WALTER CREEK VALLEY FILL

HEAP LEACH FACILITY

PROJECT DESCRIPTION

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

June 23, 2006

FORT KNOX MINE

WALTER CREEK VALLEY FILL
HEAP LEACH FACILITY
PROJECT DESCRIPTION

Submitted to:

Alaska Department of Natural Resources
Division of Mining, Land and Water
3700 Airport Way
Fairbanks, Alaska 99709

Alaska Department of Environmental Conservation
Division of Air and Water Quality
610 University Avenue
Fairbanks, Alaska 99709-3643

and

Department of the Army
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Submitted by:

Fairbanks Gold Mining, Inc.
A Subsidiary of Kinross Gold Corporation
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June 23, 2006

Certification

This Project Description document was prepared by Fairbanks Gold Mines Inc. (FGMI) and Knight Piésold and Co. (KP) from information provided by FGMI, KP, and Water Management Consultants (WMC). FGMI developed the sections of the report addressing mining, KP developed the sections addressing the proposed Walter Creek Valley Fill Heap Leach Pad, and WMC developed the sections dealing with mine closure and reclamation, including the reclamation cost estimate. Mr. Thomas F. Kerr, P.E. (Alaska) of KP has familiarity with these aspects of the project and has supervised the development of, and approved the contents of, this document.

Thomas F. Kerr, P.E.
Vice President
Knight Piésold and Co.

STATE OF ALASKA
49TH
THOMAS F. KERR
No. 10969
CE
REGISTERED PROFESSIONAL ENGINEER

June 23 /06

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LIST OF ABBREVIATIONS

ADEC – Alaska Department of Environmental Conservation

AGI – Amax Gold Inc.

AGP – Acid Generation Potential

ANP – Acid Neutralizing Potential

CIC – Carbon-In-Columns

COE – Corps of Engineers

EPA – Environmental Protection Agency

FGMI - Fairbanks Gold Mining, Inc.

HDPE – High Density Polyethylene

INCO – company name-patented cyanide destruction process

LCRS – Leachate Collection and Recovery System

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

TSF – Tailing Storage Facility

USFWS – United States Fish & Wildlife Service

USGS - United States Geological Service

WAD CN– Weak Acid Dissociable Cyanide

1.0 INTRODUCTION

1.1 Purpose

Fairbanks Gold Mining, Inc. (FGMI), a wholly owned subsidiary of Kinross Gold Corporation (KGC), has prepared this project description as the primary document supporting FGMI's application for the permits necessary to construct, operate, and close the Walter Creek Valley Fill Heap Leach facility. This document describes the proposed Walter Creek Valley Fill Heap Leach Project located approximately 26 miles northeast of Fairbanks, Alaska. The project location is illustrated on Figures 1.0 and 1.1. The heap leach project will be a component of the Fort Knox Mine operations, and it is located on FGMI's Millsite Lease (ADL 414960 & ADL 414961). Planning for the heap leach is in the early stages, and therefore, the plans as currently proposed are subject to change or modification as additional information becomes available from environmental studies, geochemical and engineering analyses, and input from regulatory personnel and interested parties. Any significant changes in plans will be appropriately addressed with the regulatory agencies.

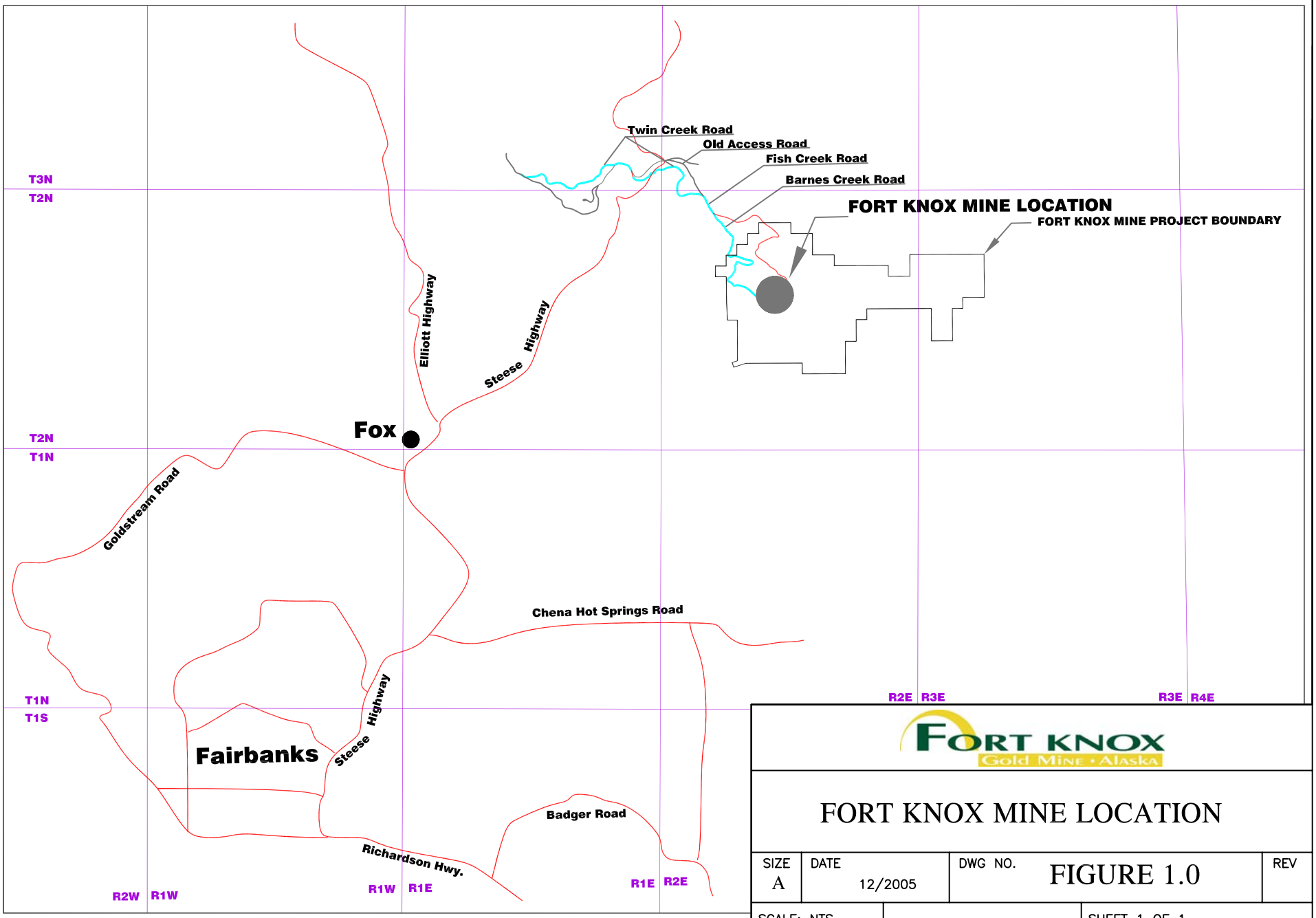
This document incorporates information from numerous sources. Project-related information gathered by Fairbanks Gold Mining Inc. and its consultants is available in separate baseline and technical reports as referenced in this document. Knight Piésold and Co. prepared the *Fairbanks Gold Mining, Inc. Walter Creek Valley Fill Heap Leach Facility Design Report Issued for Agency Review, November 30, 2005* which provides the engineering design and support for this heap leach project. Water Management Consultants, Inc. prepared *Fort Knox Mine Closure Management Plan for the Heap Leach Facility, December 2005,* which defines the closure plan and provides supporting analyses.

Environmental baseline studies for the Walter Creek area were completed during the initial permitting of the Fort Knox Mine including surface and groundwater hydrology, geochemistry, cultural resources, and socio-economic (including noise and visual) impacts (CH2MHill, 1993). A jurisdictional wetland survey was also completed (America North/Emcon, 1992). Additional sampling and data collection will include metallurgical characterizations of ore and its leaching characteristics. Laboratory analyses of run-of-mine ore in column leach tests are ongoing.

1.2 Applicant Information

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

Telephone: (907) 488-4653



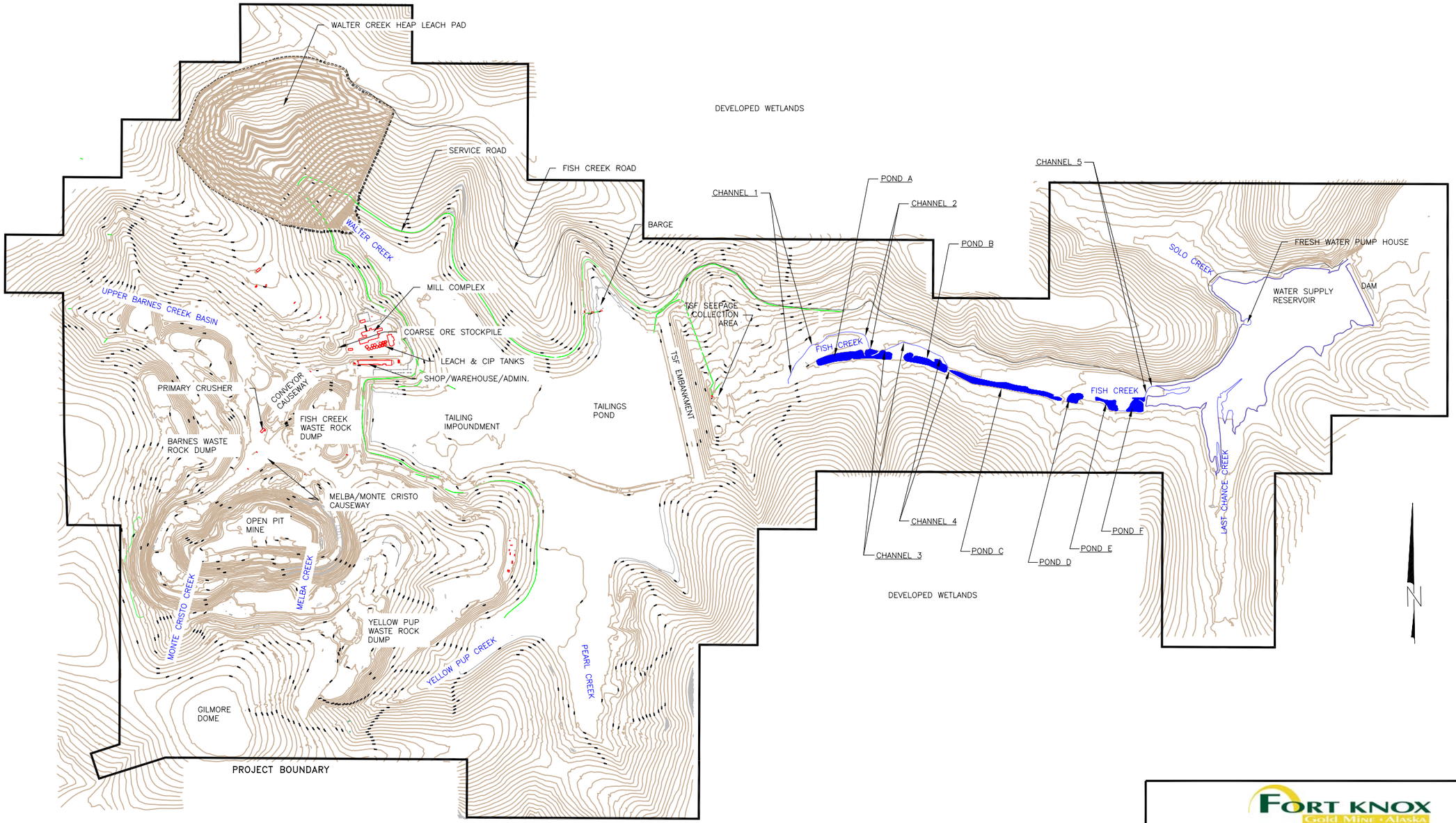
FORT KNOX
Gold Mine • Alaska

FORT KNOX MINE LOCATION

SIZE	DATE	DWG NO.	REV
A	12/2005	FIGURE 1.0	

SCALE: NTS

SHEET 1 OF 1



FORT KNOX
Gold Mine • Alaska

FORT KNOX MINE
GENERAL ARRANGEMENT

SIZE	FGMI NO.	DWG NO.	REV
		FIGURE 1.1	
SCALE		DV101-89-08-166	

Fairbanks Gold Mining, Inc. Officer Completing Application

Name: Robert Taylor
Title: Vice President and General Manager
Telephone: (907) 490-2206

Designated Contact Person

Name: Delbert Parr
Title: Environmental Manager
Telephone: (907) 490-2207

Kinross Gold Corp. Information

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Toronto, Ontario M5H 3Y2
Canada

Telephone: (416) 365-5123

President & CEO:	Tye Burt
Executive Vice President & COO:	Tim Baker
Executive Vice President & CFO:	Thomas Boehlert
Senior Vice President, Corporate Development:	Hugh Agro
Senior Vice President, Corporate Communications:	Christopher Hill
Senior Vice President, Human Resources:	Lisa Zangari
Senior Vice President, Operations:	Mike Doyle
Senior Vice President, EHS:	Rick Baker
Vice President Administration & Corp Secretary:	Shelley M. Riley

Fairbanks Gold Mining, Inc. is a wholly owned subsidiary of Kinam Gold Inc., (formerly Amax Gold Inc.), a precious metals corporation. Kinam Gold Inc. is in turn a wholly owned subsidiary of Kinross Gold USA, Inc. located at Scotia Plaza, 52 Floor, 40 King Street West, Toronto, Ontario, Canada, M5H 3Y2.

