity of Liner System	Weekly [1]
Visual inspection of channels	Weekly[1]
Ice Jam Inspection	Weekly (winter months only)[1]

1 FGMI personnel will provide informal inspections on a daily basis as part of normal operating procedures.

Table 3.5 - Surface Water Controls - Observation and Response

OBSERVATION	RESPONSE
Erosion	Regrading to Original Lines and Grades
	Replacement of Removed Riprap
Accumulation of Debris	Remove Debris
	Remove Sediment in Retention Structures
Culvert Blockage from Sediment / Debris	Schedule to have blockage removed
Impairment of Access	Remove Unsuitable Sediment From Road
	Regrade Road to Original Lines and Grades
Liner System Integrity is Compromised	Schedule Liner Repairs
Settlement	Regrade Channel to Original Grade

3.10 Photographs

Taking photographs of conditions needing repair and of the repairs are encouraged to provide a visual record of the conditions and the repair. This is especially important when design of the repair may involve personnel who are offsite. It also provides a visual record of areas that are taking more than routine maintenance that could reduce the maintenance costs by revising the design. The photographic record is many times a real value in showing the designer the problem to be addressed.

3.11 Data Interpretation

3.11.1 Data Interpretation

This manual provides the guidelines for a consistent method for monitoring and inspecting the facilities. It also, in many cases, includes the “trigger” that initiates actions based on the results of the monitoring and inspection. However, in a number of cases making consistent plots of data versus time provide a useful way to examine the changes over time. It is strongly suggested that a consistent program of filing and storing the Daily Field Reports and summarizing key data graphically on a time basis be established and maintained. Indeed the entire system could be set up in an electronic format that would provide ready access to the results of the observations. Along with that a system to alert personnel responsible for repairs could be established and executed by simply email notification from the staff responsible for the monitoring.

Areas that would benefit from graphical summaries include but are not limited to the following:

- Graphs of piezometer readings versus time
- Graphs of water levels in the monitoring wells versus time
- Graphs of pumping rates for the LCRS and sump at the toe of the base platform fill versus time
- Graphs of water chemistry versus time

3.11.2 Internal and External Reviews

Data collected will be reviewed by HLP supervisors; Environmental department will collect and manage all data for reporting to agencies. Should an issue be identified the appropriate manager will be notified and findings recorded.

Section 4.0 - **Emergency Action Plan**

This following is an excerpt of the Fort Knox Emergency Action plan for the dams. The Emergency Action Plan in its entirety is in Appendix D. This Emergency Action Plan is also coordinated with the Fort Knox Emergency Management Plan.

The HLP Dam is considered a low hazard facility from a dam classification perspective for the following reasons:

- There are no inhabitants located immediately downstream of the HLP that would be in danger from flood waters if the HLP embankment were to overtop or breach;
- It is extremely unlikely that the embankment would overtop or breach without significant warning;
- The HLP has been sized conservatively to fully contain the 100 year/24 hour storm event, 24 hours of heap draindown, and the volume associated with 5 feet of addition freeboard (in accordance with FEMA requirements.)

4.1 General Emergency Response Procedures

Specific emergency response procedures will be developed for various types of situations (e.g., spills, earthquake, containment failure, etc.) in each of the primary work areas. Nevertheless, common sense and good decision-making will still be required in responding to emergencies. In the event of an emergency, people affected or involved in emergency response will employ the following general response procedures, in accordance with standard FGMI emergency response procedures:

1. Avoid danger to themselves, others, and the environment
2. Prevent further loss of material or damage to equipment, if this can be achieved safely
3. Assess the magnitude and severity of the emergency
4. Determine if there is an immediate health or safety hazard and evacuate the area if imminent danger exists
5. Report the emergency to their immediate Supervisor

4.2 Emergency Communication Procedures

Communications of an emergency condition will follow the general outline presented in Figures 4.1 – 4.3 additionally; communication of an emergency condition should consider the following recommendations and guidelines.

4.2.1 Internal Communications

In the event of an emergency condition, the FGMI employee should immediately report the conditions and then take appropriate precautionary and protective actions. Reports of unusual conditions should be as accurate and complete as possible. They should include at least:

1. A detailed description of the unusual condition including a description of the potential of the loss of human life and/or environmental damage
2. Time and date of the unusual condition
3. Any first response measures taken or planned
4. Assistance that may be needed
5. An estimate of the probable duration of the unusual condition

Reporting should also include the end of the unusual condition. If unusual conditions are such that downstream inhabitants or property owners will be, or are likely to be, threatened, they will be warned in accordance with the Fort Knox Emergency Response Plan.

4.2.2 Communication with Government Agencies and Media

In the event of an emergency, management personnel of FGMI will notify the Alaska Department of Natural Resources, other agencies and media in accordance with regulatory requirements.

Figure 4.1 Level 1 Notification

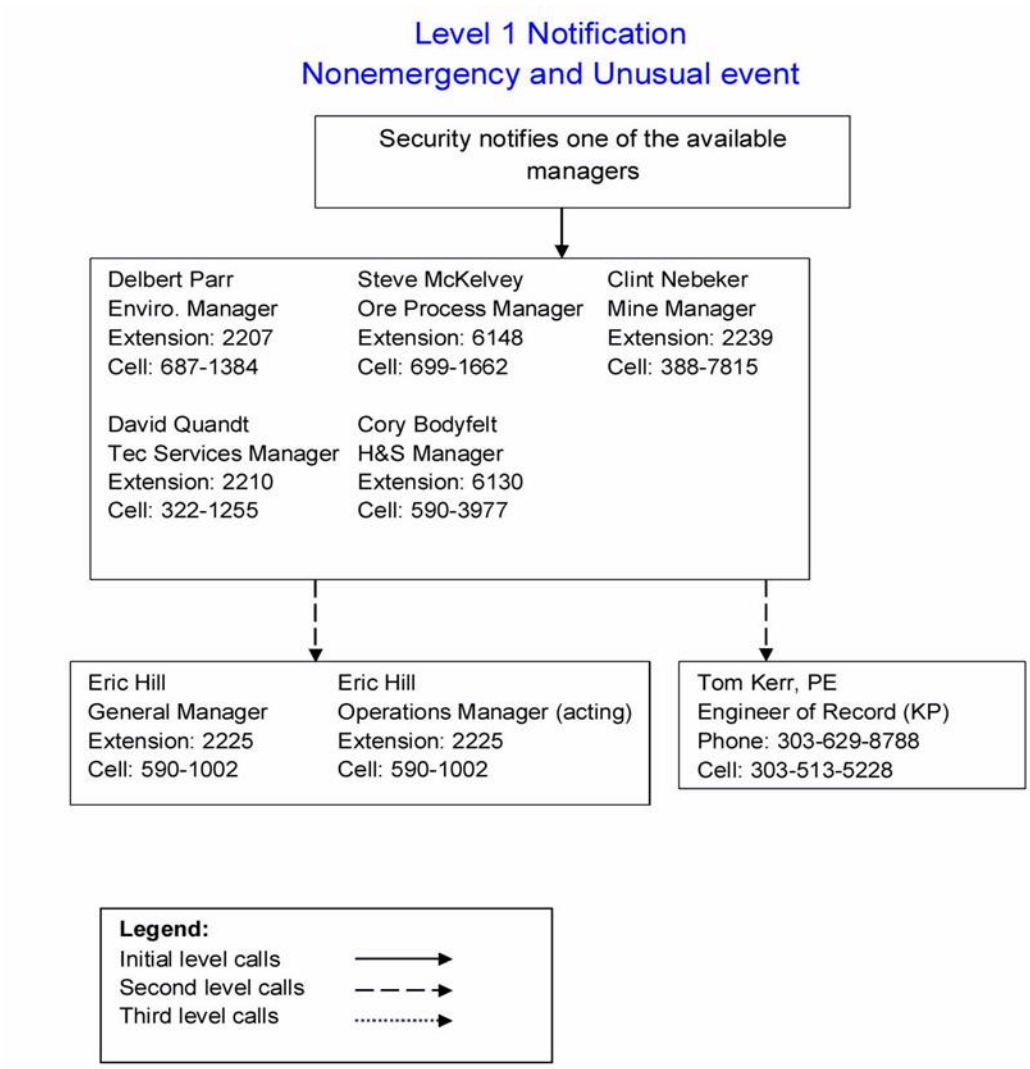


Figure 4.2 Level 2 Notification

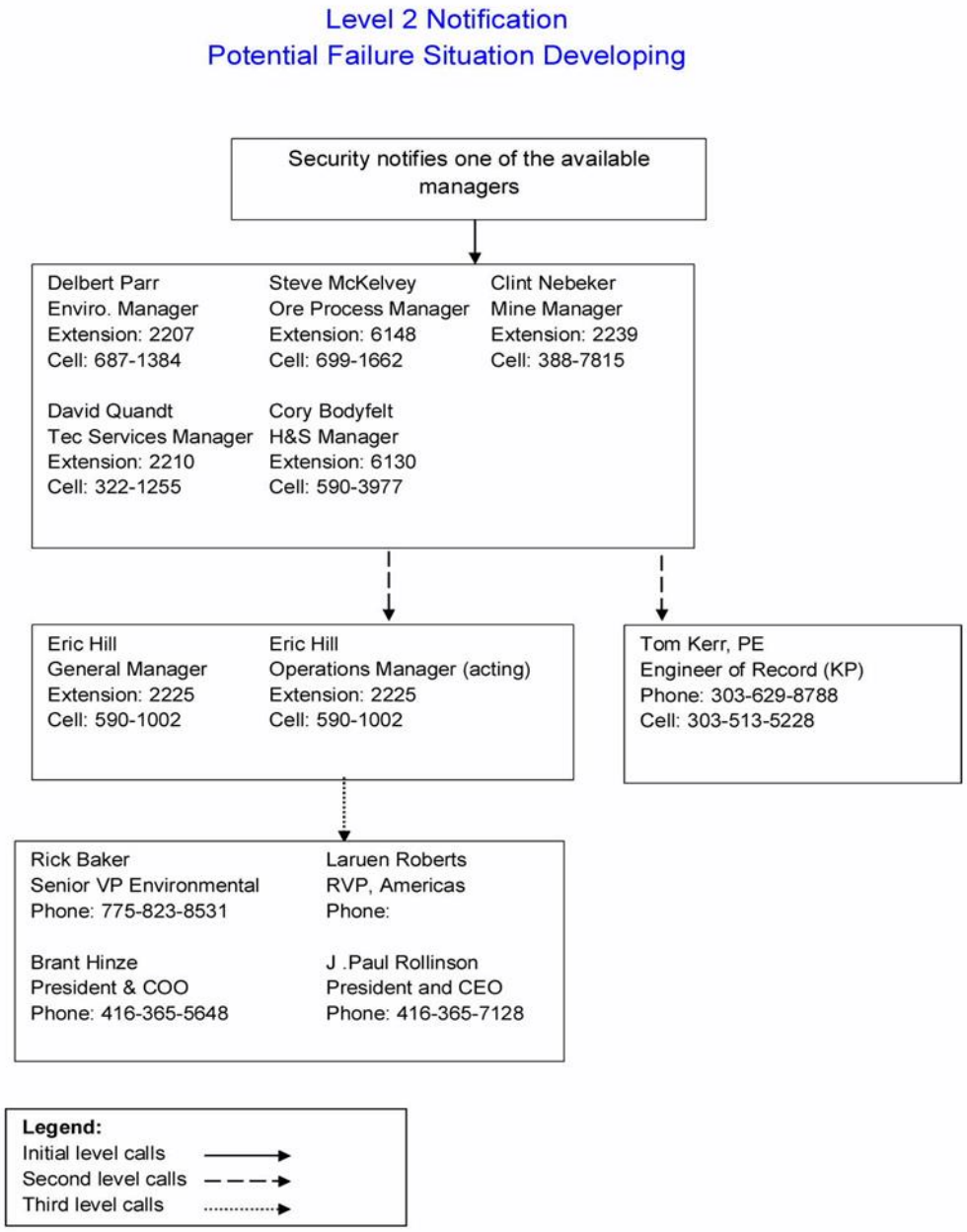
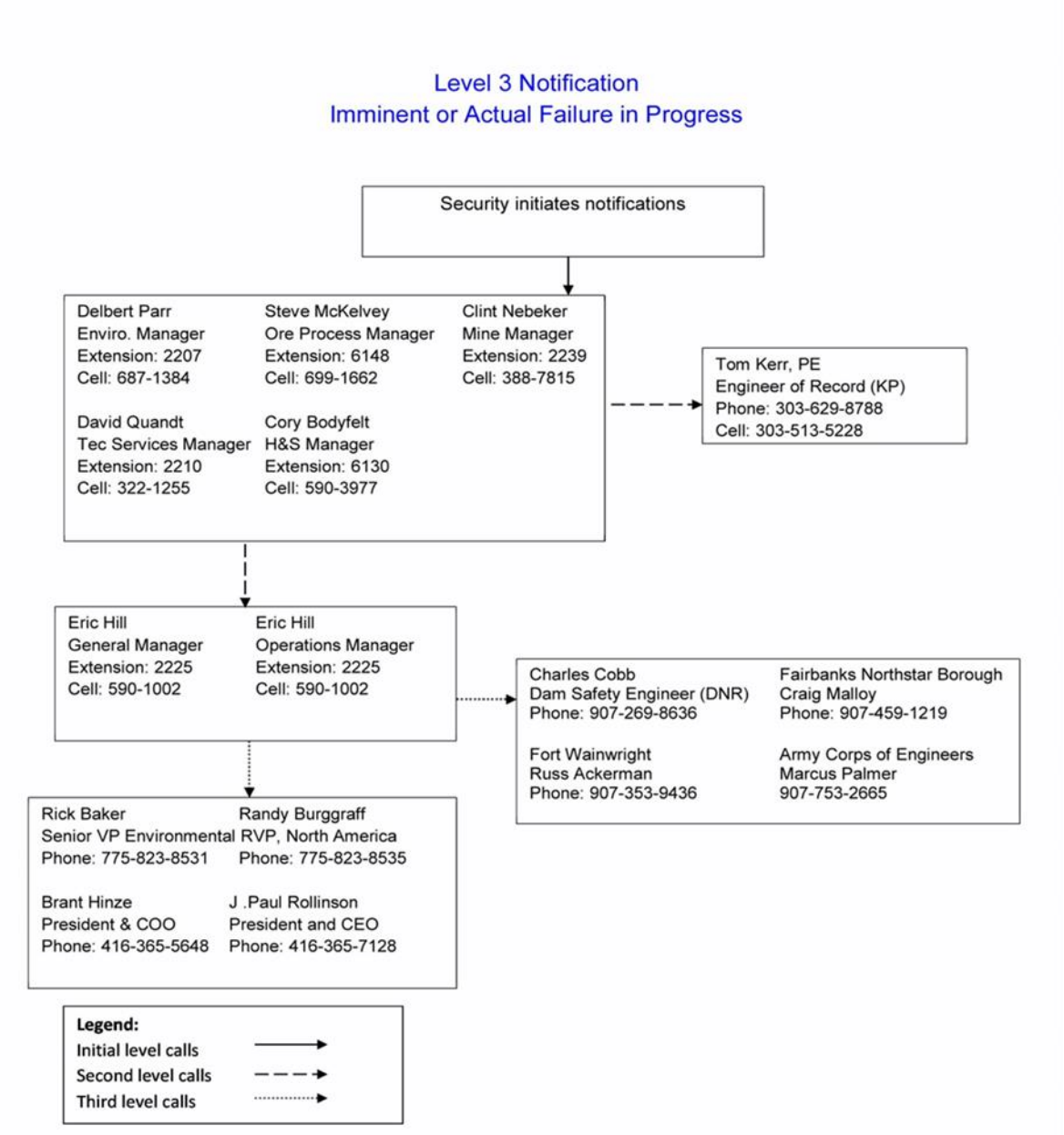


Figure 4.3 Level 3 Notification



4.3 Emergency Detection, Evaluation and Classification

4.3.1 Event Detection

This step describes the detection of an unusual or emergency event and provides information to assist the Dam Operator in determining the appropriate emergency level for the event. Unusual or emergency events may be detected by:

1. Observations by FGMI personnel or contractors
2. Observations at or near the dam by government personnel (local, state, or Federal), landowners, visitors to the dam, or the public
3. Evaluation of instrumentation data
4. Earthquakes felt or reported in the vicinity of the dam
5. Forewarning of conditions that may cause an unusual event or emergency event at the dam (for example, a severe weather or flash flood forecast)

Unusual conditions are those conditions or situations different than the normal or expected condition of the dam and impoundment. These unusual conditions may indicate problems needing investigation or corrective measures or may indicate an emergency condition requiring emergency actions. Examples of unusual conditions include:

1. Surface cracking or deformation
2. Damp spots or unanticipated seepage that develops on or near the embankment
3. Significant changes in quantity or color of seepage flows from the seepage collection system
4. Sudden changes in piezometer readings

4.3.2 Emergency Level Determination

Table 4-1 Emergency Level

Level I	Non-Failure
Level II	Potential Failure Situation Developing
Level III	Imminent or Actual Failure in Progress

Level I Notification and Emergency Action Procedures

If the emergency condition is determined to be a “Non-failure” Emergency Condition then the notification sequence outlined in the Level I Notification Flowchart will be followed. This situation is not normal but has not yet threatened the operation or structural integrity of the dam, but possibly could if it continues to develop. The condition of the dam should be closely monitored, especially during storm events, to detect any development of a potential or imminent dam failure situation. Under this level, notification is limited to internal FGMI communication. Any notification of government agencies or the media will be based on the nature of the emergency condition and will be at the discretion of the General Manager working in conjunction with the Environmental Manager. Any reporting to government agencies will be prepared under the direction of the General Manager working in conjunction with the Environmental Manager.