Alaska Registered Agent

Name: Fairbanks Gold Mining, Inc.
Address: c/o C. T. Corporation System (Agent)
240 Main Street, Suite 800
Juneau, Alaska 99801

1.3 Heap Leach Overview

The valley fill heap leach will be located in the upper end of the Walter Creek drainage immediately upstream from the tailing impoundment. Excluding the haul road and access roads, the heap leach pad with the in-heap storage embankment and base platform will cover approximately 310 acres and will have a total capacity for 160 million tons. The haul road to the pad will cover approximately 40 additional acres. The pad is to be constructed in five stages, which are illustrated on Figure 1.2. Table 1.0 provides the area and tonnage planned for each stage of development. The clearing of brush and trees, initial earthwork in preparation of liner construction, the site access road, the portion of the in-heap embankment outside the pad limit, and establishment of drainage control will occur over the entire 319 acres at the beginning of the project. Within that area, 130 acres of lined pad will be constructed for the first two stages and loaded with ore. Each of the three additional stages will be constructed as needed for loading ore.

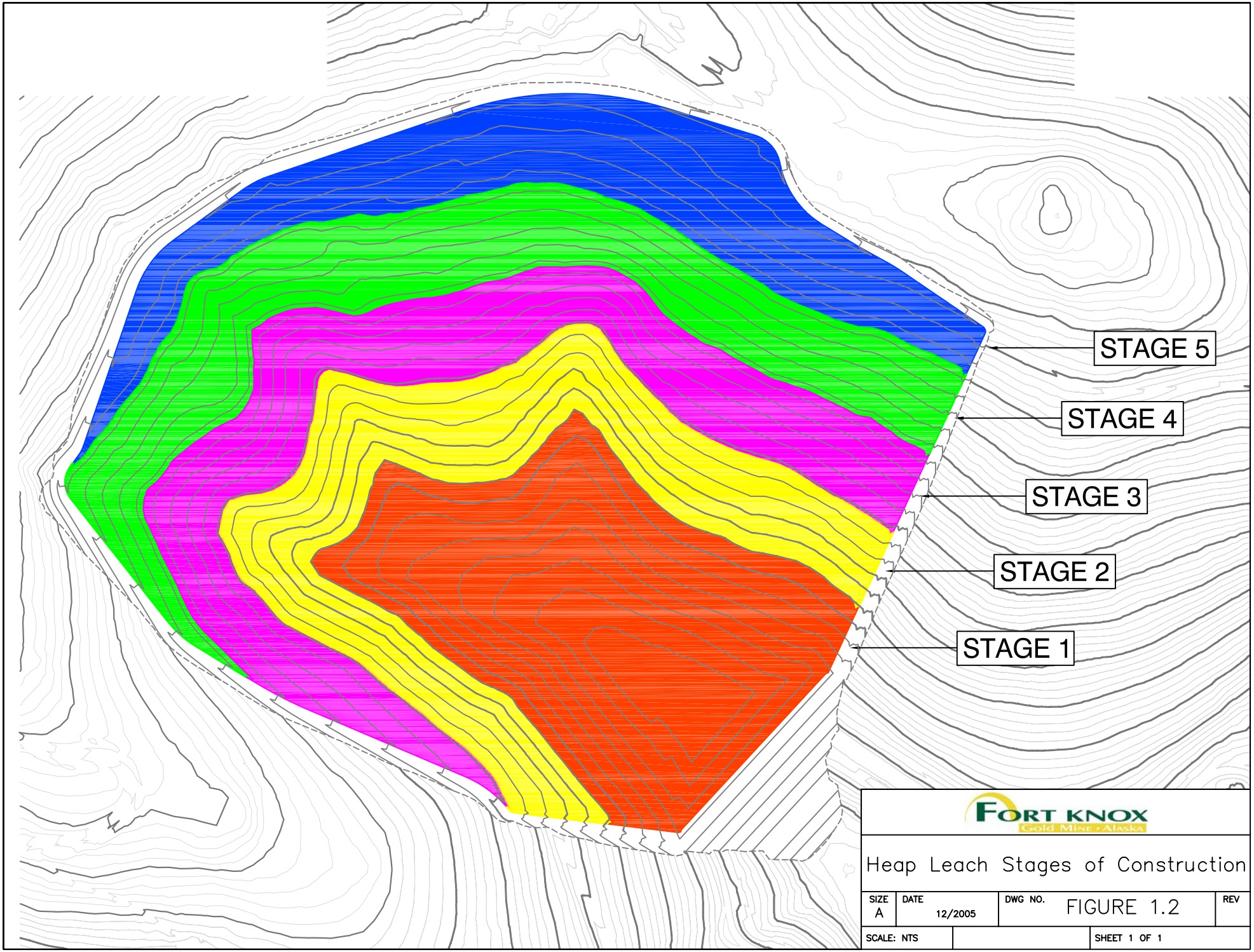
Table 1.0: Area and Tons for Each Stage of Development

	Lifts	Pad Area Square Feet	Pad Area Acres	Cumulative Leach Pad Area Acres	Capacity by Stage Tons	Cumulative Capacity Tons
Stage 1	1-4	3,034,731	70	70	13,716	13,716
Stage 2	5-7	2,362,850	54	124	21,659	35,375
Stage 3	8-10	2,422,613	56	180	31,567	66,942
Stage 4	11-13	2,392,773	55	234	36,049	102,991
Stage 5	14-19	2,030,238	47	281	58,202	161,193

Ore for the heap leach will consist of run-of-mine rock from the Fort Knox Pit and various stockpiles. The Barnes Creek and Fish Creek stockpiles currently contain 29 million tons of lower grade ore that will be loaded on the heap leach pad. The ore is characterized by relatively high permeability that will promote efficient flow in the heap for rapid solution recovery and drainage and for rapid rinsing at closure.

In-heap storage of process solution and storm water will be accomplished behind an embankment in the downstream toe of the heap. The rock planned for construction of the in-heap storage embankment is sound, durable, and of high strength similar to the quality of the rock that has been used to construct the downstream random fill for the Fort Knox Mine Tailing Storage Facility (TSF).

The valley fill heap leach pad will be constructed with a 12-inch prepared subbase with a coefficient of permeability of less than 1×10^{-5} cm/sec overlain by a geomembrane liner that will be 80-mil LLDPE or a similar material. Above the geomembrane liner, there will be an overliner constructed consisting of 3 feet of crushed rock containing a network of piping to promote rapid drainage. The overliner will provide liner protection during ore loading, promote leachate collection, and maintain a low head on the geomembrane liner.


STAGE 5
STAGE 4
STAGE 3
STAGE 2
STAGE 1
FORT KNOX
Gold Mine • Alaska
Heap Leach Stages of Construction
SIZE
A
DATE
12/2005
DWG NO.
FIGURE 1.2
REV
SCALE: NTS
SHEET 1 OF 1

The facility will utilize an in-heap storage pond for collection of pregnant solution. In addition to providing the necessary operating capacity for pregnant solution, the in-heap storage pond will be sized to contain: (1) solution from a 24-hour drain down, plus (2) the runoff from the 100-year/24-hour storm event.

Beneath the in-heap storage pond, a Leachate Collection and Recovery System (LCRS) will be constructed between an overlying primary geomembrane liner and an underlying secondary geomembrane liner underlain by a 12-inch-thick layered prepared subbase. The LCRS will consist of a drainage layer that will report to a pump back system to return any solution passing through the primary liner to the in-heap storage pond.

The LCRS constructed in conjunction with the double liner in the area of the in-heap storage reservoir will provide leak monitoring and collection. A Process Component Monitoring System (PCMS) will be constructed under the main header lines for the solution collection system, providing additional leak detection. An underdrain system consisting of a network of drainage channels containing drain rock will route water from seeps and springs under the subbase to the tailing impoundment and provide a third level of leak detection.

Barren solution will be applied on the heap leach using drip emitters, or possibly sprinklers, during the warm months. The solution will flow through the run-of-mine ore. Pregnant solution will flow to the in-heap storage reservoir, which will have an operating capacity of about 68 million gallons, or 9.1 million cubic feet. The pregnant solution that collects in the solution collection wells in the in-heap storage reservoir will be pumped to the Carbon-In-Columns (CIC) plant using vertical pumps located in the solution collection wells. Barren solution and pregnant solution will be pumped in pipes between the pad and the CIC plant. Loaded carbon will be processed in the existing Fort Knox mill facilities.

The heap leach pad will be located immediately upstream of the tailing impoundment. The tailing dam is an earth-filled structure designed to hold tailing and process water from the mill as well as surface runoff water. The dam is designed and will be maintained to contain the 100-year/24-hour storm event and the average 30-day spring breakup plus provide 3 feet of freeboard. In the extremely unlikely event of a catastrophic failure of the heap leach embankment during the time of operation of the pad when only the first two stages have been developed, all water released would be contained within the existing 3-foot freeboard of the operational tailing dam. The tailing impoundment is a zero discharge facility. The mill recycles water from the tailing impoundment for reuse in the beneficiation process. The water in the tailing impoundment will also be utilized for the heap leach process.

1.4 Project Location

FGMI proposes to develop the Walter Creek Valley Fill Heap Leach Project located at Fort Knox Mine approximately 26 miles northeast of Fairbanks, Alaska (Figure 1.0). The facility is located on the Livengood U.S. Geological Survey (USGS) quadrangle map in Township 2N, Range 2E of the Fairbanks Meridian. The approximate GPS coordinates of the facility center are latitude 65º 0.76N, longitude 147º 20.92W.

1.5 Land Status

Surface Ownership

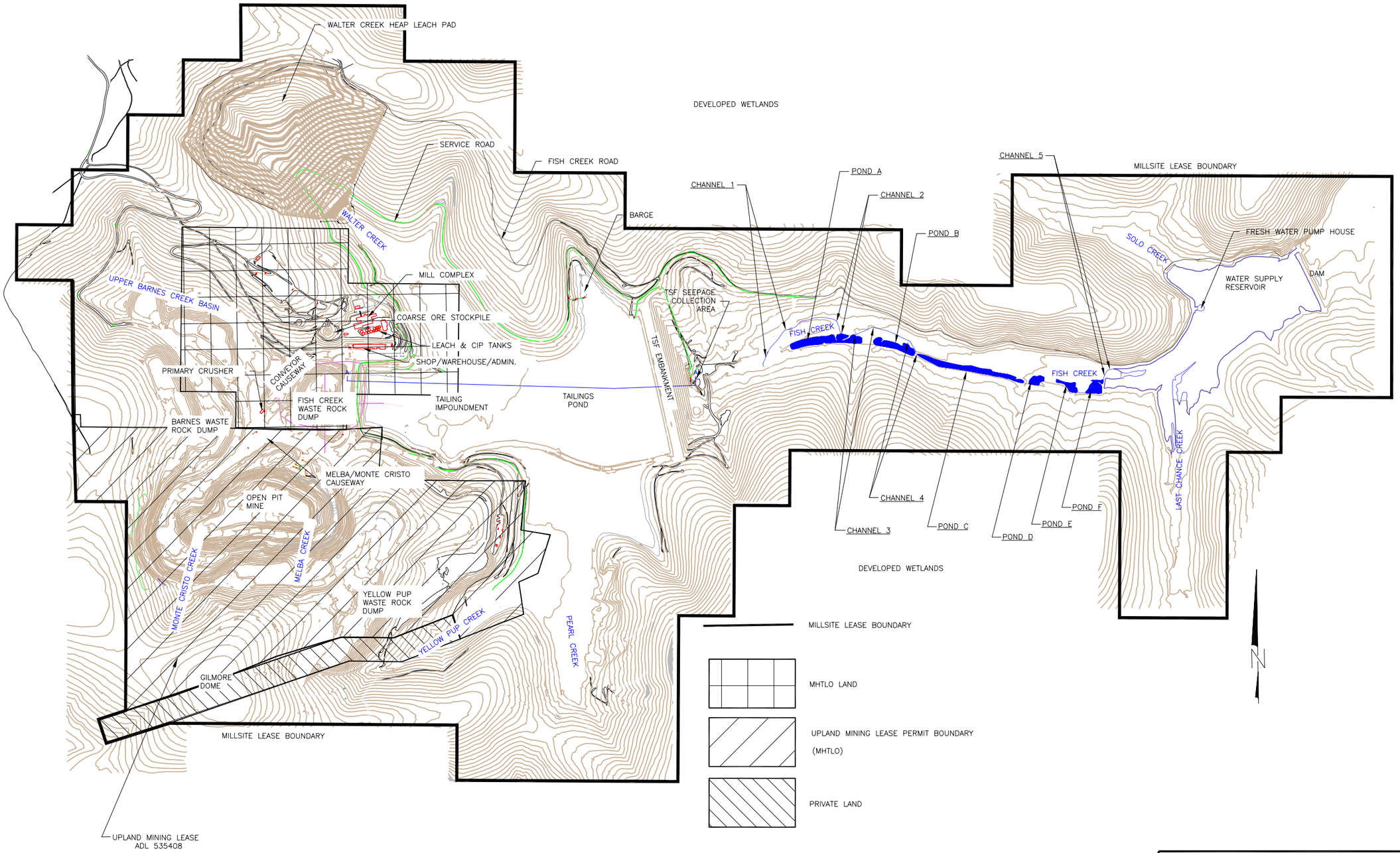
Surface ownership in the area planned for development of the valley fill heap leach pad is held by the State of Alaska (ADNR). Mental Health Trust Land Office (MHTLO) holds surface rights adjacent to the proposed heap leach pad. The affected lands for the heap leach project are within the existing Millsite Lease (ADL Nos. 414960 and 414961) for Fort Knox Mine. Although the heap leach pad is not located on land controlled by MHTLO, ancillary facilities such as the access and haul road to the heap leach pad will be located on MHTLO holdings (Figure 1.3).

Mineral Ownership

FGMI holds valid mining claims for all areas planned for disturbance for development of the heap leach facility. Figure 1.4 is a claim map covering the area planned for the heap leach and the entire Millsite Lease area.

Water Rights

FGMI holds Permit to Appropriate Water LAS 13988 that grants FGMI the right to use water in the Fish Creek drainage for ore processing. The water required for the heap leach facility will be part of this existing water right.

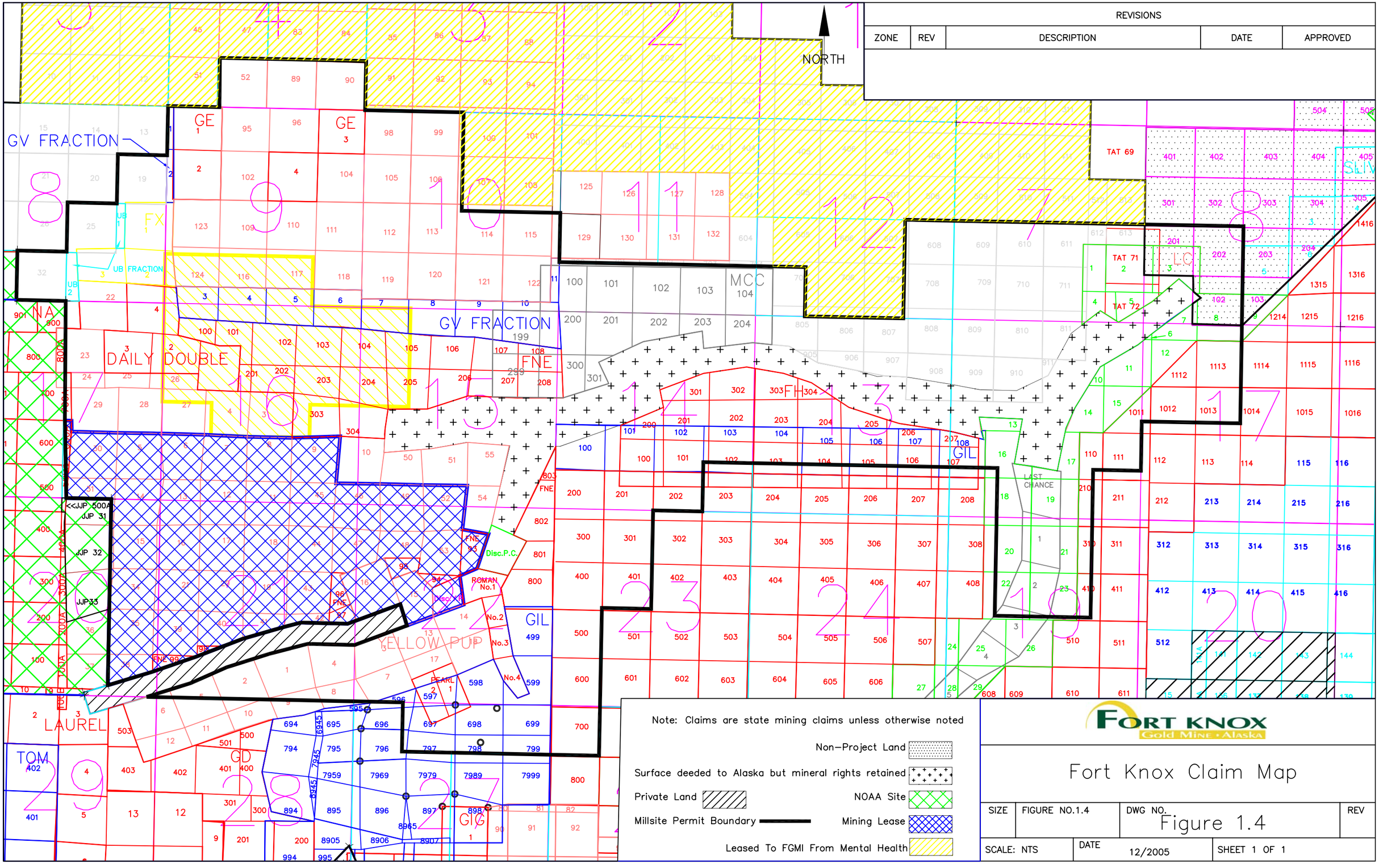


FORT KNOX
Gold Mine • Alaska

FORT KNOX
SURFACE OWNERSHIP

SIZE	FGMI NO.	DWG NO. FIGURE 1.3	REV
SCALE		DV101-89-08-166	

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED



Note: Claims are state mining claims unless otherwise noted

Non–Project Land

Surface deeded to Alaska but mineral rights retained

Private Land

NOAA Site

Millsite Permit Boundary

Mining Lease

Leased To FGMI From Mental Health

FORT KNOX Gold Mine • Alaska

Fort Knox Claim Map

SIZE	FIGURE NO.1.4	DWG NO. Figure 1.4	REV
SCALE: NTS	DATE 12/2005	SHEET 1 OF 1	

2.0 SITE DESCRIPTION

2.1 History

Area History

In 1901, Felix Pedro and Tom Gilmore discovered gold in a gravel bar near the mouth of Fish Creek; however, they decided not to stake the discovery because they considered it to be only a spring freshet deposit and not a valuable placer deposit (Parker, 1929). They continued prospecting in the area, and on July 22, 1902, Pedro made a discovery on Pedro Creek, starting a stampede into what became the Fairbanks District (Parker, 1929).

Pedro's discovery resulted in the establishment of Fairbanks as a major mining center (Cashen, 1971). By 1904, Fairbanks had become one of the principal gold producing districts in Alaska. Placer production peaked in 1909 (Parker, 1929), marking a transition from the relatively low grade, easily mined shallow placers to the high grade, underground "drift mines" (Parker, 1929). Between 1903 and 1930, an estimated 3.9 million ounces of placer gold and 100,000 ounces of lode gold were recovered from the district (Hill, 1933).

During the boom years of 1903 to 1905 (Cashen, 1971), towns sprang up on numerous creeks throughout the region (Wold, 1971). In 1908, 5,000 people lived in Fairbanks and another 5,000 lived in the surrounding area. By 1910, however, the Fairbanks population had dwindled to 1,500 (Cashen, 1971). Mining activity steadily declined from 1910 to 1915 (Anon., 1916) and continued to drop until the 1920s when dredges were introduced. Mining activity rose from the late 1920s until World War II when gold mining was suspended under the war moratorium. The U.S. Smelting, Refining, and Mining Company, dba Fairbanks Exploration Company (F.E. Co.), operated 12 dredges in the Fairbanks Mining District in 1930, but in 1953, only six operating dredges remained (Cooley, 1954). Activity remained low until the price of gold began to rise in the 1970s.

Lode gold mining did not start in the Fairbanks District until 1910 (Brooks, 1915), and it peaked in 1913 (Hill, 1933) when ten mills were operating (Brooks and others, 1914). Lode mining declined during the First World War (Hill, 1933) and revived after construction of the Alaska Railroad in 1923 (Boswell, 1979). In 1924, the F.E. Co. began purchasing large tracts of land and constructing a water conveyance system, the Davidson Ditch, in preparation for dredging activities. The Davidson Ditch was an engineering milestone that consisted of approximately 90 linear miles of hydraulic ditch, flumes, and siphons. Total lode gold production from the Fairbanks District through1960 was 239,247 ounces (Cobb, 1973).

In 1984, lode gold was discovered at what was to become the Fort Knox Mine. Between 1987 and 1991, a number of companies were involved for varying lengths of time in exploration and pre-development of the Fort Knox Project. In January 1992, Amax Gold Inc. (AGI) acquired 96 percent ownership of Fairbanks Gold Ltd., a publicly held British Columbia corporation, and merged with Gilmore Gold Inc., a closely held Delaware corporation, into AGI. On March 31, 1992, AGI acquired the remaining 4 percent of Fairbanks Gold Ltd., thus obtaining full ownership of the Fort Knox Project. AGI established FGMI as the operating company for the

mine. On June 1, 1998, AGI and Kinross Gold Corporation merged. FGMI is a wholly owned subsidiary of Kinross Gold Corporation.

History of Fort Knox Mine

On July 22, 1902, Italian prospector Felix Pedro discovered gold in the interior of Alaska. Just 19 days after making this initial discovery, Pedro staked a discovery claim on Fish Creek downstream from what is now known as the Fort Knox ore body. Intermittent drift mining occurred throughout the Fish Creek valley prior to 1917 when a dredge was erected by the Tanana Valley Mining Co. (Shannon and Wilson, 1985). In the 1930s, the upper reaches of Pearl Creek and Yellow Pup Creek were mined by slackline scraper and dragline. In 1963, hydraulic stripping and bulldozer-dragline mining took place along Fish Creek, Barnes Creek, and Pearl Creek (CH2MHill, 1993). The Fairbanks Mining District has produced, from 1880 through 2004, an estimated 11,506,646 ounces of gold. Placer deposits account for 8,188,517 ounces and lode deposits for 3,318,129 ounces (Szumigala & Hughes, 2004). For a more complete discussion of the placer mining history of the Fort Knox area, see *History of Mining on Upper Fish Creek, Fairbanks, Alaska*, (Higgs and Sattler, 1994).

In 1984, geologists discovered visible gold in the granite and noted the potential importance of the Fort Knox deposit. Between 1987 and 1990, Monte Cristo Mining, Inc.; the Fort Knox Limited Partnership; Gilmore Mining, Inc; Fairbanks Gold, Ltd.; Fairbanks Gold, Inc.; and Gilmore, Inc. were involved for varying lengths of time in the exploration and pre-development program. In January 1992, Amax Gold Inc. acquired ownership of the Fort Knox project, and Fairbanks Gold Mining, Inc., an Amax Gold Inc. subsidiary, was established as the project operator.

In 1994, the environmental review (CH2MHill, 1993) for Fort Knox was completed, and in accordance with the National Environmental Protection Act (NEPA), an Environmental Assessment was finalized. The required permits were issued in 1994, and the next year construction began. The first gold pour occurred in December of 1996. Kinross Gold Corp. and Amax Gold Inc. merged in 1998, and Fairbanks Gold Mining, Inc. became a wholly owned subsidiary of Kinross Gold Corporation, a Toronto-based corporation. In 1999, the first million ounces of gold were produced at Fort Knox, and in 2002, the second million ounces were produced. In 2003, Kinross Gold Corp. merged with TVX and Echo Bay, making Kinross Gold Corp. the seventh largest gold producer in the world.