Conditions that triggered the initial notification will be investigated, monitored, evaluated, and steps will be taken to correct the situation. Monitoring will be conducted daily until it is determined that the condition is under control and does not represent a threat to the safety of the dam. Investigations and studies will be planned and carefully designed to provide information that can be used to analyze and evaluate the

nature of the condition. Measures to correct the condition will be based on sound engineering and cost effective techniques.

Level II Notification and Emergency Action Procedures

If the emergency condition is determined to be a “Potential Failure Situation Developing” then the notification sequence outlined in the Level II Notification Flowchart will be followed. This situation may eventually lead to dam failure and flooding downstream, but there is not an immediate threat of dam failure. This level expands the notification outside the FGMI organization and includes government agencies, such as the Department of Natural Resources and local emergency management organizations. Any notification of government agencies or the media will be based on the nature of the emergency condition and will be the responsibility of the General Manager working in conjunction with the Environmental Manager. Any reports to government agencies will be prepared under the direction of the General Manager working in conjunction with the Environmental Manager.

Conditions that triggered the initial notification will be investigated, monitored, evaluated, and steps will be taken to correct the situation. Monitoring will be conducted daily until it is determined that the condition is under control and does not represent a threat to the safety of the dam. Investigations and studies will be planned and carefully designed to provide information that can be used to analyze and evaluate the nature of the condition. Measures to correct the condition will be based on sound engineering and cost effective techniques.

Level III Notification and Emergency Action Procedures

If the emergency condition is determined to be an “Imminent or Actual Failure in Progress” then the notification sequence outlined in the Level III Notification Flowchart will be followed. This is an extremely urgent situation when a dam failure is occurring or obviously is about to occur and cannot be prevented. This level expands the notification outside the FGMI organization and includes government agencies, such as the Department of Natural Resources and local emergency management organizations and requires the initiation of the evacuation of the downstream floodplain, in accordance with the following:

1. Contact the Army Corps of Engineers
2. Contact the Emergency Services Department at Fort Wainwright
3. Contact the Northstar Borough
4. Contact State Dam Safety Office and begin any recommended procedures
5. Take preventive actions described in Section 7.0 of the Emergency Action Plan.

Any notification of government agencies or the media will be based on the nature of the emergency condition and will be the responsibility of the General Manager working in conjunction with the Environmental Manager. Any reports to government agencies will be prepared under the direction of the General Manager working in conjunction with the Environmental Manager. Classification of an Emergency Condition

Table 4-2 **-** Guidance for Determining the Emergency Level

Event	Situation	Emergency Level Notification
Spillway flow	Reservoir water surface elevation at spillway crest above low flow channel or spillway is flowing with no active erosion	1
	Spillway flow could result in flooding of people downstream if the reservoir level continues to rise	2
	Spillway flow is flooding people downstream	3
Embankment overtopping	Water level has encroached the freeboard	2
	Water level has encroached the freeboard and is rising flow over the dam is imminent. Water is flowing is over the top of the dam	3
Seepage	New seepage areas in or near the dam	1
	Increase in new or existing seepage rates. New or existing seepage have a cloudy discharge or increasing flow rate.	2
	Is the new or existing seepage cloudy and the discharge flow rate is rapidly increasing. Surface cracks are developing. Notable and unusual conditions are occurring.	3
Earthquake	Measurable earthquake felt or reported on or within 50 miles of the dam Earthquake resulting in uncontrolled release of water from the dam 3	1
	Earthquake resulting in visible damage to the dam or appurtenances	2
	Earthquake resulting in uncontrolled release of water from the dam	3
Embankment cracking	New cracks in the embankment less than ¼-inch wide without seepage	1
	New cracks in the embankment greater than ¼-inch wide without seepage	2
	Cracks in the embankment with seepage	3
Embankment movement	Visual movement/slippage of the embankment slope	1
	Sudden or rapidly proceeding slides of the embankment slopes	3
Instruments	Instrumentation readings beyond predetermined values	1
Sinkholes	Observation of new sinkhole in reservoir area or on embankment 2	2
	Rapidly enlarging sinkhole	3
Security threat	Verified bomb threat that, if carried out, could result in damage to the dam Damage to dam or appurtenances with no impacts to the functioning of the dam 1	2
	Detonated bomb that has resulted in damage to the dam or appurtenances	3
Sabotage/ vandalism	Damage to dam or appurtenance with no impacts to the functioning of the dam	2
	Modification to the dam or appurtenances that could adversely impact the functioning of the dam	2
	Damage to dam or appurtenances that has resulted in seepage flow	3
	Damage to dam or appurtenances that has resulted in uncontrolled water release	3

Section 5.0 - **REFERENCES**

[1] Fairbanks Gold Mining, Inc., “Walter Creek Valley Fill Heap Leach Project Description”, Fairbanks, Alaska, June 23, 2006.

[2] “Guidelines for Cooperation with the Alaska Dam Safety Program”, Alaska Department of Natural Resources, June 2005.

[3] Knight Piésold and Co., “Walter Creek Valley Fill Heap Leach Pad Design Report”, Denver, Colorado, April 2007.

[4] Knight Piésold and Co., “Fairbanks Gold Mining, Inc Walter Creek Valley Fill Heap Leach Facility Stage 3, 2011 Construction Completion Report”, Denver Colorado

[5] Knight Piésold and Co., “Walter Creek Valley Fill Heap Leach Pre-Feasibility Study Rev 0”, Denver Colorado, December 7, 2011.

[6] Knight Piésold and Co., “Walter Creek Valley Fill Heap Leach Pre-Feasibility Study Rev 3”, Denver Colorado, April 24, 2013

Section 6.0 - **LIST OF REVISIONS**

This revision log is included to provide the manual user with a description of the revisions made to the manual. The manual should be reviewed on at least an annual basis. If updates are necessary they should be made to the manual and a revised manual issued. The following revision log should be completed for each revision. It should include the revision number and date, as well as a description of the revision and the section number in the manual to which the revision was made. The revision number and date on the cover of the manual should be updated as well. Other than a file copy of the revised manual, outdated copies should be discarded and replaced with the latest revision.

REVISION LOG	
REVISION NUMBER AND DATE	**DESCRIPTION OF REVISIONS**
Revision 0 – September 2009	Initial issue of O&M Manual
Revision 1 – October 2010	Addition of Winter 2010/2011 operating levels Update / Clean up of inspection form Pump flow updates General editing
February 2011	Change in operating elevations with 9100 gpm pumping
Revision 2 - August 2011	Changes associated with increasing cyanide solution application rate Changes associated with increasing ore lifts
Revision 3 – March 2012	Changes associated with installing two solution collection wells, 16,000gpm pumping and general editing
Revision 4 – June 2013	Changes associated with the heap leach expansion and drawdown analysis. Appendix A Project data sheet will be revised as construction progresses.
Revision 5 – January 2014	Changes associated with the 2013 Periodic Dam Inspection and Stage 4 construction completion report. Updated EAP Plan. Updated Monthly Inspection Form.

Section 7.0 - **Acronyms and Abbreviations**

ADEC	Alaska Department of Environmental Conservation
ADNR	Alaska Department of Natural Resources
AGI	Amax Gold Inc.
AGP	Acid Generation Potential
ANP	Acid Neutralizing Potential
CIC	Carbon-In-Columns
COE	Corps of Engineers
DCS	Data Collection System
EPA	Environmental Protection Agency
FGMI	Fairbanks Gold Mining, Inc.
GCL	geosynthetic clay liner
HLP	Heap Leach Pad (Valley Fill)
HDPE	High Density Polyethylene
INCO	company name-patented cyanide destruction process
LCRS	Leachate Collection and Recovery System
LLDPE	Linear low density polyethylene
MHTLO	Mental Health Trust Land Office
OHMP	Office of Habitat & Permitting
OPT	Ounces per Ton
PCMS	Process Component Monitoring System
QA/QC	Quality Assurance/Quality Control
RTD	Resistance Temperature Device
TSF	Tailings Storage Facility
USFWS	United States Fish & Wildlife Service
USGS	United States Geological Service
WAD CN	Weak Acid Dissociable Cyanide

Appendix A

Project Data Sheets

Fort Knox Mine
WALTER CREEK VALLEY FILL HEAP LEACH PAD
PROJECT DATA SHEET

A. GENERAL

Dam Name	Fort Knox Walter Creek Leach Facility Dam	
NID Number	AK00310	
Hazard Potential Class	III	
Purpose	Heap leach Solution Storage	
Year Built	2008/2009	
Year Modified	Dam has not been modified	
Location	Latitude 65º00'N Longitude 147º20'W	
Reservoir Name	Walter Creek Heap Leach Facility In-heap Pond	
River or Creek Name	Walter Creek	
Owner	Fairbanks Gold Mining Inc. (FGMI)	
Owner Contact	General Manager	

B. DAM

Type	Membrane Faced Rockfill	
Core Type	LLDPE Geomembrane-Two Layers With LCRS Between	
Crest Length	1,000	feet
Crest Width	50	feet
Crest Elevation	1,653	feet
Crest Height (from d/s toe)	113	feet
Hydraulic Height	110.5 to spillway invert	feet
Capacity	Approximately 15 M (in ore pore spaces)	cubic feet

C. PRIMARY SPILLWAY N/A

Type		
Location		
Spillway Crest Elevation		feet
Top Width		feet
Bottom Width		feet
Length		feet
Discharge Capacity at Dam Crest		cfs

D. EMERGENCY SPILLWAY

Type	Overflow	
Location	North (left) abutment	
Spillway Crest Elevation	1,650.5	feet
Top Width	65	feet
Bottom Width	15	feet
Length	Approximately 50 (these dimensions are for concrete crest only)	feet
Discharge Capacity at Dam Crest	220	cfs

E. OUTLET WORKS

N/A – solutions removed by pumping from 5 sumps just upstream of dam

Type		
Location		
Inlet Invert Elevation		feet
Outlet Invert Elevation		feet
Diameter		inches
Length		feet
Outlet Type		
Discharge Capacity at Dam Crest		cfs

F. RESERVOIR

Normal Water Surface Elevation	Approximately 1,600 (water level at time of PDSI)	feet
Maximum Normal Storage Capacity (1)	210 (68.1 M gal) at water level 1629.8 ft	acre-feet
Maximum Normal Water Surface Elevation (1)	1,629.8	feet
Maximum Storage Capacity	370 (119.8 M gal) at water level 1653 ft (dam crest)	acre-feet
Maximum Surface Area at Dam Crest	31.27 at elev. 1653 ft. (this area is under the ore heap)	acres
Surface Area at Spillway Invert	30.14 at elev. 1,650.5 ft. (this area is under the ore heap)	acres

G. HYDROLOGY

Drainage Basin Area	0.3 (above the Stage 4 limits)	sq. miles
Average Annual Rainfall	16.5	inches
100 Year/24 Hour Rainfall (4)	4.14 (January rain on snow event)	inches
100 Year/24 Hour Flood	92 (29.9 M gal)	acre-feet
1/2 Probable Maximum Precipitation/24 Hour	5.5	inches
1/2 Probable Maximum Flood/24 Hour	217 based on a total catchment area of 20.6 M sf	acre-feet
Flood of Record	unknown	cfs
Inflow Design Flood		cfs

Appendix B

Heap Leach Pad – Inspection Forms

**********HEAP LEACH DEPARTMENT DAILY CHECKLIST**********

.

==========ORE HEAP AREAS==========

ARE THERE ANY INDICATIONS OF EROSION, SLOUGHING OR OTHER
MOVEMENT OF THE OVERLINER?

YES NO

.

ARE THE SOLUTION DISTRIBUTION LINES WORKING PROPERLY?

YES NO

.

THERE IS NO OR MINIMAL PONDING OF LEACH SOLUTION ON THE HEAP SURFACE?

YES NO

.

DESCRIBE ANY REPAIRS OR REVISIONS MADE TO THE ORE HEAP AND
OVERLINER OUTSIDE NORMAL OPERATIONS:

.

.

.

.

HAS ORE PLACEMENT ON THE OVERLINER DAMAGED THE OVERLINER?

YES NO

.

HAS THERE BEEN ANY WILDLIFE MORTALITY?

YES NO

.

IS THE ALKALINITY OF THE LEACHATE SOLUTION AT THE PROPER LEVEL? 10-12PH

YES NO PH _____

.

==========

==========IN-HEAP POND AREAS==========

IS THE SOLUTION LEVEL AT VIBRATING PIEZOMETER PAIR 9 AND 10 ABOVE
THE MINIMUM ELEVATION OF 1558 FEET TO PREVENT PUMP CAVITATION?

YES NO ELEV _____

.

IS THE SOLUTION LEVEL WITHIN THE NORMAL OPERATING POND RANGE
BETWEEN ELEVATIONS 1603 FEET AND 1625 FEET?

YES NO ELEV _____

.

=====DESCRIPTION AND REMEDIATION OF ANY EXCEEDANCE OF ANY SOLUTION LEVEL==

DESCRIBE THE EXCEEDANCE AND IT CAUSE.

.

.

DESCRIBE THE ACTIONS BEING TAKEN TO RETURN THE SOLUTION LEVELS TO
WITHIN THEIR NORMAL LIMITS.

.

.

==========SOLUTION COLLECTION SYSTEM==========

ANY DAMAGE TO THE SOLUTION COLLECTION PIPES?
YES NO
.
IS THERE ANY DEFICIENCY OF SOLUTION BEING RETURNED TO THE INCLINED OR VERTICA
SOLUTION COLLECTION WELLS THAT WOULD INDICATE THE SOLUTION COLLECTION SYST
IS NOT FUNCTIONING PROPERLY?
YES NO
.
==========COMPOSITE LINER SYSTEM==========
IS THERE ANY DAMAGE TO THE COMPOSITE LINER SYSTEM?
YES NO
.
==========LCRS==========
IS THE LCRS SOLUTION LEVEL BELOW ELEVATION 1554?
YES NO
.
DOES THE PUMPING RATE FOR THE DAY EXCEED THE MAXIMUM DESIGN
LEAKAGE RATE OF 520 GPM WITH THE POND IN THE NORMAL OPERATING RANGE?
YES NO
.
ARE THE LCRS PUMPS FUNCTIONING PROPERLY?
YES NO
.
DESCRIBE ANY REPAIRS OR MAINTENANCE OUT OF THE NORM.
.
.
.
.
HOW MANY GALLONS WERE PUMPED? WHAT WAS THE TOTALIZER READING?
.
.
==========DAM EMBANKMENT==========
*********CREST********
ANY SETTLEMENT?
YES NO
.
ANY MISALIGNMENT?
YES NO
.
ADEQUATE FREEBOARD?
YES NO
.
ANY CRACKING?
YES NO
.
CREST ROAD IN GOOD REPAIR?
YES NO

.
==========UPSTREAM SLOPE==========
IS THE OVERLINER IN GOOD REPAIR?
YES NO
.
ANY EROSION OR BREACHING?
YES NO
.
TREES OR BRUSH GROWING ON SLOPE?
YES NO
.
ANY BUDGING?
YES NO
.
VISUAL SETTLEMENT?
YES NO
.
ANY SINKHOLES?
YES NO
.
IS THE "V" DITCH IN GOOD REPAIR?
YES NO
.
==========DOWNSTREAM SLOPE==========
ADEQUATE SLOPE PROTECTION?
YES NO
.
ANY EROSION?
YES NO
.
TREES OR BRUSH GROWING ON SLOPE?
YES NO
.
ANIMAL BURROWS?
YES NO
.
VISUAL SETTLEMENT?
YES NO
.
SINKHOLES?
YES NO
.
SURFACE SEEPAGE?
YES NO
.
==========ABUTMENT & DOWNSTREAM OF TOE==========
ANY EROSION?