2.2 Geology

Regional Geology

The Yukon-Tanana Upland consists largely of metamorphic rocks formerly mapped as the Birch Creek Schist Formation but which are now generally referred to as the Yukon-Tanana metamorphic complex. In the Fairbanks Mining District, the complex can be subdivided into four metamorphosed stratigraphic groups: the Chatanika terrain, the Fairbanks Schist unit, the Chena River sequence, and the Birch Hill sequence. The Fairbanks Schist unit, of greenschist

facies metamorphic grade, is the predominant rock assemblage in the district. Lithologies include muscovite-quartz schist, micaceous quartzite, biotite-muscovite-quartz schist, and massive brown and gray quartzite. These are interpreted to be metasedimentary with mine meta-volcanic rocks. The Cleary sequence is an assemblage of metasedimentary and metavolcanic rocks located near the center of the Fairbanks Schist unit. The sequence includes calcareous greenschist, chlorite schist, and interlensed potassium feldspar-quartz schist and muscovite quartz schist. The latter two rock units host most of the known base and precious metal-sulfide deposits in the district. The Cleary sequence also contains areas of chlorite schist and impure marble. The Birch Hill sequence occurs in a narrow band in the southern part of the district and consists of phyllite, micaceous calc-schist, cacl-amphibolite, and quartzite.

The Chatanika terrane is a unit exposed in the northern part of the district and includes high-grade metamorphic rocks. Structurally above the Fairbanks Schist unit is the Chena River sequence, consisting of amphibolite, tremolite marble, and coarse-grained garnet muscovite schist. The Chatanika terrane, the Fairbanks Schist unit, the Chena River sequence, and the Birch Hill sequence are all believed to be in thrust-fault contract.

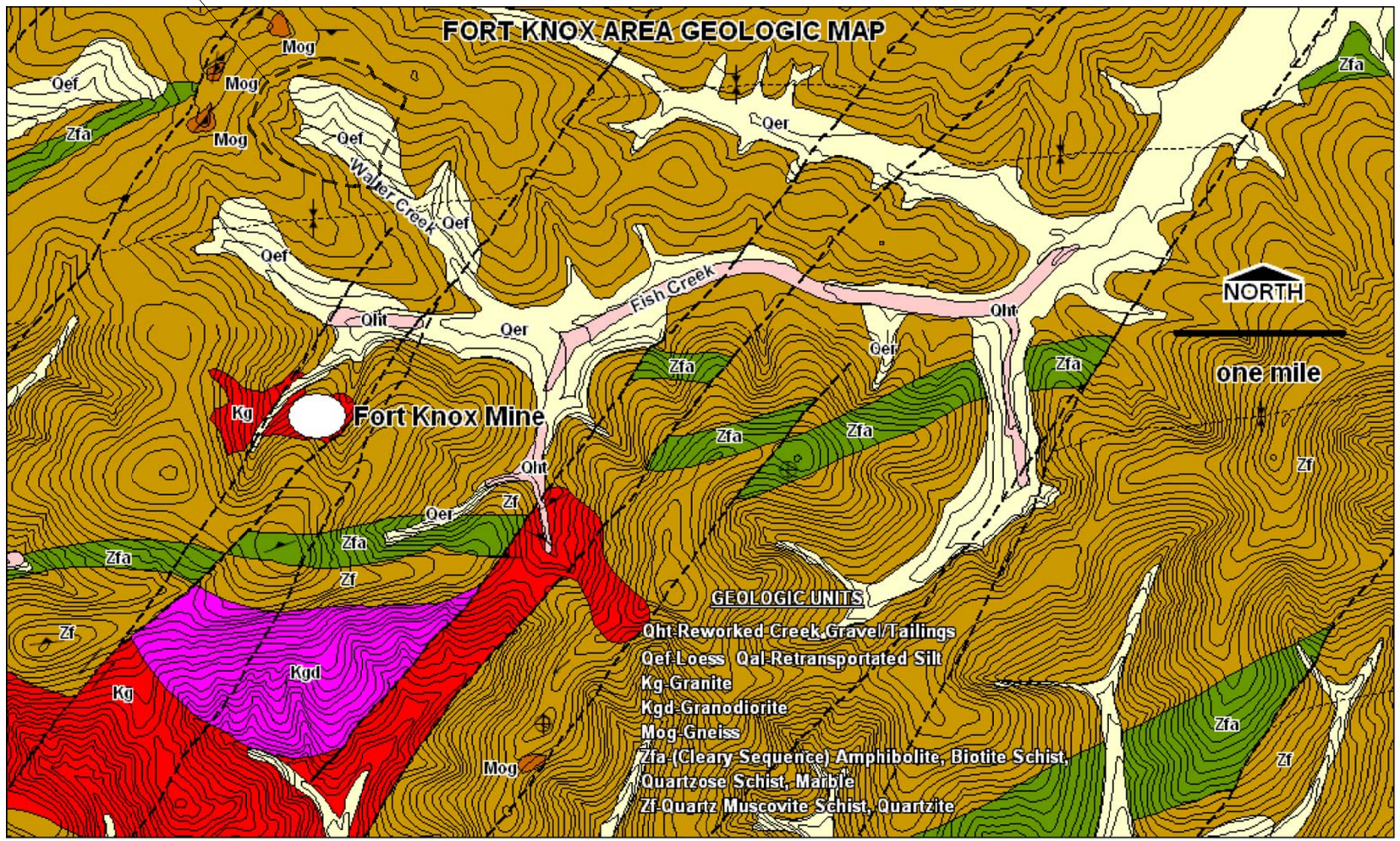
Two dominant intrusive rock types are found within the district. The first consists of northeasterly-trending masses of hornblende-bearing granodiorite found in the northern and southwestern parts of the district. The second consists of porphyritic quartz monzonite and granite at Gilmroe Dome and near Twin Creek. Ages of the plutons range from 118 to 60 million years and appear to cluster around two ages, approximately 90 and 60 million years.

Larger plutons such as the Pedro Dome and Gilmore Dome plutons have associated contact metamorphic zones in the adjoining metamorphic rocks. These zones can be up to 1,600 feet in width.

Walter Creek Geology

Figure 2.0 illustrates the geology. The planned heap leach pad is underlain by a quartz muscovite schist. Quaternary unconsolidated valley-fill deposits are found along the valley bottoms. These consist of silty gravels with sand and sandy silts with gravel. Bedrock on the valley side slopes is covered with generally 5 to 15 feet of dense silty sands and gravels; however, locally these may be up to 30 feet thick. A series of parallel northeast-to-southwest-trending faults traverse the areas adjacent to the project site. No faults have been mapped on the leach pad site, and exploratory drilling at the site of the leach pad did not reveal any evidence of faulting at the site. Numerous relatively thin shear zones are present, and they appear to follow foliation or joints or both. Drill results also indicate dominant joint orientations of from 40 to 60 degrees to the core axis. This indicates that the bedrock should provide a stable foundation for the leach pad since the high angle joints do not “daylight” to provide a zone of weakness along which failure could occur.

APPROXIMATE WALTER CREEK VALLEY FILL HEAP LEACH FACILITY ULTIMATE LIMIT



PLAN

2000 0 2000 4000 FEET

NOTE:

1. GEOLOGIC MAP PROVIDED BY FGMI.

FORT KNOX Gold Mine • Alaska

FORT KNOX
AREA GEOLOGIC MAP

SIZE	FGMI NO.	DWG NO.	REV
		FIGURE 2.0	
SCALE		DV101-89-08-166	

Geotechnical Stability

Geotechnical stability evaluations including seismic analysis for the in-heap storage embankment and heap leach pad were performed. The results indicate that the stability of the facility meets or exceeds the minimum regulatory requirements and is in keeping with those commonly accepted as industry standards.

2.3 Hydrology

Surface Water

The surface water and groundwater conditions across the site (including the area of the proposed heap leach pad) have been evaluated through various investigations prior to and during active mining. Preliminary work was completed during pre-feasibility (EBA Engineering, 1990) and initial design activities (JCHA, 1992a, 1992b, and 1996). Most recently, Knight Piésold (2005c) completed an investigation of the surface and subsurface conditions as part of the geotechnical work required for the engineering design. This included test pit excavation, condemnation/geotechnical drilling, and laboratory testing. The following discussion is based on the hydrologic data compiled during these investigations.

Fish Creek, which flows to the east and northeast, is the main or master stream and is fed by lesser tributary streams including Walter, Barnes, Pearl/Yellow Pup, Solo, and Last Chance Creeks. The project lies in the Walter Creek sub-basin, a tributary to the Barnes/Fish Creek drainage (Figure 1.1). Walter Creek valley was never disturbed by placer mining. Walter Creek now flows to the existing Tailing Storage Facility basin.

A number of springs, seeps, and wet areas support the stream flow that occurs in the leach pad footprint. Stream flows and surface water above the ultimate limits and active stage of the leach pad will be transported around the pad in diversion ditches to the tailing impoundment. For seeps, springs, and wet areas occurring within the lined area of the pad, a series of underdrains will be installed to collect these flows and transport the flows to a tailing storage facility.

A series of diversion channels will be constructed to divert runoff from the 100-year/24-hour storm around the ultimate limits and various stages of the pad. Diversion ditches will be included to provide diversion around the constructed stages of the leach pad (Figure 1.2). The runoff will be discharged into drainages downstream of the in-heap storage embankment.

Ground Water

The two principal hydrostratigraphic units in the area of the proposed heap leach facility are the alluvium that occurs within the Walter Creek drainage and the fractured bedrock. The following sections provide a description of each unit.

Alluvium

The alluvium in Walter Creek typically consists of a thin layer of organic soils, moss, and vegetation underlain by organic silts with occasional channel deposits of sand and gravel. Laboratory testing completed by Knight Piésold (2005c) indicates that the alluvium consists predominantly of silty sands and gravel with lenses of silt. These soils are generally light gray to dark gray in color. The alluvium overlies an erosional surface of the weathered bedrock. The depth to groundwater in the alluvium ranges from 0 to 10 feet below ground surface.

Based on aquifer tests performed by JCHA (1992a), the permeability of the basal gravel ranges between 10^{-4} to 10^{-5} cm/sec. Hydraulic conductivity values for the alluvial material are estimated to range between 10^{-2} to 10^{-5} cm/sec with an average of 7×10^{-3} cm/sec.

Bedrock

The underlying bedrock aquifer consists primarily of schist (referred to as the Fairbanks schist) and is interpreted to be of pre-Cambrian Age. This schist is host to younger granitic intrusions such as the one outcropping at the Fort Knox mine site. Based on condemnation drilling results, the upper portion of the bedrock (ranging up to 100 feet in thickness) is highly weathered. The degree of weathering depends on the original lithologic content of the bedrock and exposure. Weathering characteristics consist of intense fracturing, alteration of primary minerals to clays and oxides (such as iron oxide), dislocation from soil creep, and the filling of fractures with sand, silt, and clay.

Movement of groundwater in the bedrock aquifer occurs in open fractures. The degree of fracturing observed during the drilling of the condemnation holes was variable, as indicated by the range of hydraulic conductivities ranging from 10^{-2} to 10^{-5} cm/sec. Air-lift flow rates measured during drilling range from less than 1 to 25 gpm. Depth to water in the bedrock ranges from 2 to greater than 100 feet below ground surface.

2.4 Downgradient Facilities

Facilities located downgradient of the proposed heap leach pad include the tailing impoundment, the seepage collection system, and the freshwater reservoir. Of these, the tailing impoundment and seepage collection system are the most significant because they will provide contingency containment during operation and will be an integral part of the site-wide closure plan that includes the heap leach pad.

The tailing impoundment has been designed as a zoned earthfill/rockfill water and tailing retention structure. Slurried tailing is currently discharged sub-aerially from pipes located at the upstream margin of the tailing facility. Approximately 40,000 to 45,000 tons per day are processed and deposited in the tailing impoundment. To date, approximately 123 million tons of tailing have been placed in the facility. The decant pool covers an area of approximately 175 acres, serves as the source of makeup water to the mill, and will be the source of makeup water for the heap leach operation.

Seepage from the tailing impoundment is collected in a seepage collection sump located at the downgradient toe of the embankment. The sump is connected to the foundation drain in the dam. In addition, there are six interceptor wells that collect any bypass flow from the sump. Pumping from these wells has created a cone of depression that provides hydraulic containment. Solutions collected in the sump and by the interceptor wells are returned to the tailing impoundment.

Below the tailing impoundment within the Fish Creek drainage are a series of constructed wetlands developed by FGMI in areas of old placer mining. The wetlands discharge to the freshwater reservoir constructed by FGMI to provide makeup water for processing ore. In addition to the Fish Creek drainage, Solo Creek and Last Chance Creek discharge to the freshwater reservoir which discharges through a spillway to Fish Creek.

2.5 General Environmental Conditions

Climate

The climate of the general project area is subarctic and is typically cold and dry although summers can be wet. The mean annual precipitation is approximately 18 inches. Temperatures typically range from a high of approximately 80 degrees Fahrenheit to a low of minus 50 degrees Fahrenheit.

Geomorphology and General Conditions

The Walter Creek valley fill heap leach pad is located in the Walter Creek/Barnes Creek/Fish Creek drainage, an elongated east-west to southwest-northeast-oriented valley. Topography of the area consists of rounded, moderately sloping hills and ridges and broad, flat-bottomed valleys. The topography is approaching maturity, apparently never having been glaciated. Weathering is deep and intense, and thus rock outcrops are scarce.