YES NO
.
SEEPAGE, WET OR MOIST AREAS PRESENT?
YES NO
.
BOILS OR SPRINGS DOWNSTREAM?
YES NO
.
BUDGING?
YES NO
.
CRACKNIG?
YES NO
.
==========SPILLWAY==========
ANY SETTLEMENT?
YES NO
.
ANY MISALIGNMENT?
YES NO
.
ANY CRACKING?
YES NO
.
ANY DETERIORATION OF CONCRETE INLET RIPRAP AND CHANNEL?
YES NO
.
ANY EXPOSED REINFORCEMENT IN THE CONCRETE?
YES NO
.
EROSION?
YES NO
.
SILT OR OTHER DEPOSITS IN THE CHANNEL?
YES NO
.
==========ENERGY DISSIPATION AT TOE==========
ANY EXCESSIVE EROSION AT TOE?
YES NO
.
********ACCESS ROAD**********
ANY SETTLEMENT?
YES NO
.
ANY EROSION OF WEARING COURSE?
YES NO
.

EASY ACCESS TO SPILLWAY?
YES NO
.
********PCMS HEADER OUTLET FLOW MONITORING**********
ANY FLOW IN THE PCMS HEADER FROM VALLEY 1,2, OR 3?
YES NO
.
ANY REPAIRS NEEDED TO PCMS HEADER FROM VALLEY 1, 2, OR 3?
YES NO
.
**********COMPOSITE LINER SYSTEM**********
IS THERE ANY DAMAGE TO THE COMPOSITE LINER SYSTEM?
YES NO
.
.
==========PIPELINE CORRIDOR==========
****GROUND SURFACE ALONG ALIGNMENT*****
ANY SETTLEMENT?
YES NO
.
ANY CRACKING?
YES NO
.
ANY MISALIGNMENT?
YES NO
.
ADEQUATE FREEBOARD?
YES NO
.
****PIPELINE*****
ANY FLOW FROM THE LINED PIPELINE CORRIDOR INDICATING LEAKAGE FROM
THE PIPES?
YES NO
****NOTE**** FLOWS ARE EXPECTED FOLLOWING RAINFALLS OR
SNOWMELT. IF FLOWS DO NOT REDUCE TO ZERO IN A REASONABLE TIME,
A WATER SAMPLE SHALL BE COLLECTED AND CHECKED FOR CN.******
ANY SETTLEMENT?
YES NO
.
ANY MISALIGNMENT?
YES NO
.
ANY CRACKING?
YES NO
.
********CONTROL STRUCTURES**********
MECHANICAL EQUIPMENT OPERABLE?

YES NO
********ACCESS ROAD**********
ANY SETTLEMENT?
YES NO
.
ANY EROSION OF WEARING COURSE?
YES NO
.
EASY ACCESS TO CORRIDOR?
YES NO
.
==========SURFACE WATER CONTROL SYSTEMS==========
*******DIVERSION CHANNELS**********
ANY SETTLEMENT?
YES NO
.
ANY CRACKING?
YES NO
.
ANY MISALIGNMENT?
YES NO
.
ANY DETERIORATION?
YES NO
.
EROSION?
YES NO
.
SILT OR OTHER MATERIAL IN CHANNEL?
YES NO
.
ANY ICE JAMS?
YES NO
.
*******CHANNEL DISCHARGES**********
ANY DETERIORATION?
YES NO
.
EROSION?
YES NO
.
*******CULVERTS**********
ANY DETERIORATION OR DAMAGE OF THE CULVERTS THEMSELVES?
YES NO
.
ANY BLOCKAGE?
YES NO

.
********ACCESS ROAD**********
ANY SETTLEMENT?
YES NO
.
ANY EROSION OF WEARING COURSE?
YES NO
.
EASY ACCESS TO CORRIDOR?
YES NO
.
==========LIME SILO==========
OK BAD TRAVELWAYS CLEAR OF DEBRIS
OK BAD STAIRS, GRATING, AND HANDRAILS
OK BAD LIGHTING
OK BAD ELECTRICAL ROOM
OK BAD EYE WASH STATION
OK BAD SILO TANK AND SUPPORTS
OK BAD LIME BUILD UP
OK BAD GUARDS
OK BAD SKIRTING
OK BAD PULLEYS
OK BAD ROLLERS
OK BAD CONVEYOR BELT AND CLIPS
OK BAD CONVEYOR MOTOR AND DRIVE COMPONENTS
OK BAD HOPPER, CLAMSHELL, AND HYDRAULICS
OK BAD MIRROR CLEAN
ROTARY VALVE SETTING : _____ MIN
.
CHECK LIME SILO FILL HOSES _____
.
==========VALVE ENCLOSURE==========
OK BAD DOOR ACCESS CLEAR
OK BAD HOUSEKEEPING, LIGHTS, AND HEATER ON
OK BAD PIPING AND VALVE LEAKS
OK BAD HEAT TRACE CONTROL BOX
PREG GPM:_____
BARREN GPM: _____ BARREN TEMP: _____

==========ELECTRICAL ENCLOSURE & GENERATOR ENCLOSURE========
OK BAD DOOR ACCESS CLEAR
OK BAD HOUSEKEEPING, LIGHTS, AND HEATER ON
OK BAD ENCLOSURE CONDITION
OK BAD HEAT TRACE CONTROL BOX
PREG MOTOR AMPS:
F27PP201_____ F27PP202 _____ F27PP203_____

==========PREGNANT PUMPS AND ENCLOSURES========
*******F27PP201***********

OK BAD DOOR ACCESS CLEAR
OK BAD HOUSEKEEPING, LIGHTS, AND HEATER ON
OK BAD HEAT, VIBRATION, AND NOISE
OK BAD PIPING AND VALVES

.

*******F27PP202***********

OK BAD DOOR ACCESS CLEAR
OK BAD HOUSEKEEPING, LIGHTS, AND HEATER ON
OK BAD HEAT, VIBRATION, AND NOISE
OK BAD PIPING AND VALVES

.

*******F27PP203***********

OK BAD DOOR ACCESS CLEAR
OK BAD HOUSEKEEPING, LIGHTS, AND HEATER ON
OK BAD HEAT, VIBRATION, AND NOISE
OK BAD PIPING AND VALVES

.

PREG PSI:_____

.

========== 5 S PAD ROUTE ==========:

LIME SILO

YES NO BROOM
YES NO SHOVELS
YES NO TWO LIME BUCKETS
YES NO LIME BARREL
YES NO ICE MELT
YES NO CLEANLINESS

COMMENTS :

.

.

VALVE ENCLOUSER

YES NO BROOM
YES NO DUST PAN
YES NO ICE MELT
YES NO CLEANLINESS

COMMENTS :

.

.

ELECTRICAL ENCLOUSER

YES NO BROOM
YES NO DUST PAN
YES NO ICE MELT
YES NO CLEANLINESS

COMMENTS :

.

DATE:_____

DAM EMBANKMENT

Item	Yes	No	Remarks
CREST			
1. Any settlement?			
2. Any cracking?			
3. Crest road in good repair?			
4. Any misalignment?			
5. Adequate Freeboard?			
UPSTREAM SLOPE			
1. Is overliner in good repair?			
2. Any erosion or beaching?			
3. Any trees or brush growing on slope?			
4. Any bulging?			
5. Any visual settlement?			
6. Any sinkholes?			
7. Is "V" ditch in good repair?			
DOWNSTREAM SLOPE			
1. Adequate slope protection?			
2. Any erosion ?			
3. Any trees or brush growing on slope?			
4. Any bulging?			
5. Any visual settlement?			
6. Any sinkholes?			
7. Any surface seepage?			
8. Are underdrains performing as anticipated?			
9. Any animal burrows?			
ABUTMENTS AND DOWN STREAM TOE			
1. Seepage, wet or moist areas present?			
2. Any erosion ?			
3. Boils or springs down stream?			
4. Any bulging?			
5. Any cracking?			
DESCRIBE ANY MAINTENANCE OR REPAIRS OUT OF NORM			

SPILLWAY

Item	Yes	No	Remarks
CREST			
1. Any settlement?			
2. Any cracking?			
3. Any misalignment?			
4. Any deterioration of concrete, riprap or channel?			
5. Any exposed reinforcement in the concrete?			
6. Any erosion?			
7. Silt or other deposits in channel?			
ENERGY DISSIPATION AT TOE			
1. Any excessive erosion?			

SURFACE WATER CONTROL SYSTEMS

Item	Yes	No	Remarks
DIVERSION CHANNELS			
1. Any settlement?			
2. Any cracking?			
3. Any misalignment?			
4. Any deterioration?			
5. Erosion?			
6. Silt orany other material in channel?			

SURFACE WATER CONTROL SYSTEMS CONT.

Item	Yes	No	Remarks
CHANNEL DISCHARGES			
1. Any deterioration?			
2. Erosion?			
CULVERTS			
1. Any deterioration or damge of the culverts themselves?			
2. Any blockage?			

Appendix C

Analytical Profile Chemistry

Analytical Profile II - Groundwater Inorganic Parameters

Major Ion Chemistry	Minor Ion Chemistry	Trace Ion Chemistry
Lab pH	*Arsenic	*Antimony
Lab Conductivity	Cyanide	*Barium
Temperature (field)	Total	*Bismuth
Turbidity	WAD	*Cadmium
Total Suspended Solids	Fluoride	*Chromium
Total Dissolved Solids	*Iron	*Copper
*Calcium	*Manganese	*Lead
*Magnesium	Nitrogen, Ammonia	*Mercury
*Potassium	Nitrate as Nitrogen	*Nickel
*Silicon	Nitrite as Nitrogen	*Selenium
*Sodium	Total Phosphorus	*Silver
Chloride	Sulfide	*Zinc
Sulfate	TPH	
Alkalinity (as CaCO3)		
Bicarbonate		
Total		
Calcium Hardness		
Magnesium Hardness		

* Dissolved

Appendix D

Emergency Action Plan

EMERGENCY ACTION PLAN

Revision 2

FORT KNOX TAILINGS DAM

NID ID#AK00212

WALTER CREEK HEAP LEACH PAD DAM

NID ID#AK00310

WATER SUPPLY DAM AND RESERVOIR

NID ID#AK00211

December 2013

Statement of Purpose

This Emergency Action Plan is a basic outline of the steps and measures that would be taken by Fort Knox Gold Mine, Inc. (FGMI) in the event of a Walter Creek Heap Leach (WHL), Water Supply Dam (WSR) or Tailings Storage Facility (TSF) emergency condition. This manual contains information and instructions necessary for FGMI to:

1. Protect lives and property if an emergency condition develops at a dam.
2. Prepare owners, operators, and emergency management personnel for an emergency event.
3. Detail the actions and measures that will be taken individuals and organizations that are responsible for responding to an emergency.
4. Facilitate the coordination and cooperation of the various emergency responders.

Additionally, this manual will be used in training emergency response personnel in emergency action procedures.

Section 1.0 - Communication Procedures

1.1 Emergency Communication Procedures

Communications of an emergency condition will follow the general outline presented in Figure 1.1-1.3. Appendix B is the Kinross Corporate notification tree. Additionally, communication of an emergency condition should consider the following recommendations and guidelines.

1.2 Internal Communications

In the event of an emergency condition, the FGMI employee should immediately report the conditions and then take appropriate precautionary and protective actions. Reports of unusual conditions should be as accurate and complete as possible. They should include at least:

1. A detailed description of the unusual condition
2. Time and date of the unusual condition
3. Any first response measures taken or planned
4. Assistance that may be needed
5. An estimate of the probable duration of the unusual condition

Reporting should also include the end of the unusual condition. If unusual conditions are such that downstream inhabitants or property owners will be, or are likely to be, threatened, they will be warned in accordance with the Fort Knox Emergency Response Plan.

Communications for on-site emergencies is coordinated through the Security Office, located in the Fort Knox administration building. Security has telephone and radio communication with mine personnel and the Fairbanks North Star Borough Division of Emergency Management Dispatch. The Fort Knox on-site emergency telephone number is **3333**. The off-site emergency assistance number is **911**.

Fort Knox Heap Leach crews utilize Channel 1 on the radios and the Fort Knox mine crews utilize Channel 2. The Technical Services department utilizes Channel 3 and the mill operations Channel 4. Channel 5 is reserved for Security. Any or all of these channels may be used for emergency communications. Security monitors all radio frequencies.

1.3 Communication with the Public

The General Manager working with the Community/Government Relations Manager and the Environmental Manager is responsible for the information released to the public.

1.4 Communication with Government Agencies

Upon implementation of contingency procedures to mitigate unusual or abnormal conditions a courtesy call will be made by the General Manager or his designated person-in-charge to the government stakeholders listed below. The purpose of the call is an appraisal of the situation and that contingency procedures have been initiated and periodic updates will continue until the situation is back to normal.

US Army Corps of Engineers
Tim Feavel (Chena Project Manager)
W: 907-488-2748
C: 907-322-0267
Jake Kresel (Senior Ranger)
W: 907-488-2748
C: 907-322-2657
Charles Abbott (Dam Tender)
W: 907-488-2748
C: 907-322-2866

Fort Wainwright CBRNE Ops
(907) 353-9436

Fairbanks North Star Borough
Division of Emergency Management
(907) 459-1481
After Hours (907) 479-2001

Alaska Department of Environmental Conservation
Spill Response Division
(907) 451-2121
After Hours 1-800-478-9300

Alaska Department of Natural Resources
Division of Mining & Water Management
Dam Safety Section
(907) 269-8636