The leach pad will be located near the upper end of the Walter Creek drainage. The upper end of the drainage is bowl-shaped with the main drainage oriented in an east-west direction joined by two sub-drainages feeding in from the north side. This valley has not been disturbed by placer mining as have a number of other valleys in the area. The Walter Creek drainage and the heap leach pad are located immediately upstream of the existing Fort Knox Mine Tailing Storage Facility (Figure 1.1).

Soils underlying the valley bottom include silty sands and gravels with lenses of silts. The soils are underlain by weathered to competent schist. Walter Creek flows year round in the main drainage. The valley bottom supports a growth of brush and grass vegetation. Foundation preparation will include removal of the vegetation and soils within the valley bottom such that the base platform fill and in-heap storage embankment are founded on competent schist bedrock. The soil removal will extend up the drainages until competent soils for support of the proposed pad are encountered. Any zones of weak or significantly altered bedrock that would not provide suitable support for the planned facility will be removed.

The width of the Walter Creek valley bottom varies from 150 to 300 feet wide in its lower reaches. The valley bottom is heavily vegetated with marshland vegetation and is wet. The valley side slopes are, on average, 2.5:1 to 3:1 although locally they can be steeper. Maximum relief across the project area in the Walter Creek valley is on the order of 900 to 1,000 feet.

The valley side slopes are generally underlain by 5 to 15 feet of dense silty sands and gravels. There are areas where the thickness of these soils is on the order of 30 feet. Groundwater was generally not encountered in the depths explored by test pits on the valley side slopes. Water in the valley bottom was generally encountered at depths of 5 to 10 feet. The soils are underlain by highly weathered, competent schist. Foundation preparation of the valley side slopes will entail removal of the trees and other vegetation, topsoil, any soft soils, and highly organic soils. The ground will be shaped to provide a basin with slopes of 2.5:1 or flatter to facilitate liner construction. Any rock outcrops will be leveled, smoothed, and covered with at least 3 feet of soil cover.

Permafrost

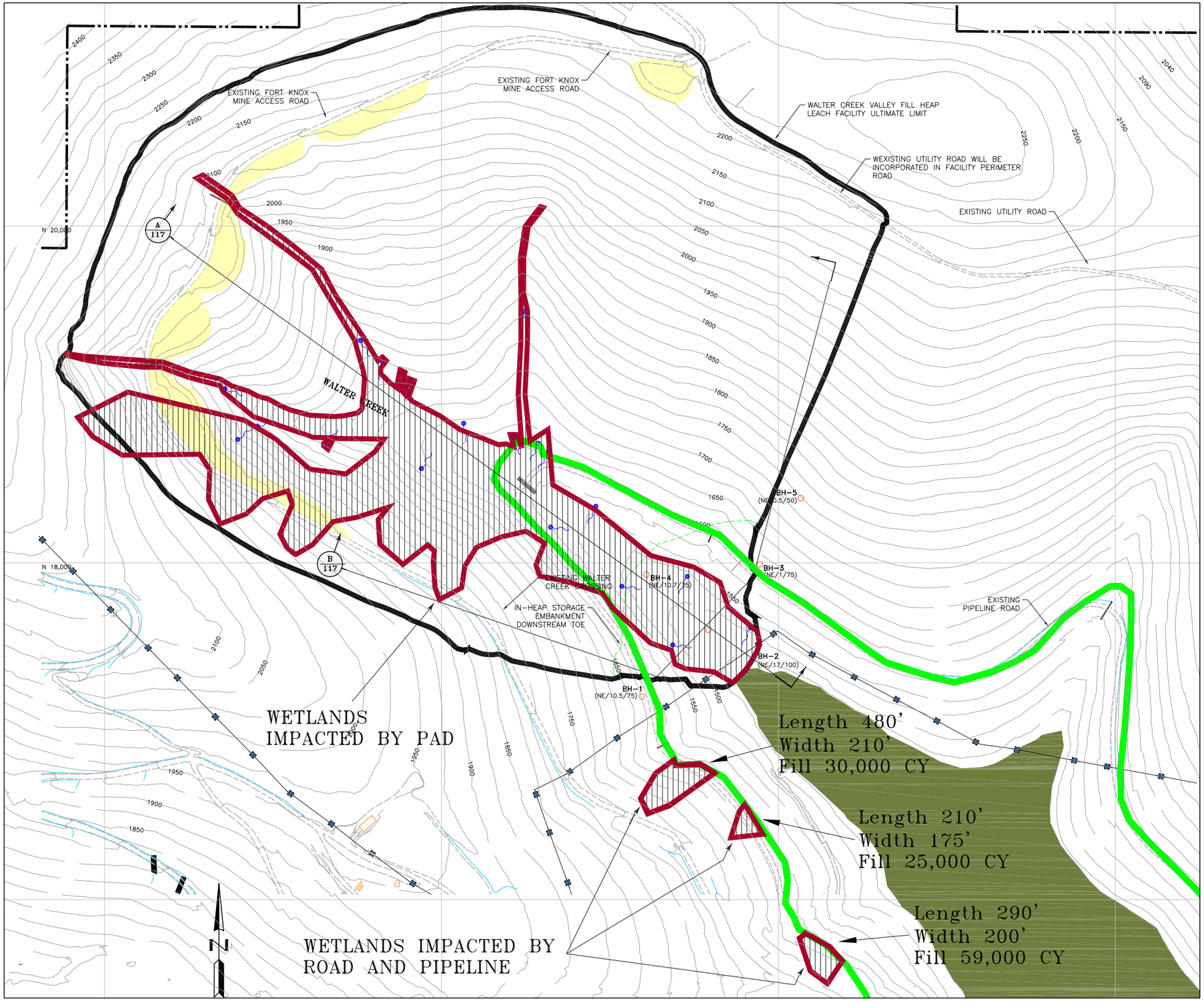
Limited amounts of permafrost have been identified at the toe of the south slope in the Walter Creek valley. Where encountered and judged to be a problem, the permafrost will be removed to bedrock. The limited amount of permafrost is not expected to cause freezing of the solutions in the heap. In general, permafrost forms as a result of cold air temperatures freezing the soils and rock from the surface down. Covering the permafrost with the leach pad will cause it to melt since the supply of cold air that is needed to maintain permafrost is removed and replaced by the relatively warm ore and solution in the leach pad. Any permafrost that could melt and provide unsuitable support for the pad and its related facilities will be removed.

Vegetation

Most undisturbed ground within the project area that includes the Walter Creek valley is forested. Well drained soils of the uplands and alluvial plains are vegetated mainly with white spruce, paper birch, and quaking aspen. Moderately well drained soils support vegetation similar to that found on well drained soils; however, black spruce and willows are commonly found. Mosses, horsetail, and grasses usually cover the ground in these areas. Poorly drained soils usually support communities of black spruce, willow, and alder. Ground cover consists of moss, lichens, Labrador tea, cranberry, blueberry, and shrubs of bog birch and tussocks of cotton grass.

2.6 Wetlands

In 1992, a jurisdictional wetland survey was completed for the Fort Knox Project. Additional acreage has been identified based on current conditions and current regulations. Figure 2.1 illustrates the planned heap leach pad and the 54.7 acres of jurisdictional wetlands that will be impacted by the pad. An additional 2.91 acres of jurisdictional wetlands identified on Figure 2.1 will be disturbed by roads and pipelines to be constructed in conjunction with the heap leach pad. Within the footprint of the heap leach pad, 15.3 acres of wetlands were previously permitted to receive fill as part of the tailing impoundment.



LEGEND:

- 2200 — EXISTING GROUND SURFACE CONTOUR AND EL, FEET
- PROPERTY BOUNDARY
- EXISTING PIPELINE
- EXISTING DRAINAGE/DIVERSION
- Existing Utility Pole — EXISTING POWER LINE
- EXISTING ROAD
- EXISTING CULVERT
- EXISTING SPRING
- Tailing Permit Boundary
- Heap Leach Boundary
- Wetlands Boundary
- 1992 Jurisdictional Wetlands
- EXISTING SITE ACCESS ROAD FILL
- Jurisdictional Wetlands
- TAILING (CONFIGURATION AS OF 4/30/2005)

NOTES:

1. SUMMARY LOGS OF THE TEST HOLES AND TEST PITS ARE INCLUDED IN THE WALTER CREEK VALLEY FILL HEAP LEACH FACILITY DESIGN REPORT.
2. BOREHOLES BH-1 THROUGH BH-5, DRILLED FOR SOIL SAMPLING, DUPLICATE THE LOCATIONS OF BH-WSS1 THROUGH BH-WSS5, DRILLED FOR ROCK, RESPECTIVELY.
3. TEST PITS TP-5, 9, 10, 11, AND 15 WERE NOT COMPLETED DUE TO INACCESSIBILITY CAUSED BY DENSE FORESTED AREAS.

REFERENCE:
TOPOGRAPHIC MAPPING PROVIDED BY CLIENT DATA FILE NAMED: FORT_KNOX_2005_LOCAL.DWG. DATED: 07/06/05 RECEIVED BY KNIGHT PIESOLD ON 7/2005. SEE G:\101\00089.08\A\Data_Info\External\TOPO\071505

PLAN

300 0 300 600 FEET

FORT KNOX Gold Mine · Alaska

Heap Leach Pad
Jurisdictional Wetlands

Figure 2.1

REV

SCALE: 1" = 1000'

DATE: 5/2006

SHEET 1 OF 1

PLOT SCALE 1:2

XREF: NO

3.0 HEAP LEACH FACILITY

3.1 Overview

The design of the Walter Creek valley fill heap leach was developed by Knight Piésold and Co. (2005). The heap leach pad will be constructed in five stages with the first two stages constructed initially. The pad will be loaded with run-of-mine ore from the Fort Knox pit and lower grade stockpiles. Ore will be loaded on the pad in lifts of 40 feet at a rate of 40,000 tons per day.

The valley fill heap leach pad will be constructed with a 12-inch prepared subbase with a permeability of less than 1×10^{-5} cm/sec overlain by a geomembrane liner which will be 80-mil LLDPE or a similar material. Above the geomembrane liner, there will be an overliner constructed of 3 feet of crushed rock predominantly less than one inch in size containing a network of piping to promote rapid drainage. The overliner will provide liner protection during ore loading, promote leachate collection, and maintain a low head on the synthetic liner.

The facility will utilize an in-heap storage pond for collection of pregnant solution. In addition to providing the necessary operating capacity for pregnant solution management, the in-heap storage pond will be sized to contain: (1) solution from a 24-hour drain down, plus (2) the runoff from the 100-year/24-hour storm event. Within the limits of the in-heap storage pond, an LCRS will be constructed between the primary and secondary 80-mil LLDPE geomembrane above the prepared subbase.

The LCRS will consist of the two geomembrane liners with a pump back system to return any solution passing through the primary liner to the in-heap storage pond. A PCMS that will consist of a network of drains located below areas of high solution flow will also be utilized for leak detection. An underdrain system designed to capture and transport flow from seeps and springs under the pad will provide a third level of leak detection.

Solution will be removed from the heap with a series of three pregnant solution collection wells located at the lowest portion of the in-heap storage basin. The pumping rate will approximate the solution application rate of 8,000 gallons per minute (gpm). Each of the pumps will have a capacity of 4,000 gpm. Typically, two pumps will be in operation with the third pump on standby. Pregnant solution will be pumped directly to a new CIC located adjacent to the existing mill.

The CIC plant will consist of a train of carbon columns that will adsorb the gold and silver on to carbon. The barren solution from the CIC plant will be returned to the pad. The application of barren solution will likely utilize a network of solution emitters. All solution will be moved to and from the pad in pipes.

3.2 Site Preparation

Construction of the heap leach facility will begin with removal of vegetation and topsoil material from the 310 acres planned for pad development. Vegetation and topsoil will be stockpiled for use in site reclamation. Additionally, any soils identified as unsuitable for foundation material beneath the pad will be removed. Material removed from the surface of the basin will be stockpiled in the two areas identified on Figure 3.0. Additional stockpiles may be utilized depending on the proximity to the work areas. The south stockpile will be constructed on tailing by first developing a base platform using waste rock from the Fort Knox pit. Sufficient room will be left between the stockpile and north slope for flows from the heap leach pad to enter the tailing storage facility. A sufficient amount of growth media will be stockpiled to allow replacement of a minimum of one foot of growth media on the heap leach pad disturbance at closure.