Figure 1.1 Level 1 Notification

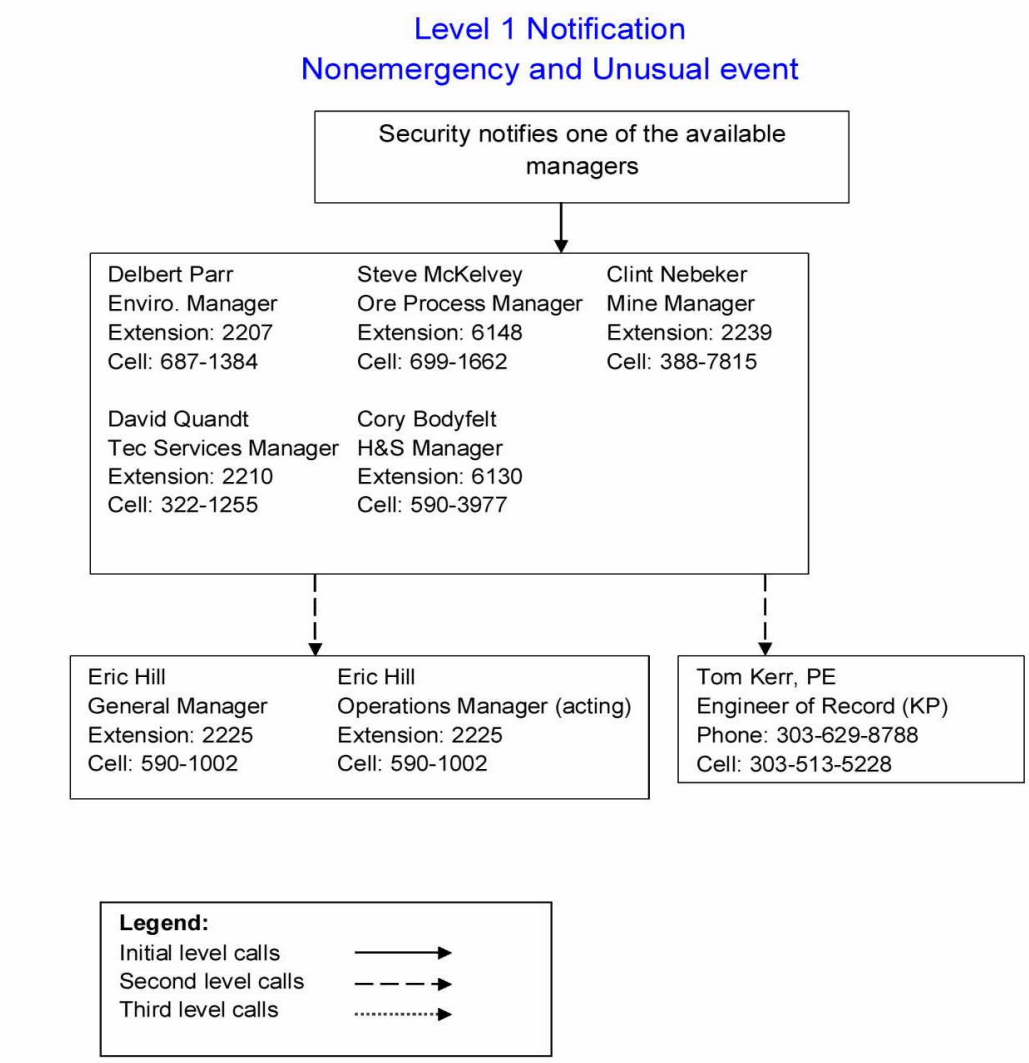


Figure 1.2 Level 2 Notification

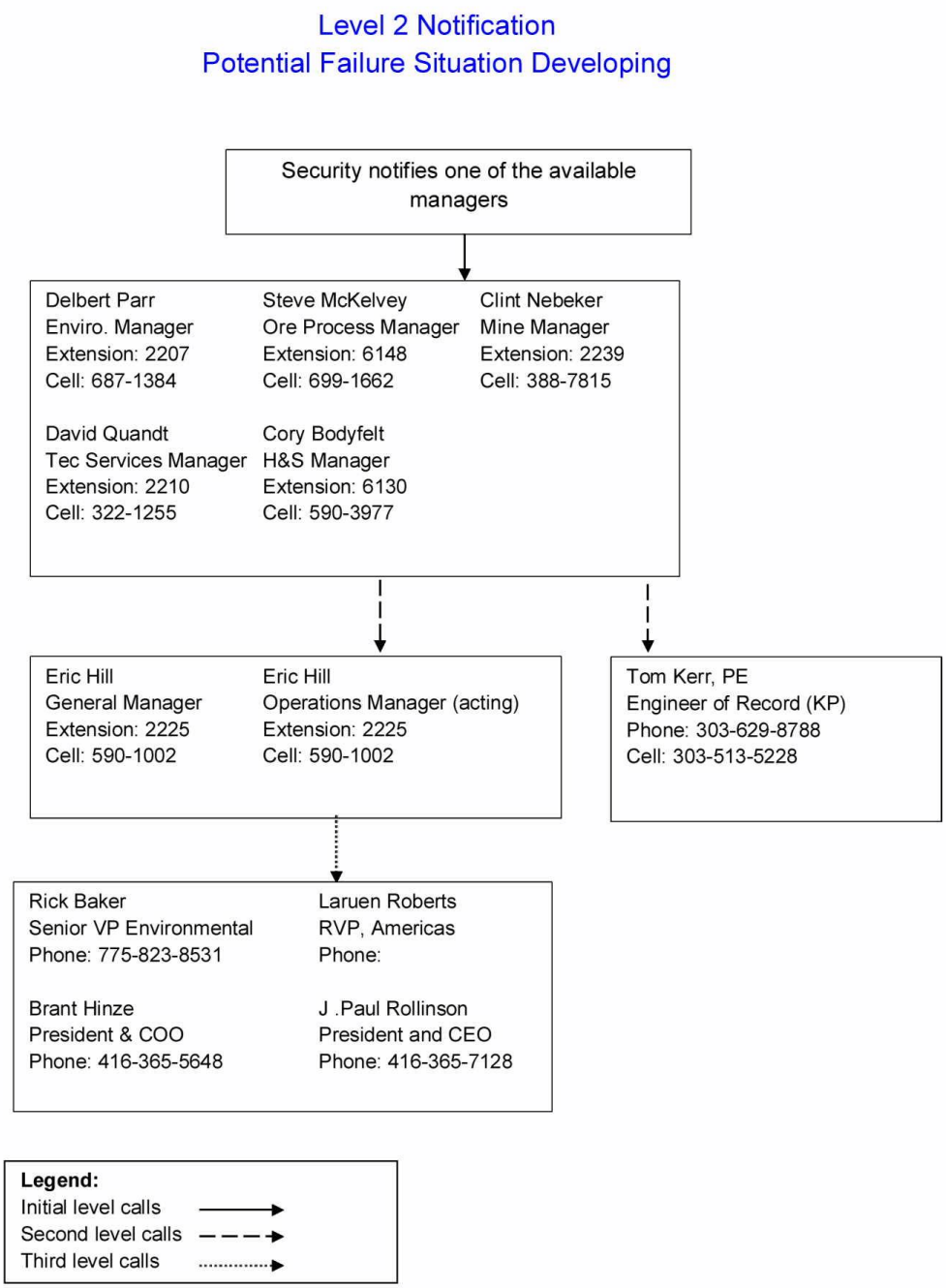
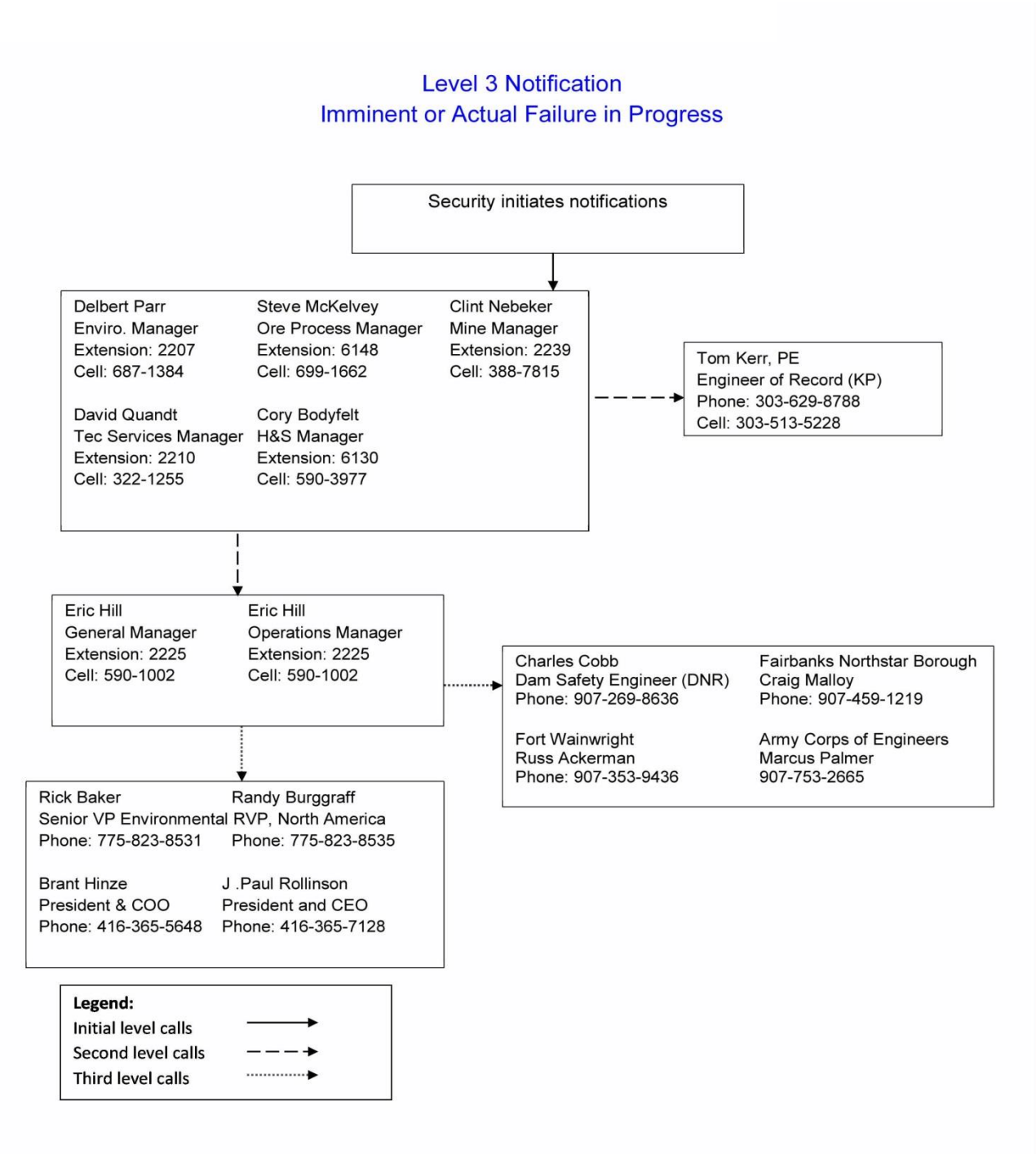


Figure 1.3 Level 3 Notification



Section 2.0 - Introduction

2.1 Location

The Fort Knox Mine is owned and operated by Fairbanks Gold Mining, Inc. (FGMI), a wholly owned subsidiary of Kinross Gold USA, Inc. The Fort Knox Mine is located in the Fairbanks North Star Borough, approximately 26-road miles northeast of Fairbanks, Alaska. Access to the site is obtained by driving north from Fairbanks via the Steese Highway to the town of Fox (approximately ten miles) and then traveling northeast on Steese Highway for approximately 10 miles to Cleary Summit. At the top of Cleary Summit traveling southeast on the unpaved Fairbanks Creek Road, Fish Creek Road, and finally the Fort Knox Road for approximately six miles to the site.

The Fort Knox Mine is located in portions of Sections 8-17, 20-23, and 26-27, Township 2 North Range 2 East and Sections 7-8 and 17-19, Township 2 North, Range 3 East, Fairbanks Meridian. The Water Supply Reservoir is located in the Fish Creek Valley, below the confluences of Solo Creek and Last Chance Creek within the southwest quarter of Section 17, T2N, R3E, Fairbanks Meridian.

2.2 General Information

Site Mailing Address
Fort Knox Mine
P.O. Box 73726
Fairbanks, Alaska 99707-3726
(907) 488-4653
Fax (907) 490-2290

Site Physical Address
#1 Fort Knox Road
Fairbanks, Alaska 99712

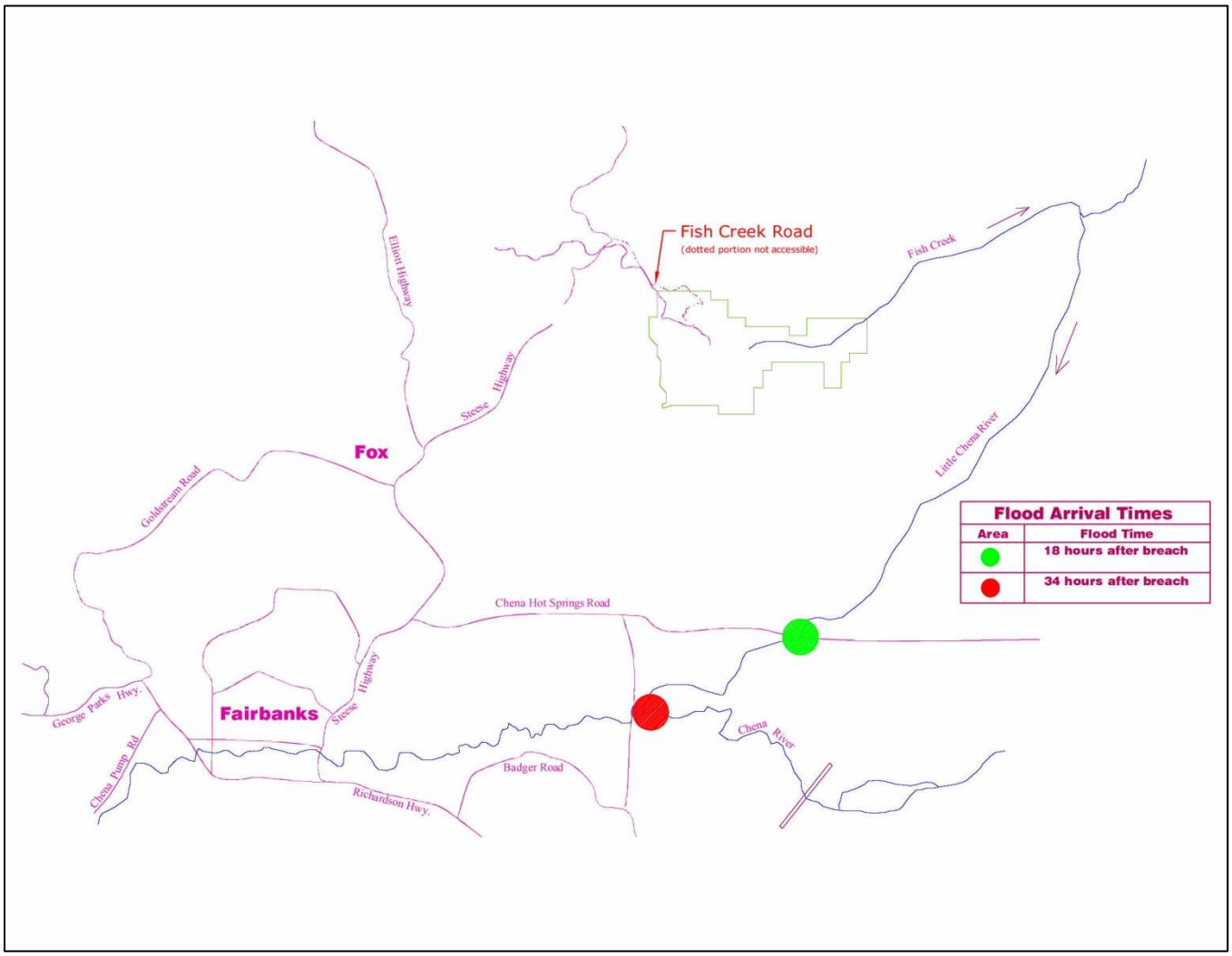
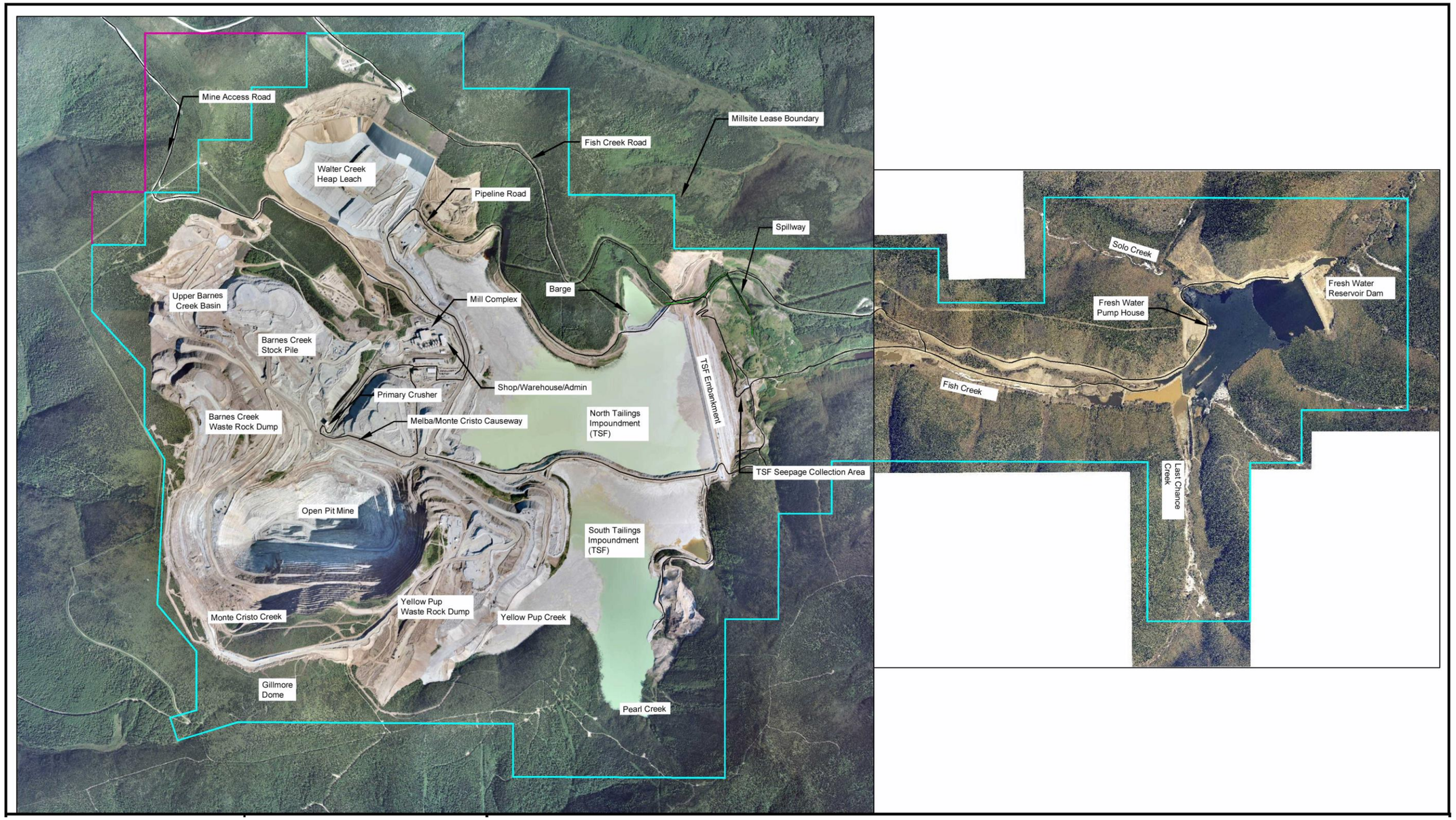


Figure 2.1: Location of Fort Knox Mine

Figure 2.2 - Fort Knox General Arrangement



Section 3.0 - Facility/Project Descriptions

There are three dams Fort Knox Mine owns and operates under the approval of the State of Alaska.