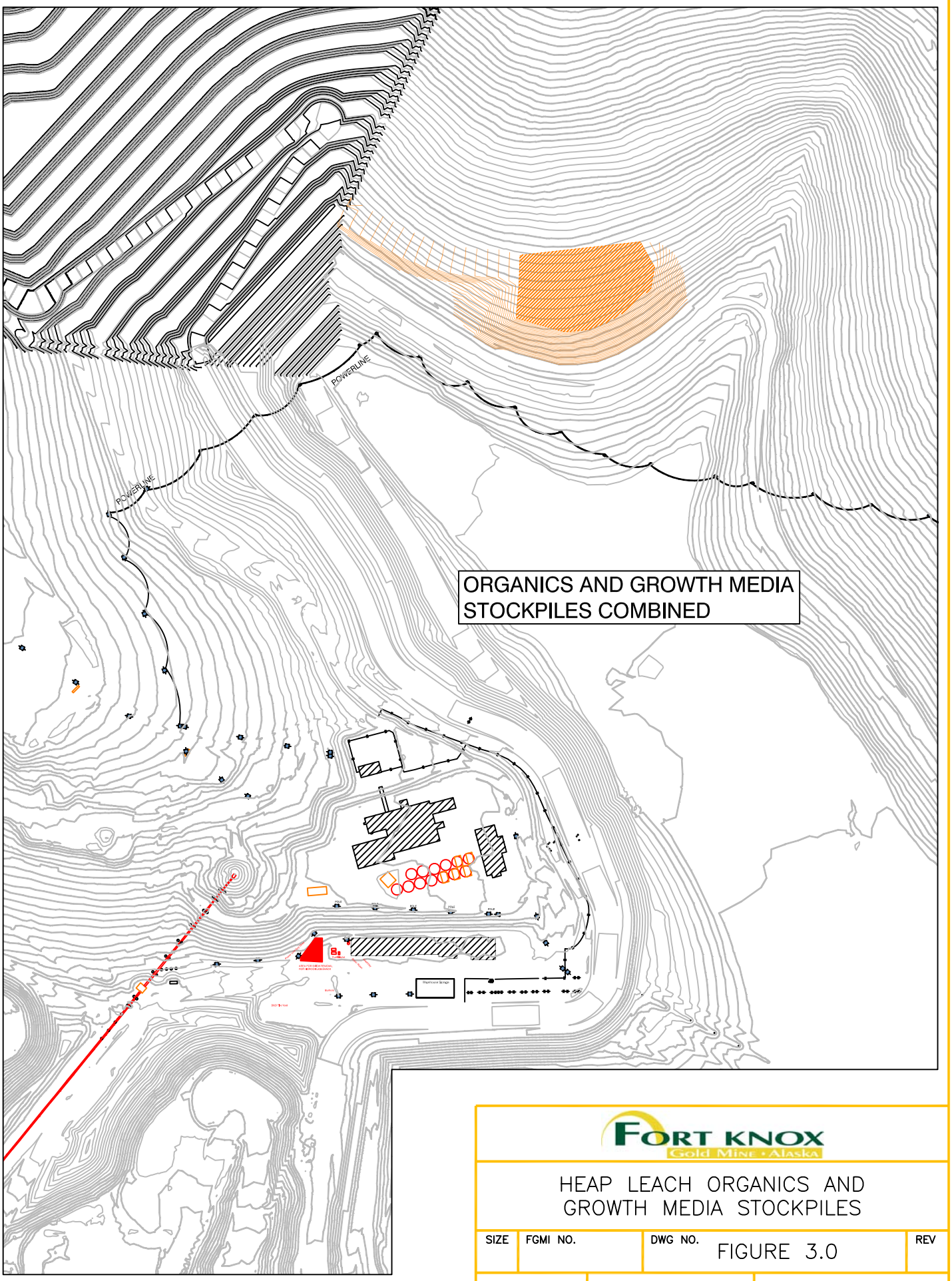
3.3 Base Platform

The base platform fill will be constructed to provide a base for the in-heap storage embankment and in-heap pond area. Figure 3.1 illustrates the design of the base platform. It will have a downstream slope of 2.5:1. The top of the platform at the downstream side will be at elevation 1539.7. The base platform will be about 50 feet high as measured from the existing ground level. It will be founded on rock approximately 15 feet below the existing ground surface.

The base platform has been designed so that the top of the platform will remain above the level of the tailing anticipated in the future. The ultimate level of the tailing will cover the lower 40 feet of the base platform. The top of the base platform will be approximately 10 feet above the ultimate tailing surface. A horizontal bench 50 feet wide will be located at the top of the base platform downstream of the toe of the in-heap storage embankment. The PCMS monitoring collection sumps and underdrain monitoring well will be located on this bench. The base platform will be constructed of mine waste rock comparable to the random fill used in construction of the tailing embankment. The waste rock will be placed in 4-foot lifts compacted by controlled routing of the mine haul trucks and will be a granular material with particles ranging predominantly from 2 inches to 2 feet in size.

3.4 In-Heap Storage Pond Embankment

The heap leach facility is designed with in-heap storage of process solution and storm water behind an embankment, which eliminates any surface exposure of process solution. Random fill composed of mine waste rock will be used to construct the embankment. It will be placed in approximately 4-foot lifts compacted by controlled routing of the mine haul trucks. The geomembrane liner system for the heap leach facility will be extended up the upstream face of the embankment to provide solution containment. The total volume for solution storage behind



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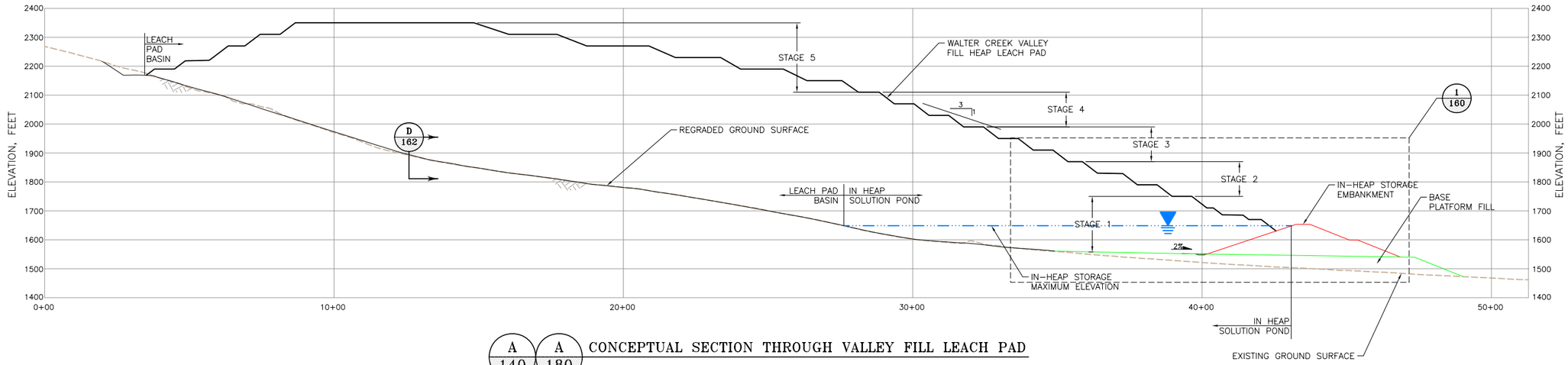
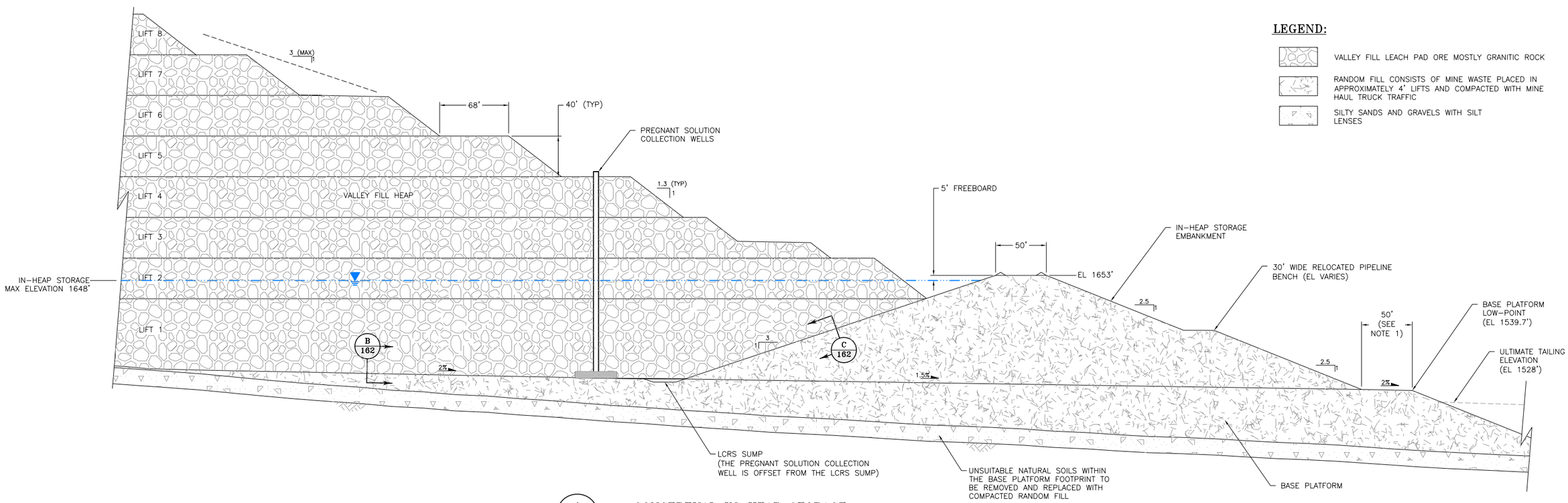
HEAP LEACH ORGANICS AND
GROWTH MEDIA STOCKPILES

SIZE	FGMI NO.	DWG NO.	REV
		FIGURE 3.0	
SCALE NTS		DV101-89-08-166	



A 140 A 180 CONCEPTUAL SECTION THROUGH VALLEY FILL LEACH PAD

200 0 200 400 FEET



LEGEND:

- VALLEY FILL LEACH PAD ORE MOSTLY GRANITIC ROCK
- RANDOM FILL CONSISTS OF MINE WASTE PLACED IN APPROXIMATELY 4' LIFTS AND COMPACTED WITH MINE HAUL TRUCK TRAFFIC
- SILTY SANDS AND GRAVELS WITH SILT LENSES

1 160 CONCEPTUAL IN-HEAP STORAGE EMBANKMENT AND BASE PLATFORM

50 0 50 100 FEET

NOTE:

1. THE UNDERDRAIN COLLECTION SUMP AND PCMS SUMP WILL BE LOCATED ALONG THE 50' WIDE BASE PLATFORM FILL SETBACK DOWNSTREAM OF THE IN-HEAP STORAGE EMBANKMENT.

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BASE PLATFORM AND HEAP STORAGE EMBANKMENT

SIZE	FGMI NO.	DWG NO.	REV
		FIGURE 3.1	
SCALE		DV101-89-08-160	

PLOT SCALE 1:2 | XREF: NO

the embankment including the volume of ore placed behind the embankment and the volume of the interstitial pore space available for filling with solution is 64.1 million feet, or 480 million gallons.

The downstream slope of the in-heap storage embankment will be 2.5:1. The upstream slope of the in-heap storage embankment will be 3:1. The in-heap embankment will have a crest width of 50 feet at the crest elevation 1653. The downstream toe of the embankment at the top of the base platform will be at elevation 1540.7 and at the base of the base platform about elevation 1485. Thus, the height of the in-heap storage embankment above the base platform will be about 112 feet and from the toe of the base platform to the crest of the in-heap storage embankment will be about 168 feet. On the upstream side of the in-heap storage embankment from the upstream toe to the crest, the in-heap storage embankment will have a height of 102.5 feet.

Two benches will be located on the downstream slope of the in-heap storage embankment including: (1) one 30-foot-wide bench at about elevation 1590 to carry the rerouted existing pipeline and road across the Walter Creek valley, and (2) a 50-foot-wide bench at about elevation 1540 to provide access along the top level of the base platform and area for installation of the monitoring well for the underdrain system and PCMS monitoring sumps.

3.5 Liner Design

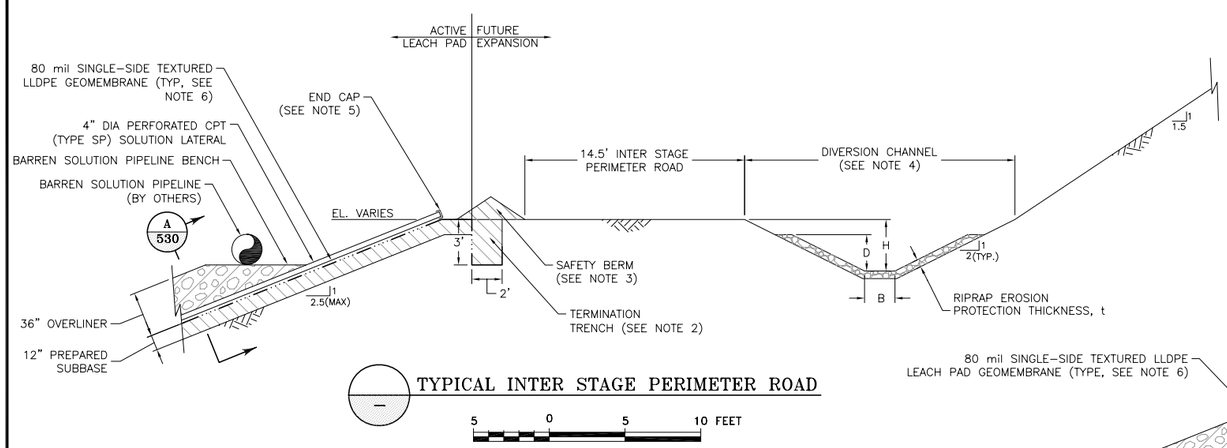
The entire base of the leach pad will be underlain by a composite liner including a 12-inch-thick prepared subbase and overlain by an 80-mil LLDPE geomembrane. For the purpose of discussion, the pad can be divided into two areas described as that area located outside the limits of the in-heap storage pond and that area beneath the in-heap storage pond. The in-heap pond area will be double lined with an LCRS system between the secondary composite liner and the primary 80-mil LLDPE liner.

Outside the In-Heap Storage Pond Liner

For the entire basin, the liner system includes a geomembrane placed directly over a one-foot-thick prepared subbase soil layer with a permeability of less than 1×10^{-5} cm/sec. Figures 3.2 and 3.3 provide sections and details of the liner system outside of the in-heap storage. The geomembrane will be an 80-mil LLDPE liner. LLDPE was chosen as a liner material since it has relatively high interface strength and excellent chemical resistance to the anticipated solutions, and it has good performance characteristics related to cold weather. In addition, it has a long history of good performance when used under heaps with high loads.

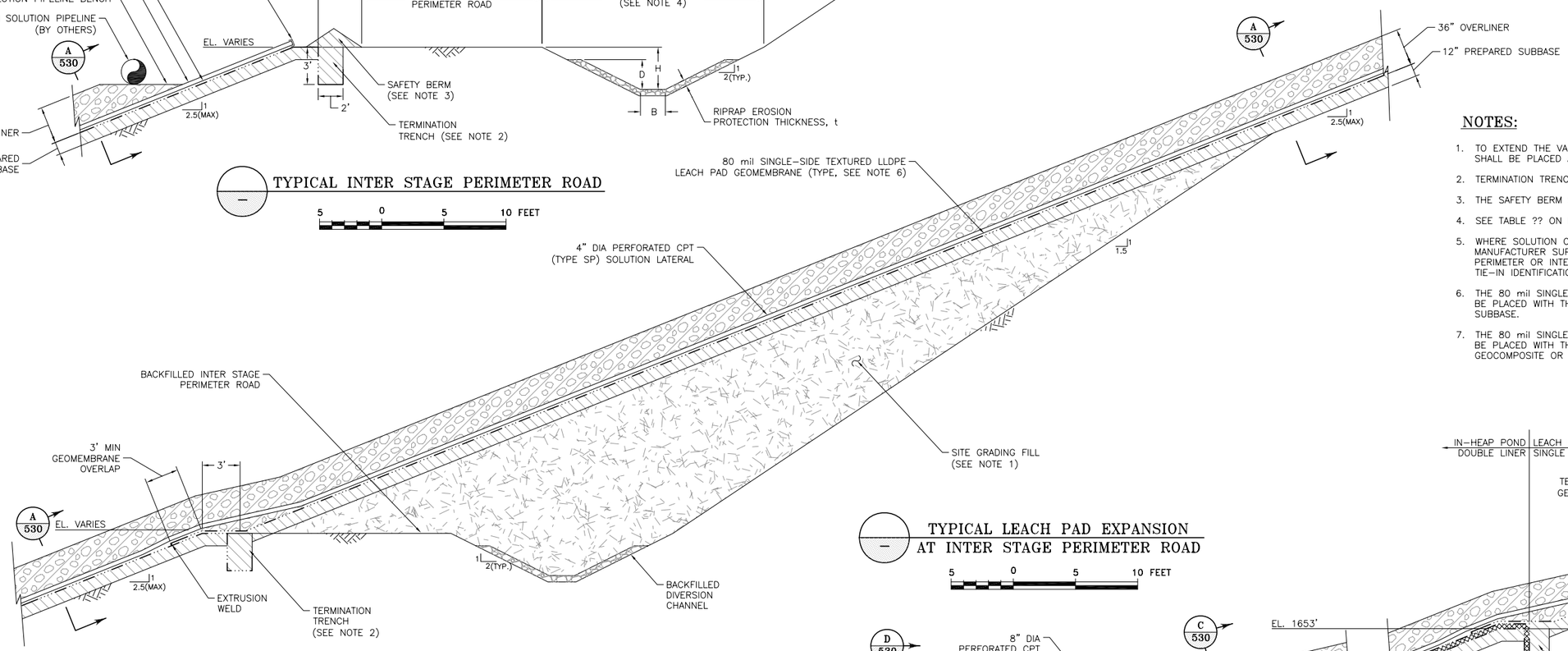
In-Heap Storage Pond Liner

Beneath the in-heap storage pond, a double liner system with an LCRS between the liners will be used. Figures 3.4 and 3.5 provide sections and design for the liner system beneath the in-heap storage pond. The one-foot-thick prepared subbase with a permeability of less than 1×10^{-5} cm/sec will be overlain by an 80-mil LLDPE geomembrane. This will be overlain by an LCRS



TYPICAL INTER STAGE PERIMETER ROAD

5 0 5 10 FEET

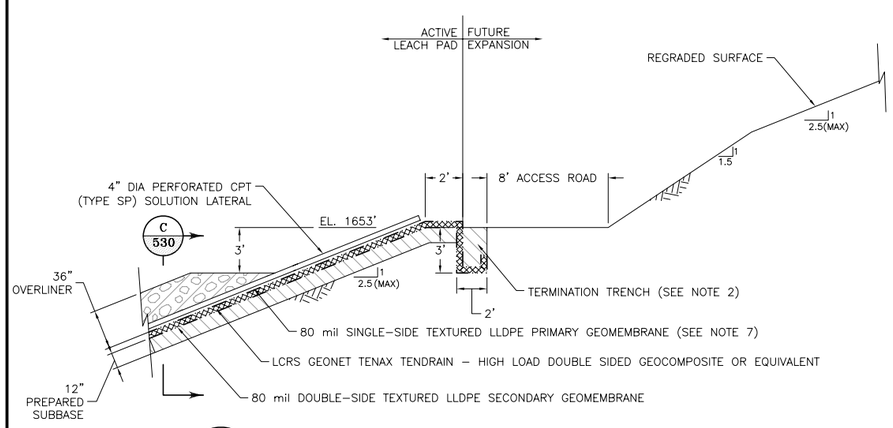


TYPICAL LEACH PAD EXPANSION AT INTER STAGE PERIMETER ROAD

5 0 5 10 FEET

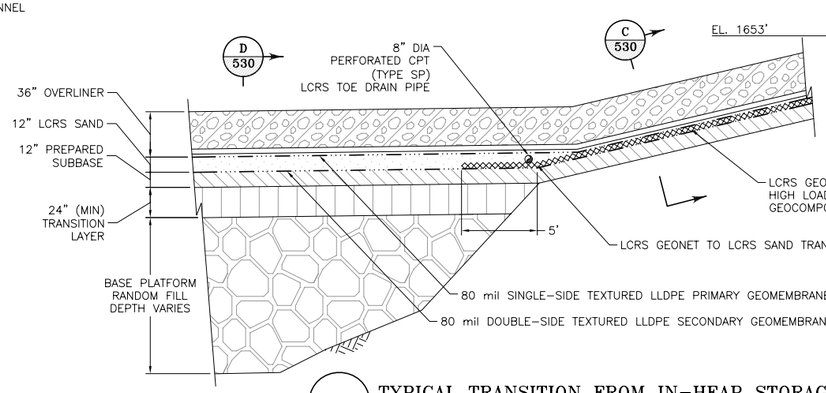
NOTES:

1. TO EXTEND THE VALLEY FILL LEACH PAD LINING SYSTEM, SITE GRADING FILL SHALL BE PLACED AND COMPACTED TO FORM THE LEACH PAD SURFACE.
2. TERMINATION TRENCH BACKFILL SHALL BE A COMPACTED PREPARED SUBBASE
3. THE SAFETY BERM SHALL BE CONSTRUCTED OF PREPARED SUBBASE.
4. SEE TABLE ?? ON DRAWING ???? FOR DIVERSION CHANNEL DATA.
5. WHERE SOLUTION COLLECTION PIPE TERMINATES, IT SHALL BE FITTED WITH A MANUFACTURER SUPPLIED END CAP. PIPEWORK TERMINATING AT THE PAD PERIMETER OR INTERMEDIATE BOUNDARY SHALL BE SURVEYED (FOR FUTURE TIE-IN IDENTIFICATION).
6. THE 80 mil SINGLE-SIDE TEXTURED LLDPE LEACH PAD GEOMEMBRANE SHALL BE PLACED WITH THE TEXTURED SIDE ADJACENT TO THE PREPARED SUBBASE.
7. THE 80 mil SINGLE-SIDE TEXTURED LLDPE PRIMARY GEOMEMBRANE SHALL BE PLACED WITH THE TEXTURED SIDE ADJACENT TO THE LCRS GEOCOMPOSITE OR LCRS SAND.



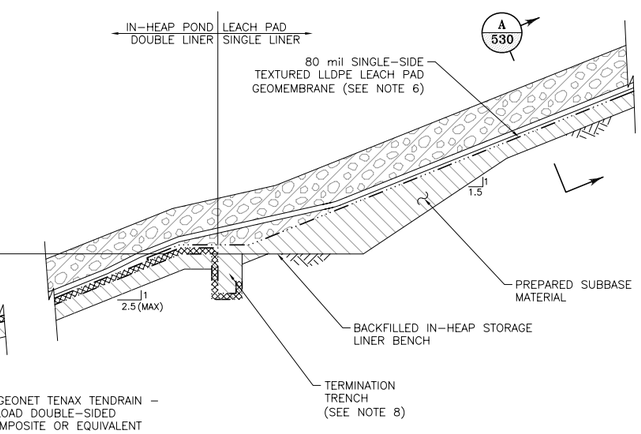
TYPICAL IN-HEAP STORAGE LINER TRANSITION BENCH

5 0 5 10 FEET



TYPICAL TRANSITION FROM IN-HEAP STORAGE POND DOUBLE LINER TO LEACH PAD SINGLE LINER

5 0 5 10 FEET



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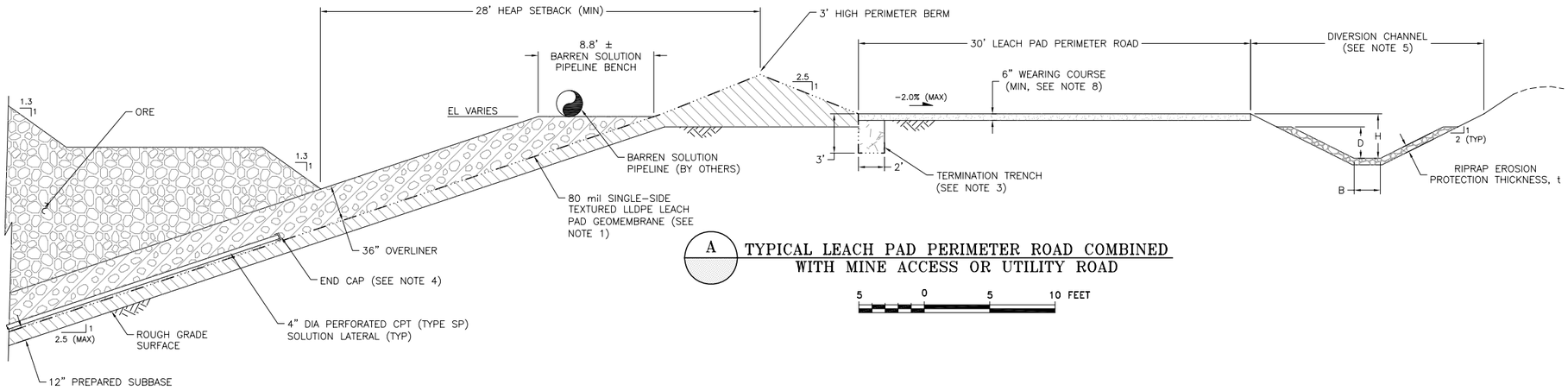
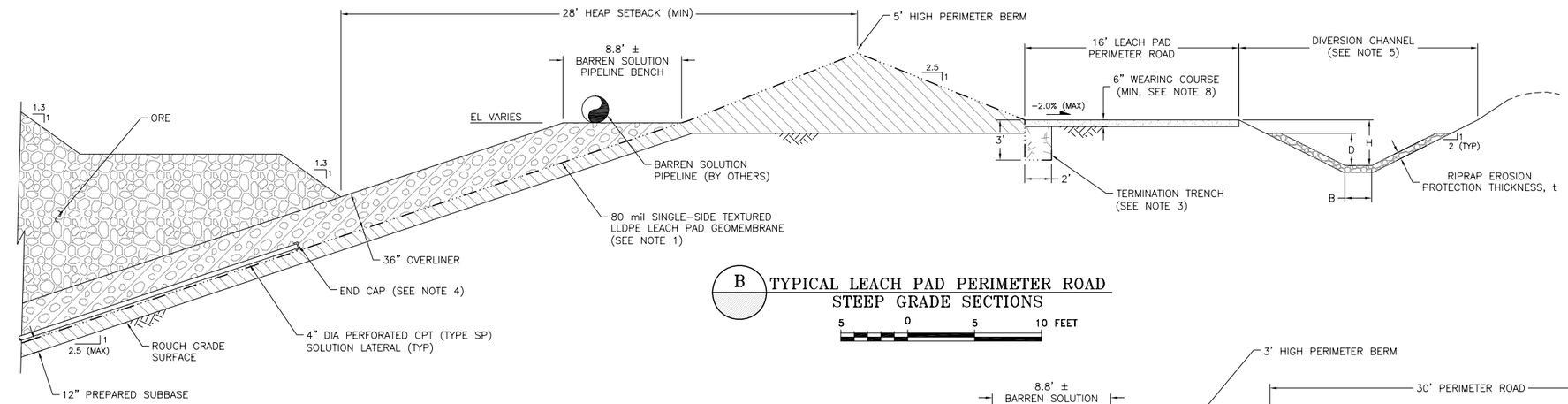
SECTION AND DETAIL OF LINER DESIGN INTERMEDIATE BOUNDRY