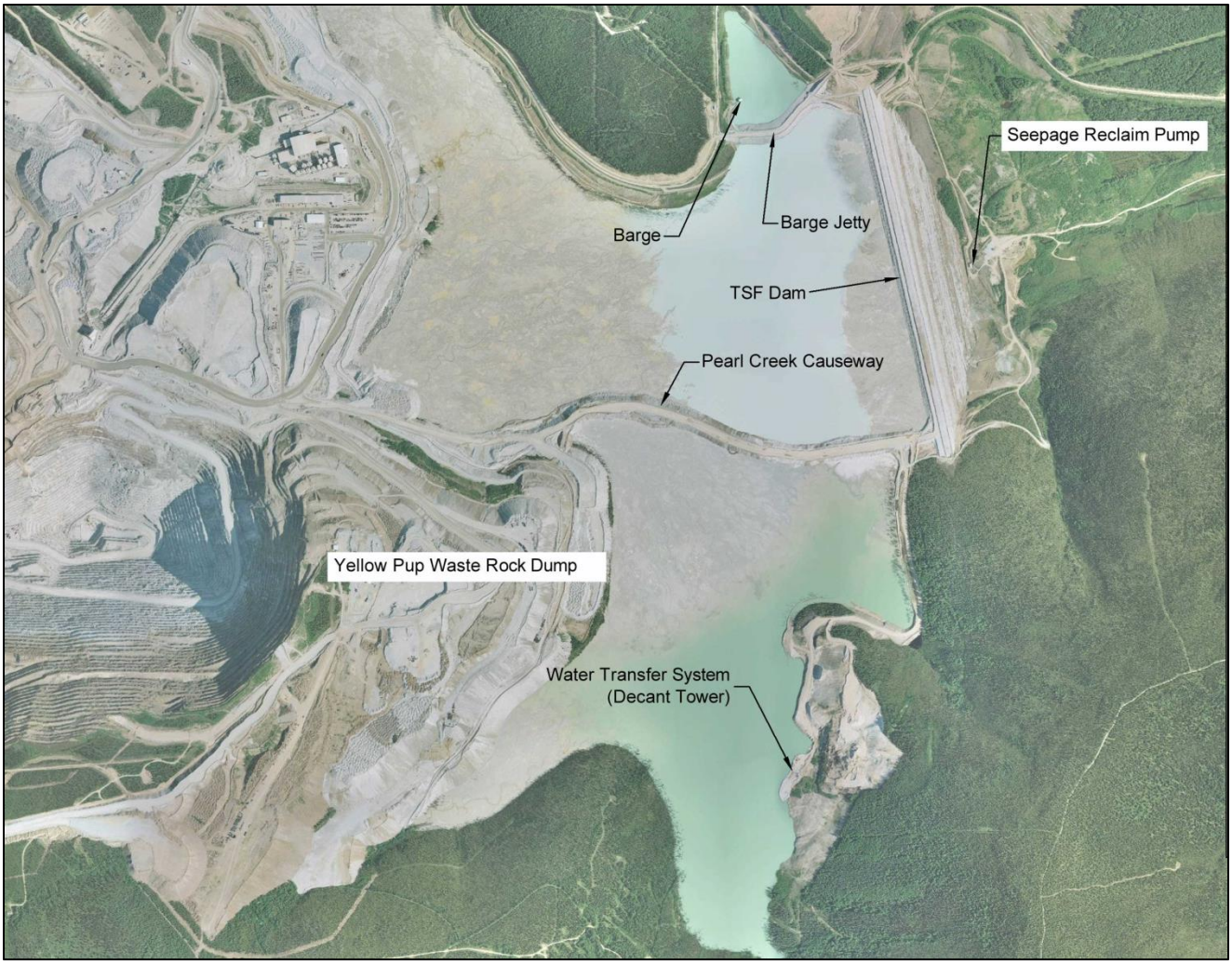
- Fort Knox Tailings Dam, Class II
  NID ID#AK00212
- Walter Creek Heap Leach Pad Dam, Class III
  NID ID#AK00310
- Water Supply Dam and Reservoir, Class III
  NID ID#AK00211

3.1 Tailings Storage Facility

The TSF is a zero-discharge impoundment incorporating a typical cross-valley type, zoned, earthfill/rockfill structure. The current facility with a dam crest elevation of 1,515 fmsl has the capacity to store 299 million tons of tailing together with a maximum 6,600 ac-ft operational pond, runoff from a 100 year/24 hour storm event (defined as 4.3 inches of rain on snow occurring in the month of January and contributing 1,238 ac-ft) and an outflow of 680 ac-ft from the Walter Creek Heap Leach Facility (the capacity of the in-heap pond) while maintaining a freeboard of 3 feet.

The facility can also store runoff from the PMF (3,311 ac-ft) together with the 6,600 operational pond and the 680 ac-ft from the Walter Creek Heap Leach Facility above these tailing tonnages with encroachment into the 3 feet of freeboard but without overtopping the dam.

Figure 3.1: Aerial View of TSF



3.1.1 Embankment

Center of the TSF embankment is located at approximately 65°00'05"N and 147°17'53"W. The tailing dam is an engineered-fill embankment.

The height above the downstream toe of the dam is 341 feet corresponding to the dam seal crest elevation of 1515 amsl. The downstream face of the embankment has a slope of 1.8H:1V and the upstream face has a slope of 2.25H:1V to elevation 1,443 feet, where it changes to 2.78:1 to the ultimate embankment crest. There are four to six vertical feet of frost protection cap over the seal, transition, and filter zones.

The embankment contains a relatively impervious seal zone constructed of highly weathered schist. Sand filter zones are located upstream and downstream of the seal zone, followed by a downstream transition zone constructed of weathered schist. Upstream and downstream random rock fill zones complete the embankment cross section. The upstream face has a riprap layer for wave erosion protection

Additional features include a gravel drain incorporated into the downstream toe of the embankment, a water interceptor system, and seepage reclaim sump and pump system to return seepage to the tailing pond.

Design of the embankment included an assessment of its stability and potential deformation resulting from earthquake loading. Based on an updated seismic hazard assessment of the site, the design earthquakes are:

- Operational Basis Earthquake (no disruption to operations) – M=6.5 with return period

  1,000 years producing a peak ground acceleration of 0.27 g at the site

- Maximum Design Earthquake (no loss of containment but disruption to operations permitted) – M=7.5 with return period 10,000 years and Maximum Credible Earthquake producing a peak ground acceleration of 0.63 g at the site

There are a total of 40 functioning vibrating wire piezometers. The cables for the original 18 functioning piezometers terminate in the seepage collection sump building located near the center of the downstream toe of the embankment. The remaining piezometers are read by manually dialing a multiplexer to the appropriate channel. Readings indicate frequency and temperature at the piezometer. The frequency and temperature readings are recorded and used to calculate the hydrostatic pressure (head) in feet of water.

3.1.2 Tailing Discharge Lines

Three, 24-inch diameter, HDPE, tailing discharge lines, designed to handle 50,000 tons per day (in combination) of solids, have been installed to carry tailing material from the mill to the impoundment. Tailing slurry from the cyanide detox building can be directed to either of these lines, depending on maintenance requirements, season, and depositional objectives.

3.1.3 Barge and Pipeline

The pump barge is located at approximately 65°00'25"N and 147°18'36"W. A floating barge located in the northeast corner of the tailing pond is used to pump water from the tailing pond to the mill. The barge is equipped with four, 400 hp pumps pumping at approximately 8,900 gpm. Pumping is on an as need basis with the pumping controlled either by radio telemetry from the mill or manually by the Mill Operator. Automatic and manual drain valves allow the entire reclaim pipe line to be drained during power outages, maintenance, and barge relocations.

3.1.4 Seepage Collection System

The seepage moves through the fractured bedrock and is captured by a large lined sump at the downstream toe of the tailings dam. An interceptor system consisting of a series of drains and wells is designed to capture any seepage that is not captured by the sump to maintain the zero-discharge status of the facility. The seepage water from the interceptor system is pumped to the lined sump at the toe of the dam. The interceptor system consists of a series of 12 pump-back wells and a dedicated drain immediately downgradient of the tailings dam. Water from the sump is pumped back to the tailings impoundment. Seepage is currently pumped back to the tailings impoundment at a rate of 1,700 to 1,800 gpm. The seepage reclaim system is designed to accommodate a maximum seepage flow of 12,200 gpm.

The seepage collection sump is located at the base of the tailings dam, at approximately 65º00'06"N and 147º17'36"W and consists of two 63-inch diameter by 50-feet long, perforated HDPE pipes set vertically. Two 450-hp pumps vertical turbine pumps, one set on top of each pipe, pump seepage back to the tailing pond. Pumps are started and stopped by a level controller with one pump providing backup to the other.

3.1.5 Barge Jetty

The barge jetty is located at approximately 65°00'20"N and 147°18'26"W. The jetty is designed as flow-through, homogeneous, rockfill structure. Its purpose is to act as a barrier to prevent slimes and fines from entering the barge area and an additional route to cross the northeast section of the TSF.

3.2 Walter Creek Heap Leach Pad Dam

The Walter Creek Valley Fill Heap Leach Pad (HLP) is a gold heap leach pad located in the upper end of the Walter Creek drainage immediately upstream from the Fort Knox tailing impoundment facility. Run-of-mine ore from the Fort Knox pit and material from low grade stockpiles is stacked in the lined containment area located behind and above the in-heap storage embankment constructed in the upper reaches of the Walter Creek drainage

3.2.1 Embankment

The heap embankment is located at approximately 65°00'45"N and 147°20'46"W. The completed in-heap storage embankment has a crest width of 50 feet at Elevation 1653 feet, and the downstream toe is at approximately Elevation 1540 feet. Thus, the overall height for the in-heap storage embankment is 113 feet. On the upstream side of the in-heap storage embankment from the upstream toe to the crest, the in-heap storage embankment has a height

of 100 feet. The exterior slope of the in-heap storage embankment is 2.5:1 minimum slope, and the interior slope is 3:1 slope. The embankment is a Hazard Class III structure with a design earthquake comprising a 975-year event of magnitude 7.5 and peak horizontal ground acceleration of 0.26g.

On the downstream face of the embankment, a 30-foot-wide pipeline bench was constructed along the southwest abutment to the northwest abutment. The bench carries a pipeline and access road across the Walter Creek valley. The in-heap embankment is a 50-foot-wide bench that provides access along the top level of the base platform and to one of the underdrain monitoring wells. Two dewatering wells are installed in the interface to direct heap underdrain to pump water to the TSF.

3.2.2 Spillway

The spillway was constructed on the north side of the in-heap storage embankment to accommodate emergency overflow from within the facility. The spillway has been designed to pass the peak flow from the 100-year/24-hour storm event (220 cubic feet per second [cfs]) with 1 foot of freeboard. The spillway invert was constructed 2.5 feet below the embankment design crest at elevation 1651.5 feet. The spillway invert was constructed at the design elevation, although the actual dam crest was constructed 1 foot higher than the design elevation at 1654 feet. The spillway section through the embankment crest was constructed with reinforced concrete and has a 15-foot bottom width with 10:1 side-slopes to allow drive-through traffic across the crest.

The reinforced concrete spillway directs any overflows to the downstream TSF via the riprap-lined spillway channel, Approximately 350 feet down the embankment emergency spillway channel, it transitions into three 36-inch-diameter solid CPT (Type S) culverts placed beneath the pipeline access road, where it conveys the flows to the surface of the TSF located near the valley floor.

3.3 Water Supply Dam and Reservoir

The WSDR for the Fort Knox Project provides water storage for mill makeup water and other fresh water uses at the mine

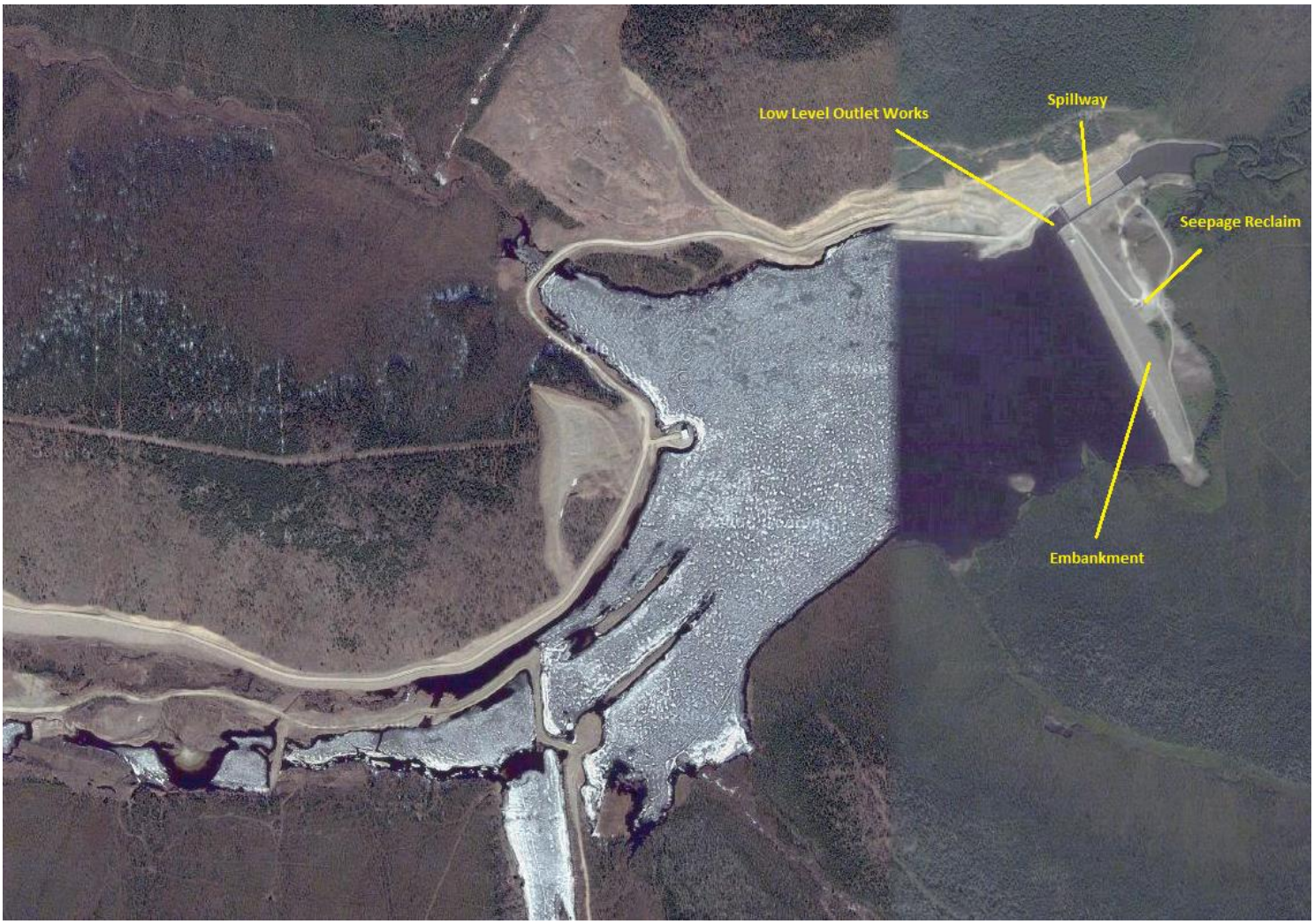


Figure 3.2: Aerial View of WSD&R

3.3.1 Embankment

Center of the embankment is located at approximately 65°00'28"N and 147°11'54"W. The dam is a zoned fill embankment. The embankment was built to a crest elevation of 1,038 feet, with a seal zone crest elevation of 1,031 feet. The height from downstream toe to crest is 70 feet; however the maximum structural height from bedrock is approximately 110 feet. The downstream face of the embankment has a slope of 1.8H:1V and the upstream face has a slope of 2.25H:1V to elevation 1,015 feet, where it breaks to 3.8H:1V to the embankment crest. The crest length of the embankment is approximately 1,550 feet.

The embankment contains a relatively impervious seal zone constructed of highly weathered schist. Sand filter zones are located upstream and downstream of the seal zone, followed by upstream and downstream transition zones constructed of weathered schist. Upstream and downstream random rockfill zones complete the embankment cross section. The upstream face

Additional features of the embankment include a grout curtain, installed in the bedrock below the seal zone cutoff trench, and a gravel drain incorporated into the downstream toe of the embankment. The toe drain is directed to a sump to collect seepage passing through the embankment for recycling back to the reservoir, if required.

Design of the embankment included an assessment of its stability and potential displacement resulting from earthquake loadings. The design took into account an earthquake inducing horizontal acceleration of 0.27 g.

3.3.2 Spillway

Center of the spillway is located at approximately 65°00'36"N and 147°11'59"W. An open channel spillway, with a crest elevation of 1,025 feet, allows flow above the 3,500 acre-feet capacity to exit the reservoir. The spillway has a crest width of 106 feet, with a design flood depth of 8 feet. Incorporated in the spillway is a low flow channel sized to confine a base flow of up to 10 CFS. The low flow channel was included to reduce the buildup of ice in the spillway chute during winter months.

The spillway is designed to handle one-half of the Probable Maximum Flood (1/2 PMF). The ½ PMF is estimated at 8,334 CFS, emanating from the entire upstream watershed, including the area above the tailing dam.

The spillway provides for 8 feet of flood rise at the spillway, which equates to 1,600 acre-feet of surge capacity. An additional 6 feet of embankment height is provided for frost protection of the seal zone. This provides an additional 1,300 acre-feet of emergency surge storage. In the event that additional outflow capacity is required, the low-level outlet is capable of passing approximately 120 CFS under full head conditions.

3.3.3 Low-level Outlet Works

The low level outworks are located at approximately 65°00'34"N and 147°12'04"W. A low-level outlet system is provided for drainage of the reservoir, for maintenance or repairs, and can provide additional drainage in emergency situations. The low-level outlet works was designed according to United States Corps of Engineers (USCOE) criteria, which requires the system to have the capability of reducing the reservoir water level, over a period of 4 months, to a volume equal to one-tenth the design volume, or to within 20 feet of the pre-construction maximum flow elevation, whichever is lesser.

The low-level outlet works consists of a primary valve, on the upstream end of the 30-inch outlet pipe. The sluice gate valve is operated by a manual control in the control house located along the dam crest. A secondary valve, a knife gate valve, is located at the end of the outlet pipe in the spillway chute wall. The secondary valve is manually controlled and is normally to be left open and locked.

The low-level outlet works has an inlet invert elevation of 987.5 feet, which would impound a volume of approximately 300 acre-feet. The maximum capacity of the low-level outlet works is approximately 120 CFS at full pool elevation (1,025 feet). Manual operation of an upstream gate

valve is necessary in order to activate the low-level outlet. Outflow is discharged to the spillway channel and outflow energy is dissipated in the spillway stilling basin.

3.3.4 Seepage Reclaim System

The dam incorporates a toe drain to collect seepage and divert it to a collection sump along the downstream toe. Seepage may either flow into Fish Creek, or may be pumped back to the reservoir.

The collection system consists of a 54-inch-diameter perforated HDPE sump connected to the toe drain by drainage gravel and 12-inch-diameter perforated HDPE pipe. The sump is located at approximately 65°00’30”N and 147°11’50”W A pump can be located in the sump to return seepage back to the reservoir. When pumping is not required, the sump overflow pipe allows seepage to drain into a layer of gravels and then on to Fish Creek.

The seepage reclaim system is designed to accommodate a maximum seepage flow of 1,400 gpm. Seepage flows are normally less than this amount.

Section 4.0 - Emergency Detection, Evaluation and Classification

4.1 Event Detection

This step describes the detection of an unusual or emergency event and provides information to assist the Dam Operator in determining the appropriate emergency level for the event. Unusual or emergency events may be detected by:

1. Observations by FGMI personnel or contractors
2. Observations at or near the dam by government personnel (local, state, or Federal), landowners, visitors to the dam, or the public
3. Evaluation of instrumentation data
4. Earthquakes felt or reported in the vicinity of the dam
5. Forewarning of conditions that may cause an unusual event or emergency event at the dam (for example, a severe weather or flash flood forecast)

Unusual conditions are those conditions or situations different than the normal or expected condition of the dam and impoundment. These unusual conditions may indicate problems needing investigation or corrective measures or may indicate an emergency condition requiring emergency actions. Examples of unusual conditions include:

1. Surface cracking or deformation
2. Damp spots or unanticipated seepage that develops on or near the embankment
3. Significant changes in quantity or color of seepage flows from the seepage collection system
4. Sudden changes in piezometer readings

4.2 Emergency Level Determination

Table 4-1: Notification Level

Level I	Non-Failure
Level II	Potential Failure Situation Developing
Level III	Imminent or Actual Failure in Progress

4.2.1 Level I Notification and Emergency Action Procedures

If the emergency condition is determined to be a “Non-failure” Emergency Condition then the notification sequence outlined in the Level I Notification Flowchart will be followed. This situation is not normal but has not yet threatened the operation or structural integrity of the dam, but possibly could if it continues to develop. The condition of the dam should be closely monitored, especially during storm events, to detect any development of a potential or imminent dam failure situation. Under this level, notification is limited to internal FGMI communication. Any notification of government agencies or the media will be based on the nature of the emergency condition and will be at the discretion of the General Manager working in conjunction with the Environmental Manager. Any reporting to government agencies will be prepared under the direction of the General Manager working in conjunction with the Environmental Manager.

Conditions that triggered the initial notification will be investigated, monitored, evaluated, and steps will be taken to correct the situation. Monitoring will be conducted daily until it is determined that the condition is under control and does not represent a threat to the safety of the dam. Investigations and studies will be planned and carefully designed to provide information that can be used to analyze and evaluate the nature of the condition. Measures to correct the condition will be based on sound engineering and cost effective techniques.

4.2.2 Level II Notification and Emergency Action Procedures

If the emergency condition is determined to be a “Potential Failure Situation Developing” then the notification sequence outlined in the Level II Notification Flowchart will be followed. This situation may eventually lead to dam failure and flooding downstream, but there is not an immediate threat of dam failure. This level expands the notification outside the FGMI organization and includes government agencies, such as the Department of Natural Resources and local emergency management organizations. Any notification of government agencies or the media will be based on the nature of the emergency condition and will be the responsibility of the General Manager working in conjunction with the Environmental Manager. Any reports to government agencies will be prepared under the direction of the General Manager working in conjunction with the Environmental Manager.

Conditions that triggered the initial notification will be investigated, monitored, evaluated, and steps will be taken to correct the situation. Monitoring will be conducted daily until it is determined that the condition is under control and does not represent a threat to the safety of the dam. Investigations and studies will be planned and carefully designed to provide information that can be used to analyze and evaluate the nature of the condition. Measures to correct the condition will be based on sound engineering and cost effective techniques.

4.2.3 Level III Notification and Emergency Action Procedures

If the emergency condition is determined to be an “Imminent or Actual Failure in Progress” then the notification sequence outlined in the Level III Notification Flowchart will be followed. This is an extremely urgent situation when a dam failure is occurring or obviously is about to occur and cannot be prevented. This level expands the notification outside the FGMI organization and includes government agencies, such as the Department of Natural Resources and local emergency management organizations and requires the initiation of the evacuation of the downstream floodplain, in accordance with the following:

1. Contact the Army Corps of Engineers
2. Contact the Emergency Services Department at Fort Wainwright
3. Contact the Northstar Borough
4. Contact State Dam Safety Office and begin any recommended procedures
5. Take preventive actions described in Section 6.1 of this plan

Any notification of government agencies or the media will be based on the nature of the emergency condition and will be the responsibility of the General Manager working in conjunction with the Environmental Manager. Any reports to government agencies will be prepared under the direction of the General Manager working in conjunction with the Environmental Manager. Classification of an Emergency Condition

Table 4-2 Guidance for Determining the Emergency Level

Event	Situation	Emergency Level Notification
Spillway flow	Reservoir water surface elevation at spillway crest above low flow channel or spillway is flowing with no active erosion	1
	Spillway flow could result in flooding of people downstream if the reservoir level continues to rise	2
	Spillway flow is flooding people downstream	3
Embankment overtopping	Water level has encroached the freeboard	2
	Water level has encroached the freeboard and is rising flow over the dam is imminent. Water is flowing is over the top of the dam	3
Seepage	New seepage areas in or near the dam	1
	Increase in new or existing seepage rates. New or existing seepage have a cloudy discharge or increasing flow rate.	2
	Is the new or existing seepage cloudy and the discharge flow rate is rapidly increasing. Surface cracks are developing. Notable and unusual conditions are occurring.	3
Earthquake	Measurable earthquake felt or reported on or within 50 miles of the dam	1
	Earthquake resulting in visible damage to the dam or appurtenances	2
	Earthquake resulting in uncontrolled release of water from the dam	3
Embankment cracking	New cracks in the embankment less than ¼-inch wide without seepage	1
	New cracks in the embankment greater than ¼-inch wide without seepage	2
	Cracks in the embankment with seepage	3
Embankment movement	Visual movement/slippage of the embankment slope	1
	Sudden or rapidly proceeding slides of the embankment slopes	3
Instruments	Instrumentation readings beyond predetermined values	1
Sinkholes	Observation of new sinkhole in reservoir area or on embankment	2
	Rapidly enlarging sinkhole	3
Security threat	Verified bomb threat that, if carried out, could result in damage to the dam	2
	Detonated bomb that has resulted in damage to the dam or appurtenances	3
Sabotage/ vandalism	Damage to dam or appurtenance with no impacts to the functioning of the dam	2
	Modification to the dam or appurtenances that could adversely impact the functioning of the dam	2
	Damage to dam or appurtenances that has resulted in seepage flow	3
	Damage to dam or appurtenances that has resulted in uncontrolled water release	3

4.3 Conditions and Evaluation

The potential emergency conditions or unusual occurrence are reviewed in this section. Section 7 identifies preparedness measures to mitigate the effects of the emergency conditions.

4.3.1 Extreme Runoff from Rainfall or Snowmelt

On a heavy rain warning from the National Weather Service, the water level in the impoundment and reservoir will be monitored closely and facilities will be maintained as necessary during the event.

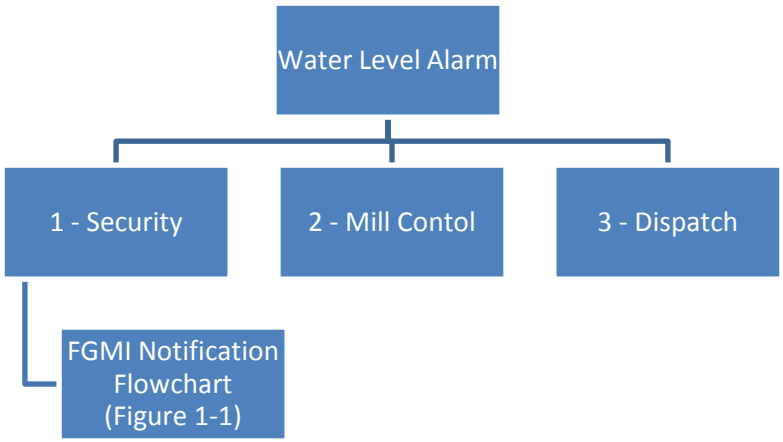
After any major storm or thaw runoff event, a thorough inspection of all ditches, culverts, ponds, and other water-related facilities will be completed. Necessary repairs will be completed as soon as is reasonably possible to reduce the chance of additional damage during subsequent storm events.

FGMI has recently installed a water level gauge (data logger and satellite transmitter) at the Freshwater Reservoir. Its purpose is to provide notification to the appropriate individuals in the event of a significant change in water level.

The gauge has been programmed for two outgoing messages. One will be a notification should water levels reach an elevation of 1027.5 feet (which corresponds to about a 40 year flood). The other will be a notification if the water level rises rapidly (any two successive one minute interval water level readings are more than 0.5 feet higher than the previous ten readings).

The system will follow the notification chart seen below (Figure 4-1). It will first call Security, who will be responsible for going down to the dam to assess the situation. Mill Control will receive the second call; they will send a pond operator down to assess the situation as well. The final call will be to Dispatch to notify them of the potential situation. The system will call each number twice to allow for missed calls. The system does not deal with voicemail or text. Additionally, e-mails will be sent out to individuals who subscribe to the alarm service.

Figure 4.1: Water Level Gauge Notification



If Security visibly notices a situation occurring at the dam, they will start the notification flow outlined in Figures 1.1-1.3. If there are no visible changes, the pond operators will check the piezometers and water depths to verify a false alarm.

Near real-time water level data can be viewed at:
http://waterdata.usgs.gov/ak/nwis/uv/?site_no=15502000&PARAmeter_cd=00065,00060

4.3.2 Increase in Seepage

Observations of water levels and flow rates on the piezometers, seepage reclaim sump, and interceptor and monitoring wells should be evaluated to determine if there are any significant changes in seepage rates associated with any of the dams. If an increase in seepage is detected, the flow will be examined to see if it is cloudy or clear and a determination of the reason for the increase in seepage will be made. Water quality analyses must also be performed to help determine the source of the water.

The identification of unanticipated seepage from the embankment abutments will be investigated, monitored, evaluated, and steps taken to control it. Monitoring will be conducted daily and will include visual inspection to determine if the water is clear or cloudy. Quantity measurements and water quality samples will be taken daily provided conditions are not prohibitive.

Measures to control the seepage will be based on planned investigations and studies. Investigations will be carefully designed to provide information that can be used to analyze and evaluate the nature of the seepage.

4.3.3 Earthquakes

Earthquakes are classified as insignificant, minor, or major, with regard to the Fort Knox dams. An inspection of the dams should be conducted by FGMI engineering and management following any minor or major seismic event. All geotechnical instruments will be read or surveyed. The Engineer of Record will be contacted and made aware of the occurrence and brought out to site if the situation warrants it. Instrumentation data will be provided. Special attention should be given the normal daily inspection for the same two week period. Any necessary repairs will be completed as soon as practical.

Table 4-3: Recognition & Action for a Seismic Event

Insignificant Magnitude 3.9 or less, epicenter near Fairbanks Modified Mercalli Intensity III or less at the dam	Recognition	Insignificant earthquakes are difficult to distinguish from the nearby operation of heavy equipment and normal blasting operations.
	Action	They require no special actions or inspections. Continue daily inspections and report any deformation or movement (cracking, slump, seep, etc.).
Minor Earthquakes Magnitude 4 or 5, epicenter near Fairbanks Modified Mercalli Intensity of IV or V at the dam	Recognition	Felt outdoors as well as indoors; liquids are disturbed; small objects are displaced; doors swing open or closed; pictures move.
	Action	Inspect all pipelines and the pump barge for rupture, leakage, or other obvious damage. Immediately inspect the main embankments (Heap Leach, Freshwater Reservoir and TSF), for obvious deformation or movement (cracking, slump, seep, etc.).If any sign of damage or increased leakage is observed, arrange for an inspection by the Engineer of Record. For a two week period after an earthquake classified as minor, the piezometers should be read daily by an Environmental Technician or Engineer. After data reduction, water levels should be graphically displayed on a summary graph to track any unusual changes piezometer readings.
Major Earthquakes Magnitude 6 or greater, epicenter near Fairbanks Modified Mercalli Intensity of VI or greater at the dam	Recognition	Difficulty standing; hanging objects quiver; masonry cracks; waves occur on ponds; some minor injuries occur.
	Action	Immediately stop the pumping of reclaim water and all process solutions if problems are discovered during the inspections. If safe to do so, immediately inspect the main embankments (Heap Leach, Freshwater Reservoir and TSF), for obvious deformation or movement (cracking, slump, seep, etc.). If safe to do so, immediately inspect all pipelines and the pump barge for rupture, leakage, or other obvious damage. For a two week period after an earthquake classified as minor or major, the piezometers should be read daily by an Environmental Technician or Engineer. After data reduction, water levels should be graphically displayed on a summary graph to track any unusual changes piezometer readings. Check the interceptor and monitoring wells for any indication of changes in ground water elevations. **Arrange for an immediate inspection by the Engineer of Record**

4.3.4 Slumping of the Embankment

Any slumping or abnormal deformation of the embankment at any time is to be reported to the Ore Processing Manager and the Environmental Manager. The location, extent, and size of the slump are to be reported, as well as the pond level and any flow or seepage associated with the slump. The Engineer of Record must also be contacted.

4.3.5 Unusual Instrument Readings

Initial instrument readings from piezometers and survey monuments must be compared with design limits to see any variation. Instrument readings when obtained will be compared with previous readings of the same instrument, as well as design limits. If the current readings differ significantly from previous readings taken under similar circumstances and conditions, the Results are to be reported as outlined in Table 4.2

4.3.6 Low Temperature

Prolonged periods of sub-zero temperatures may affect operation of the dams in a number of ways:

- Ice buildup in pipelines, resulting in partial or complete blockage.
- Ice buildup restricting or diverting inflows to pipes, culverts, and conduits.
- Thermal contraction of pipe work.
- Malfunction of valves, flow meters, and hour meters.

Features included to mitigate the effects of low temperatures include the following:

- Burial of pipelines wherever practical.
- Free-draining pipelines with drain valves at low points.
- Anchoring HDPE pipelines laid on grade.
- Thermal tracing of critical valves and pipelines.
- Backup electrical power.
- An operating adjustment that could further mitigate effects of low temperatures is to modify pumping rates to ensure continuous flow or batch flow in pipelines subject to freezing.

4.3.7 Avalanche or Debris Slide

No indications exist of natural avalanches or debris slides are of concern within the TSF, HLP or Fresh water reservoir However, operating personnel will always be alert to indications of slide movement such as the development of tension cracks or scarp faces on slopes, downhill movement of roads, pipelines, or other constructed elements, and the development of seepage at the base of slopes. In addition to debris slides, be alert of the potential sliding of the overliner on the LLDPE primary geomembrane of the heap leach.

4.3.8 Power Failure

The HLP is supplied with emergency backup power. In the unlikely event of primary and backup power loss, the ability to pump water to the mill would be interrupted, as well as heating and lighting. However, a power failure would have only a minor impact on the Fort Knox dams.

Barge

In the event of a power failure, emergency power would be available for the barge. If the mill is down, there would not be a need for large amounts of water. Emergency power would be used to keep the barge warm and keep the deicing system operating until full power was restored.

Under shutdown conditions, the line from the pump barge to the mill will remain full. In case of prolonged power failure during freezing conditions, this pipeline will drain automatically to avoid freezing. The Mill Operator should check to be certain that the valves on the pump barge actuate automatically allowing the pipe to drain. Drainage is not necessary during non-freezing conditions.

TSF Seepage Reclaim Pump

A loss of power to the seepage reclaim sump, generators would serve to temporarily power the pump. If a generator were to fail, it would result in a gradual rise in water level in the sump. However, the combined capacity of the sump and gravel underdrain in the embankment foundation is extremely large. A power failure for several days would not adversely affect functioning of the underdrain or interceptor wells (which discharge into the sump).

Under shutdown conditions, the line from the seepage reclaim sump to the high point above the north abutment of the tailing embankment will remain full. In case of prolonged power failure during freezing conditions, this pipeline will drain automatically to avoid freezing. The Mill Operator should check to be certain that the valves on the pipeline from the seepage reclaim sump actuate automatically allowing the pipe to drain. Drainage is not necessary during non-freezing conditions.

Interceptor Wells

A short (several hours) loss of power to the interceptor wells is not a problem since the cone of depression in the groundwater will last for several day. Since loss of flow in the pipelines from the interceptor wells to the seepage reclaim sump could result in frozen lines during extreme cold weather. Emergency power is available to restore pumping of the interceptor wells. The interceptor wells need to be pumped during power outages to maintain the mine's zero-discharge system, i.e. these pumps must operate to maintain an appropriate cone of depression in the ground water table below the tailing dam.

Heap Leach

A loss of primary and backup power to the in-heap storage pond would result in a gradual rise in water level in the pond. However, the capacity of the in-heap storage pond is sufficiently large enough to hold the solution from the 24- hour draindown. A power failure for 24-hours would not adversely affect integrity of the in-heap pond or HLP. The in-heap pond is designed to hold the solution from the 24-hour draindown. It is, however, necessary to operate the in-heap pond within the limits described in Section 3.3 in order to maintain the needed storage capacity for a power failure and to provide for operational options in the event of upset conditions. Since the design basis for the in-heap pond is the 24-hour draindown every reasonable effort must be made to restore the design pumping capacity as quickly as possible to maintain the design solution levels in the in-heap pond. Under normal shutdown conditions, the pregnant and barren pipelines will remain full. In case of prolonged power failure during freezing conditions, these pipelines have been installed on a slope to gravity drained back into the HLP in-heap pond area

to avoid freezing. The solution volume in these pipelines is insignificant relative to the in-heap pond volume.

4.3.9 Fire

Fire would have no significant impact on the TSF. However, the on-site electrical system (13.8 kV) and any pump could be temporarily impaired or lost in the event of fire. In the case of loss of the electrical system, generators would be required temporarily in the essential processes, until power was restored. In case of damage to any pump, temporary installations may be required to quickly reestablish water for operations until repairs are made to fixed installations.

Section 5.0 - Shutdowns and Closures

5.1 Short Term Shutdowns

5.1.1 Tailings Storage

Operational activities during a short term shutdown are influenced by the reservoir stage and the water balance. The TSF reservoir capacity and stage are closely monitored and compared to water balance during a shutdown.

The seepage reclaim pumps should remain operational during a shutdown (on automatic level control, if possible). However, these pumps may be left off for a day or more, if necessary, but should be operated so that water in the seepage collection sump is kept between 20 and 34 feet below the floor grate in the seepage collection building. These pumps are on an emergency power system that will allow pumping in the event of a power failure.

When freezing is a concern, the reclaim pipeline to the mill should be checked to verify that it has drained (or is draining) back in to the operational pool. The tailing discharge lines should be drained to prevent ice buildup.

5.1.2 Heap Leach

Operational activities during a short term shutdown of up to 24-hours are influenced by the levels in the in-heap storage pond and the water balance. The in-heap storage pond level must to be closely monitored and compared to design levels during a shutdown as follows:

Normal Operating Range
- Stage 4 – 1,629.8 feet
- Stage 5 – 1,625.8 feet
- Stage 6 – 1,620.9 feet
- Stage 7 – 1,617.3 feet

Appropriate steps such as removing and treating water must be taken to maintain the pond levels within the design limits.

The LCRS and PCMS outlet monitoring point must remain operational during a shutdown. The LCRS pump is on an emergency power system that will allow pumping in the event of a power failure.

When freezing is a concern, the pregnant and barren pipelines should be checked to verify that they have drained (or are draining).

5.2 Extended Shutdowns (several days to one month)

During extended shutdowns the seepage reclaim pumps and LCRS pumps must be kept operational (on automatic level control, if possible). These pumps are on an emergency power supply that allows them to remain operational in the event of a power loss. In addition, solution accumulation in the in-heap pond needs to be closely monitored and solution removed and treated to maintain the design solution levels.

5.3 Closures (one month to three years)

5.3.1 Tailings Storage

If a Temporary Closure is experienced or required, the operational pool may need to be drawn down. Possible measures will employ enhanced water consumption where possible and may include spraying process water onto the tailing beaches to promote evaporation or pumping process water into the pit.

During temporary shutdowns the seepage reclaim pumps must be kept operational (on automatic level control if possible). This may include using the emergency generators to provide temporary power or providing alternate pumps if the original pumps are for some reason inoperable.

5.3.2 Heap Leach

Solution accumulation in the in-heap pond needs to be closely monitored and solution removed and treated to maintain the design solution levels.

If a Temporary Closure is experienced or required, it may be necessary to draw down the In-heap Storage Pond. Possible measures may include enhanced evaporation programs.

During temporary shutdowns the LCRS pumps must remain operational (on automatic level control if possible). This may include using the emergency generators to provide temporary power.

Prior to shutting the operation down for a period of over one day the Engineer of Record must be contacted to evaluate the effect of the prolonged shutdown on the water balance.

5.4 Final Closure

Final reclamation will progress according to the “Fort Knox Project Reclamation Plan.”

Section 6.0 - General Responsibilities Under EAP

When an emergency condition is discovered or identified, the employee will conduct an initial evaluation of the situation to determine:

- If anyone is in danger
- Location of the condition
- Nature of the condition
- Equipment that may be needed
- Other relevant information

The employee will then contact his/her immediate supervisor and advise them of the emergency condition along with the information listed above

Follow-up procedures will consist of a more thorough inspection and evaluation of the emergency condition. The information collected will be used to further evaluate the condition and determine the appropriate Notification Level to implement. Table 6-1 lists the notification level for a specific type of emergency condition.

6.1 Incident Response Structure and Duties

The following is an incident response structure and duties assigned to departments and individuals which will provide guidance and management support to prevent and/or minimize the loss of lives and property as a result of any incident.

6.1.1 General Manager/Operations Manager

- The General Manager/Operations Manager shall have overall charge of emergency activities. This includes the initiation and direction of the Emergency Response Plan prior to, during, and after the emergency.
- Responsible for mine/mill evacuation.
- Directs shutdown of the mine and related facilities, if required.
- Coordinate internal security activities and have security contact local law enforcement for assistance as needed.
- Communicates with the news media, families, and others as needed.

6.1.2 Area Managers/Superintendent/General Foreman

- Responsible for the orderly and safe evacuation of the area.
- Accounts for all personnel.
- Releases evacuated personnel from the designated assembly areas to leave the property.
- Responsible for crowd control and traffic.
- Coordinates transportation with other department heads.
- Assists the General Manager/Operations Manager during the emergency and assumes overall responsibility and authority in the absence of the Manager in charge.

- During an evacuation, account for all persons in an orderly and efficient manner.
- Notifies off duty and working employees of the shutdown and start-up schedules.
- Maintains inventory and knows location of essential equipment, mobile, etc. to assist in rescue or emergency activities as needed.

6.1.3 Supervisor

- Responsible for the orderly and safe evacuation of the crew.
- Responsible for keeping an up-to-date list of all employees, work locations, and shifts.
- Accounts for all personnel, insuring that all personnel remain in assembly areas until released.
- Maintains control of the crew until they are released.
- Assists the General Foreman/Superintendent in charge during the emergency and assumes overall responsibility and authority in the absence of same.
- Keeps the General Foreman/Superintendent advised of the conditions in the area and the names, locations, and activities of crewmembers.
- Conducts accident investigations.

6.1.4 Environmental Manager/Environmental Superintendent/Environmental Engineer

- Assess reports and information relating to environmental concerns obtained during the emergency.
- Assists General Manager/Operations Manager as needed.
- Coordinates any activities needed for correction of environmental concerns and cleanup.
- Completes reporting required to affected regulatory agencies.
- Communicates with the news media and others as needed along with the General Manager.

6.1.5 Purchasing Manager

- Insures that materials ordered are delivered to the scene of the emergency.
- Covers normal deliveries to the mine and related facilities during the emergency.
- Provides other technical assistance to the General Manager/Operations Manger as required.

6.1.6 Human Resources and Health & Safety Department

- Establishes communications among management and directs the Emergency Response Team Captain.
- Notifies management personnel of problems and changes in conditions.
- Establishes first-aid stations and assembly areas.
- Insures that doctors and hospitals have been alerted as needed.
- Notifies appropriate Local, State and Federal officials as required.
- Assists the General Manager/Operations Manager as needed.

6.1.7 Duties of the Emergency Response Team

- Provide for emergency medical and rescue responses in emergency situations.
- Establish communication between the scene of the incident and management as needed.

Table 6-1: Individuals Responsibilities

Name	Position	Extension	Cell	Responsibility
Eric Hill Eric Hill (acting)	General Manager Operations Manager	2225 2225	590-1002 590-1002	Implement EAP
Eric Hill Eric Hill (acting)	General Manager Operations Manager	2225 2225	590-1002 590-1002	Mine evacuation and shutdown
Delbert Parr, this may eventually be done by second party once notification system is installed.	Enviro. Manager	2207	687-1684	Contact downstream Individuals
Anna Atchison Eric Hill Eric Hill (acting) Delbert Parr	Community and Government Relations General Manager Operations Manager Enviro Manager	2218 2225 2225 2207	388-0044 590-1002 590-1002 687-1684	Communicate with the media
Specific Area Managers, Superintendents and Supervisors				Account for employees
Delbert Parr Mark Huffington	Enviro. Manger Enviro. Superintendent	2207 2287	687-1684 460-4303	Reports to related regulatory agencies
Delbert Parr Mark Huffington	Enviro. Manger Enviro. Superintendent	2207 2287	687-1684 460-4303	Coordinate environmental cleanup
John Gross	Warehouse Materials Superintendent	6151	322-2897	Ensure required materials are ordered and delivered
Cory Bodyfelt	H&S Manager	6130	590-3977	Establish first aid stations
Chelly Nelson Cory Bodyfelt	HR Manger H&S Manager	2249 6130	590-3317 590-3977	Alert hospitals and doctors if required
ER Team				Emergency medical and rescue

Section 7.0 - Preparedness

The following actions describe some of the steps that could be taken at the dam to prevent or delay failure after an emergency is first discovered. These actions should only be performed under the direction of the Dam Safety Office, or other qualified engineers.

7.1.1 Overtopping by Flood Waters

- Reduce the volume of water stored in the impoundment, if possible
- Provide erosion-resistant protection to the downstream slope by placing plastic sheets or other materials over eroding areas
- Divert flood waters around the reservoir basin if possible
- Open the low-level outlet works on the Freshwater Dam to provide storage in case of tailings embankment failure

7.1.2 Reduction in Freeboard and/or Loss of Dam Crest Width

- Place additional rip rap or sandbags in damaged areas to prevent further embankment erosion
- Lower the water level to an elevation below the damaged area
- Restore freeboard with sandbags or earth and rock fill
- Continue close inspection of the damaged area until the storm is over

7.1.3 Slide on the Upstream or Downstream Slope of the Embankment

- Lower the water level at a rate, and to an elevation, that is considered safe given the slide condition. If the barge pumps are damaged or blocked, pumping, siphoning, or a controlled breach may be required
- Restore lost freeboard if required by placing sandbags or filling in the top of the slide.
- Stabilize slides on the downstream slope by weighting the toe area with additional soil, rock, or gravel
- Open the low-level outlet works on the Freshwater Dam to provide storage in case of tailings embankment failure

7.1.4 Erosional Seepage or Leakage (Piping)

- Plug the flow with whatever material is available (hay bales, bentonite, or plastic sheeting if the entrance to the leak is in the reservoir)
- Lower the water level until the flow decreases to a non-erosive velocity or until it stops.
- Place a reverse filter directly against the soil from which the leakage is exiting.
- Deposit tailings in a manner that moves the operating pool in the impoundment away from the embankment area where the seepage and/or piping is occurring

7.1.5 Failure of an Appurtenant Structure such as Inlet or Outlet Piping

- Discontinue pumping
- Identify cause of leak (pipe penetration, landslide, etc.)
- Repair damaged pipe and attended areas

7.1.6 Mass Movement of the Dam on its Foundation

- Immediately lower the water level until excessive movement stops
- Continue lowering the water level until a safe level is reached
- Continue operation at a reduced level until repairs are made
- Place fill at the base of the movement

7.1.7 Excessive Seepage and High Level Saturation of the Embankment

- Lower the water to a safe level
- Continue frequent monitoring for signs of slides, cracking, or concentrated seepage
- Continue operations at a reduced level until repairs are made

7.1.8 Excessive Settlement of the Embankment

- Lower the water level by releasing it by pumping, or siphoning
- If necessary, restore freeboard, preferably by placing sandbags
- Lower water to a safe level
- Continue operating at a reduced level until repairs can be made
  Open the low-level outlet works on the Freshwater Dam to provide storage in case of tailings embankment failure.

7.1.9 Emergency Control Center

In an emergency situation, that does not involve the Administration Building; the Emergency Control Center will be established in the Administration Conference room. If the nature of the emergency could render the Administration Conference room vulnerable to the effects of the emergency, then the Emergency Control Center will be established in the Mill Conference room.

These locations have been chosen for the following reasons:

- They are easily accessible from all areas of the facilities
- There are telephone lines available
- They can accommodate up to 15 people
- They have room for tables and chairs
- There is adequate storage for the maps/plans and other supplies that are permanently kept in the Emergency Control Center

Both Emergency Control Centers are to be equipped with the following:

- Two telephone lines with offsite dialing capabilities
- A computer network wall jack
- Up-to-date maps and plans of the facilities and pits
- Up-to-date contact list of telephone numbers for employees and offsite emergency groups
- A copy of the Emergency Response Procedures Manual
- A copy of this Dam Emergency Action Plan

In the case that the entire Fort Knox site is considered vulnerable to the effect of an emergency, the Emergency Control Center will be formed at the FGMI AKUSA office, located at:

FGMI – Fairbanks Office
Fourth floor AKUSA Building
1292 Saddler Way
Fairbanks, AK 99701

The office will be used for coordinating communications and reducing confusion. With the large space, both internal employees and external agencies could meet to work through a plan of action.

7.2 Emergency Satellite Phone

In the event of an emergency situation where all communications are lost at the Fort Knox mine, a satellite phone (Iridium) will be used for all communication external to the site. The phone is located in the security office and all incoming calls will the answered by security and the directed to the appropriate individual. The phone will only work within the security office as it is a fixed antenna phone. The contact number for the emergency satellite phone is **866-351-5937**.

7.3 Internal Supplies and Resources

In an emergency situation, equipment and supplies might be needed on short notice in addition to those maintained by FGMI, such as sandbags, rip rap, fill materials, equipment, and laborers. The table below lists the supplies and indicates how to access them.

Table 7-1: Emergency Supplies Location

Item	Contact		Location
Earthmoving Equipment	Craig Natrop	Extension – 2279 Cell – 322-6235	In operation, parked at queue or maintenance shop.
Sand and Gravel	Craig Natrop	Extension – 2279 Cell – 322-6235	Stockpiled in various areas around mine site. (reject stockpile, borrows, growth media stockpiles, etc.)
Pumps	Randy Rogers	Extension – 6169 Cell – 347-6585	
Pipe	Marty Pahkamaa	Extension – 6120 Cell –	Dewatering storage area above the explosives storage area.
Warehouse Stock	Don Lacey	Extension – 2230 Cell – 590-8987	Warehouse
Laborers	Department Specific	Contact department manager	
Other		For department specific materials, please contact the department manager.	

7.4 External Supplies and Resources

The following contractors located within Fairbanks could be used for emergency supplies and resources on short notice:

Item	Contact		Emergency Number
Electrical	AES Electric Supply, Harry	907-474-2071	907-978-6777
	Samson Electric, Tony	907-451-0252	907-451-6103
	Fulford Electric, Laci	907-456-0671	
	Sturgeon (Norcon)	907-451-6739	907-322-3482
Mechanical	Complete Service Co., Inc	907-456-5282	907-456-5284
	Mechanical Contractors	907-456-8347	
	Western Mechanical	907-452-1831	
Earthwork	FS&G Aggregate Inc.	9017-452-3834	
	Denali Extreme Earthworks	907-457-1315	
	Great Northwest	907-452-5617	907-452-5617
	AAP	907-490-6316	907-978-2787
Crane Operations	Essential Crane Services	907-590-0052	907-590-0052
	Taylor Crane	907-488-7232	907-488-7232
	Denali Steel Pile Driving & Concrete, Richard Bush	907-451-0935	907-378-1072
Fuel Delivery	AK Petroleum	907-488-2575	
Hauling	Rainer Equipment Transport	907-457-8109	907-457-2000
	Exclusive Paving	907-488-8833	
Heavy Equipment	HC Contractors	907-488-5983	907-488-2388
	Airport Equipment Rentals, Bob or Chris	907-450-1822	
	NC Machinery, Dave Graham	907-452-7251	
	CMI, Clayton	907-455-9600	

Record of Plan Review, and Plan Distribution

The Emergency Action Plan (EAP) will be reviewed and updated by FGMI personnel annually and/or when there are major changes in operating practices or if there are any significant modifications to any of the dam facilities. Information that will be updated includes:

- Contacts (personnel changes) and Contact Telephone numbers,
- Emergency Response Equipment and its locations,
- Locations of the Emergency Response Plan,
- Descriptions of the changes in operating practices and modifications.
- Other items that may substantially influence the Emergency Action.

Additionally, the EAP will be revised to reflect improvements identified through exercises, comments from responsible parties, and actual emergency events. Exercises will be conducted according to the following schedule:

- Orientation exercise (all responsible parties) – annually
- Drill exercise (dam operator only) – annually
- Tabletop exercise (all responsible parties) – every three years
- Functional exercise (all responsible parties) – upon request of the State of Alaska's Dam Safety Engineer.

Updates will be noted and recorded in the following EAP Updates Table.

Record of EAP Updates

Date	Revision Summary
4/11/2011	Will Menheere – Updated to reflect comments made during the 02/24/2011 Table Top Exercise (Notification, supplies, alarm, etc.)
12/26/2013	Revisions made based on recommendations after TSF periodic dam safety inspection. Contact names and numbers revised.

Appendix A – Emergency Log Forms

Potential Emergency Event Log

(To be completed at the time of discovery of potential emergency)

Dam name: _____ Location: _____

When and how was the event detected? _____
_____
_____

Weather conditions: _____
_____

General description of the emergency situation: _____
_____
_____
_____

Emergency level determination: _____ Made by: _____

Actions and Event Progression

Date	Time	Action/Event Progression	Taken by

Name: _____ Date: _____

Dam Emergency Situation Report

(To be completed following the termination of the emergency)

Dam name: _____

National Inventory of Dams (NID) No: _____

Location: _____

Date: _____

Time: _____

Weather conditions: _____

General description of emergency situation: _____
_____
_____

Area(s) of dam affected: _____
_____
_____

Extent of dam damage: _____
_____

Possible cause(s): _____

Effect on dam's operation: _____

Initial reservoir elevation: _____ Time: _____

Maximum reservoir elevation: _____ Time: _____

Final reservoir elevation: _____ Time: _____

Description of area flooded downstream/damages/injuries/loss of life: _____
_____
_____

Other data and comments: _____
_____
_____
_____

Observer's Contact Information: _____

Report prepared by: _____ Date: _____

Appendix B – Kinross Crisis Notification

In the event that a major or crisis incident occurs at a Kinross site, the following notification procedure shall be used to communicate the incident. Notification should be verbal – do not rely on phone voicemail or e-mail messages.

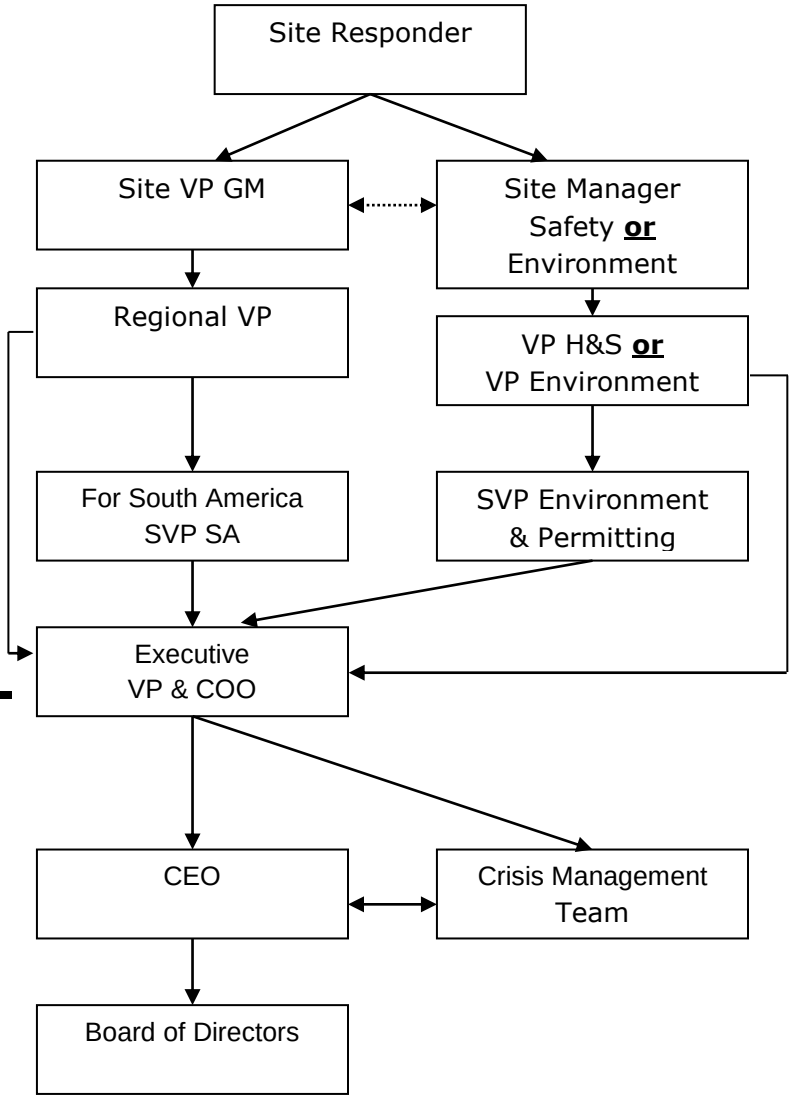
- If unable to reach the person shown in the flowchart, contact the person in the next box, etc.
- If unable to contact the COO level, contact the COO Executive Assistant who may be able to facilitate communication.
- Business units such as exploration or technical services should follow the notification tree for EHS and their respective organization through the COO.

Major Incident:

Circumstances of the incident/issue are known outside the corporate office or operation and/or the incident requires notification to outside regulatory agencies. May involve short-term interruption of operations, off-site medical attention, or off-site environmental impacts:

Examples

- Loss time injury
- Life-threatening medical condition
- Major spill/release
- Highwall failure, significant groundfall or stability issue
- Major Equipment Damage
- Material Production Loss
- Bomb threat
- Civil unrest
- Natural disaster consistent with definition



Crisis:

Situation may not be controlled. Impacts to an extended area and numerous people. Normal business operations will be curtailed and employees diverted from routine duties until situation resolved. Local response agencies may be in charge. Federal and provincial/state response agencies may be called in to assist:

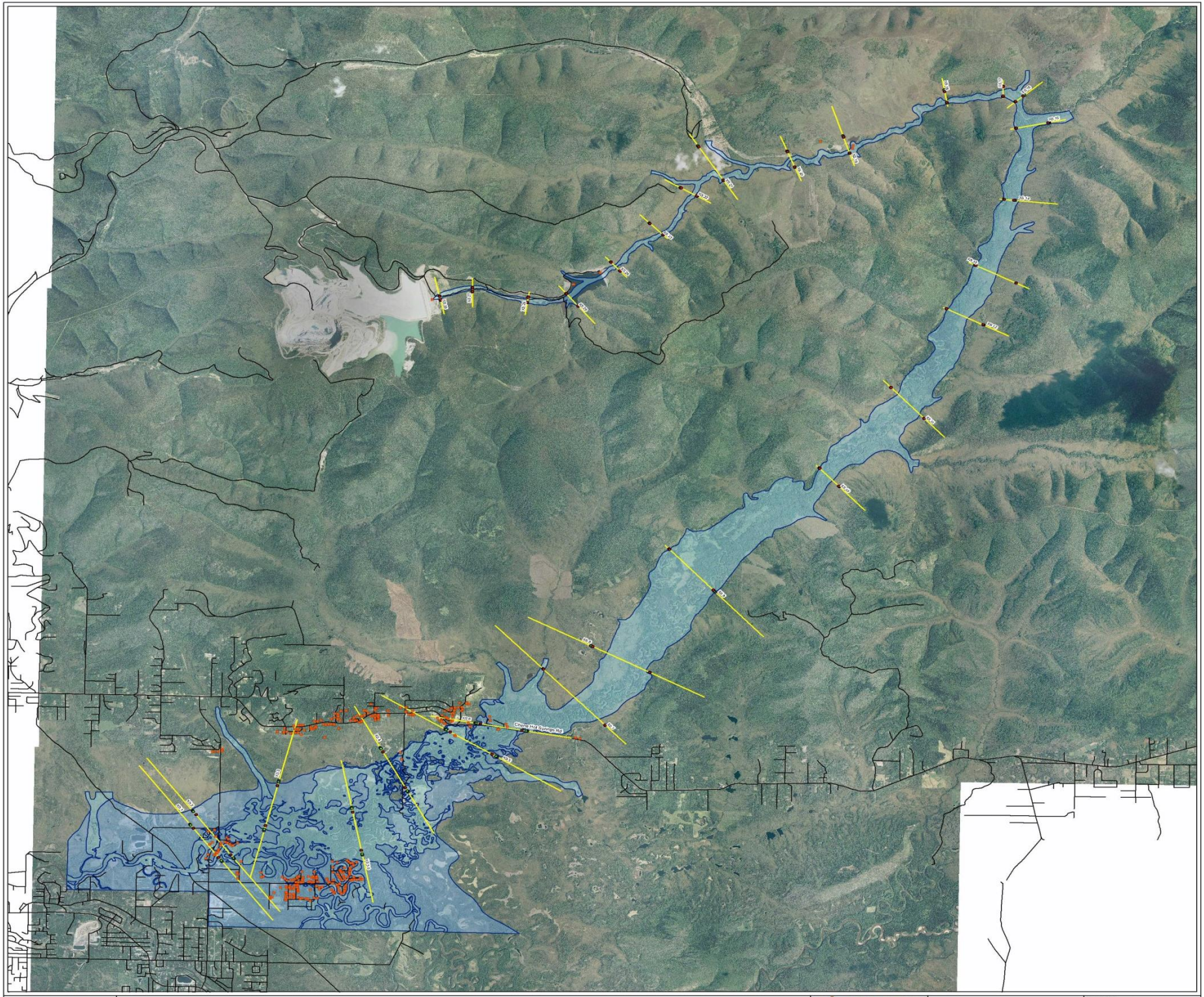
Examples

- Fatality
- Kidnapping, extortion
- Aircraft disaster
- Plant explosion / fire
- Entrapment of personnel
- Tailings dam failure
- Natural disaster consistent with definition

Appendix C – Inundation Map

Inundation map

The effective inundation maps for the Fort Knox Tailings Facility and Freshwater Reservoir dams were developed in 2010. The following map represents a dam break scenario which consists of a Tailings Facility and Freshwater Reservoir dam break coincident with the probable maximum flood. This scenario is considered the worst case scenario showing the upper limit of inundation. The maps provide a basis for evaluating existing evacuation plans for the affected areas downstream from the Fort Knox Mine. It should be noted that because of the methods, procedures and assumptions used to develop the flooded areas. Actual areas inundated will depend on the actual failure and flooding conditions at the time of failure. In addition, the age of the topographic information introduces uncertainty, particularly in areas that have experienced significant development



N

Feet
0 3,000

EXPLANATION

- Structure
- Clear Day
- Local 1/2 PMP
- Local PMP
- Cross Section
- Road
- Fema 100 Year Flood Zone
- Fema 500 Year Flood Zone

SRK Consulting
Engineers and Scientists

NAD 83 State Plane Alaska Zone 3 Feet

DESIGN: SH	DRAWN: BVB	REVIEWED: DH	
CHECKED: 1 Inch = 3,000 feet		DATE: 1/20/2011	
FILE: Draw100 Shallow Breach BVB 20110119.mxd			

FAIRBANKS GOLD MINING, INC.
FORT KNOX MINE

DRAWING TITLE:	TSF SHALLOW BREACH SCENARIO
ISSUED FOR:	INNUNDATION STUDY
DRAWING NO:	DRAWING 100
SRK JOB NO:	73400.040
REVISION NO:	A