SIZE	FGMI NO.	DWG NO. FIGURE 3.2	REV
SCALE		DV101-89-08-166	



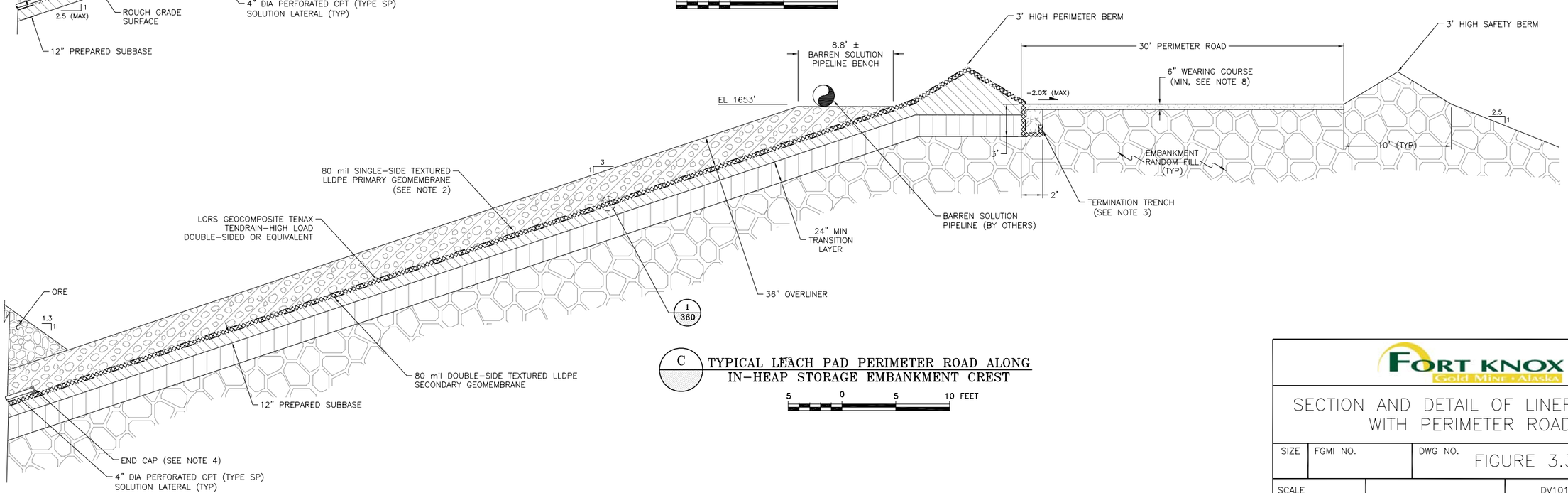
A TYPICAL LEACH PAD PERIMETER ROAD COMBINED WITH MINE ACCESS OR UTILITY ROAD

5 0 5 10 FEET



B TYPICAL LEACH PAD PERIMETER ROAD STEEP GRADE SECTIONS

5 0 5 10 FEET



C TYPICAL LEACH PAD PERIMETER ROAD ALONG IN-HEAP STORAGE EMBANKMENT CREST

5 0 5 10 FEET

NOTES:

1. THE 80 mil SINGLE-SIDE TEXTURED LLDPE LEACH PAD GEOMEMBRANE SHALL BE PLACED WITH THE TEXTURED SIDE ADJACENT TO THE PREPARED SUBBASE.
2. THE 80 mil SINGLE-SIDE TEXTURED LLDPE PRIMARY GEOMEMBRANE SHALL BE PLACED WITH THE TEXTURED SIDE ADJACENT TO THE LCRS GEOCOMPOSITE.
3. TERMINATION TRENCH BACKFILL SHALL BE A COMPACTED SITE GRADING FILL MATERIAL FREE OF EXCESSIVE GRAVEL.
4. WHERE SOLUTION COLLECTION PIPE TERMINATES, IT SHALL BE FITTED WITH A MANUFACTURER SUPPLIED END CAP. PIPEWORK TERMINATING AT THE PAD PERIMETER OR INTERMEDIATE BOUNDARY SHALL BE SURVEYED (FOR FUTURE TIE-IN IDENTIFICATION).
5. REFERE TO TABLE ?? ON DRAWING ???? FOR DIVERSION CHANNEL DATA.
6. PERIODIC MAINTENANCE OF THE DIVERSION CHANNEL SHALL BE REQUIRED FOR THE LIFE OF THE FACILITY.
7. REFER TO THE TECHNICAL SPECIFICATIONS FOR MATERIAL PLACEMENT REQUIREMENTS.
8. THE MINE ACCESS/UTILITY/PERIMETER ROAD SHALL BE GRADED AWAY FROM THE VALLEY PAD AND PERIMETER BERM BY SHAPING THE WEARING COURSE SURFACE. MINIMUM WEARING COURSE THICKNESS OF 6" SHALL BE MAINTAINED.
9. MAINTENANCE OF ALL FILL SLOPES WILL BE REQUIRED FOR THE LIFE OF THE ROAD. ANY REVEGETATION OR SEDIMENT CONTROL FOR THESE SLOPES SHALL BE PROVIDED BY FGMI.

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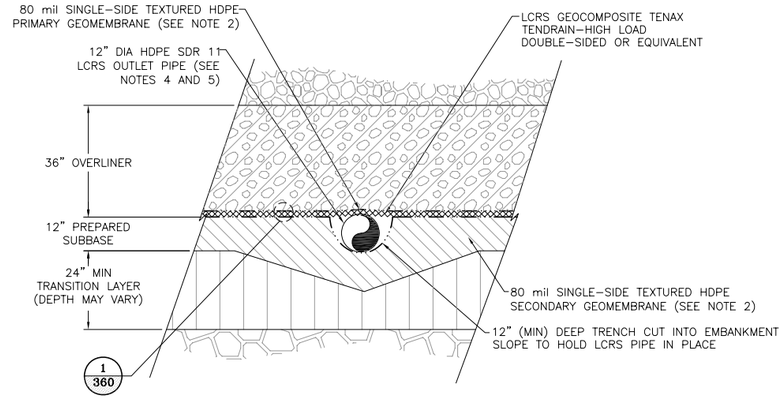
SECTION AND DETAIL OF LINER DESIGN WITH PERIMETER ROAD

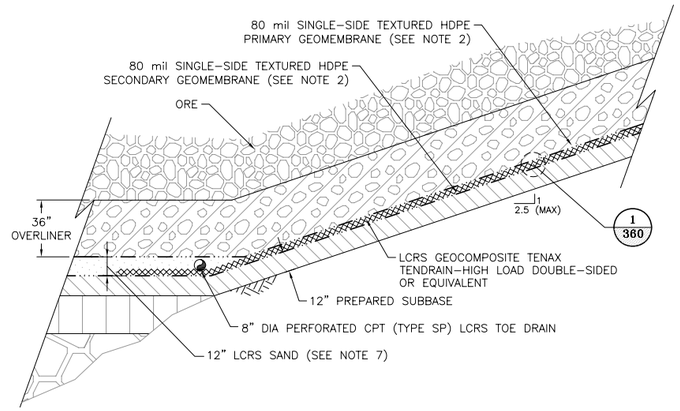
SIZE	FGMI NO.	DWG NO. FIGURE 3.3	REV
SCALE		DV101-89-08-166	



NTS

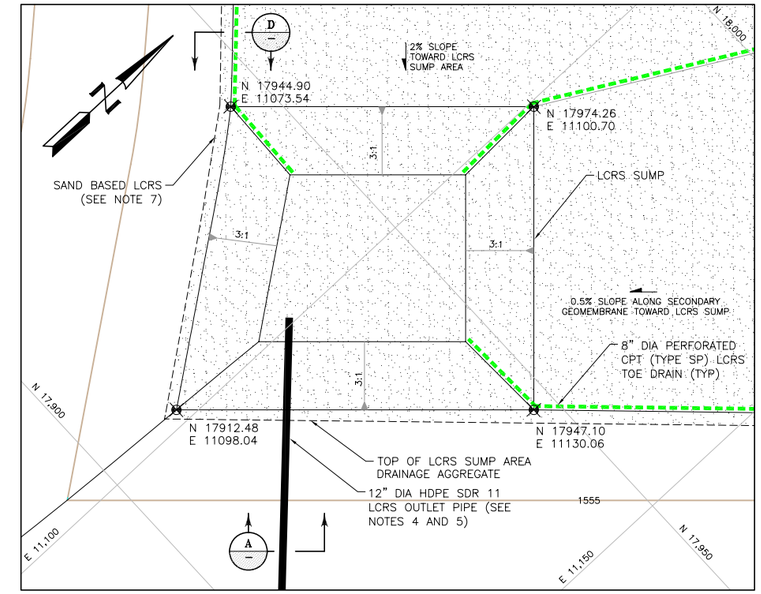
A – A 360 TYPICAL LCRS OUTLET PIPE TRENCH

2 0 2 4 FEET



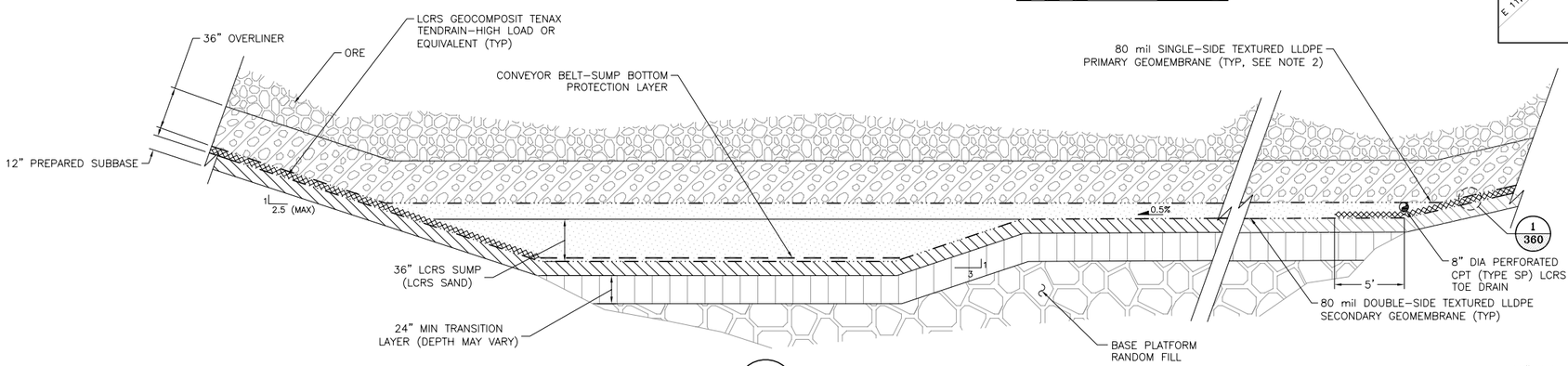
D – D 360 TYPICAL LCRS TOE DRAIN

4 0 4 8 FEET



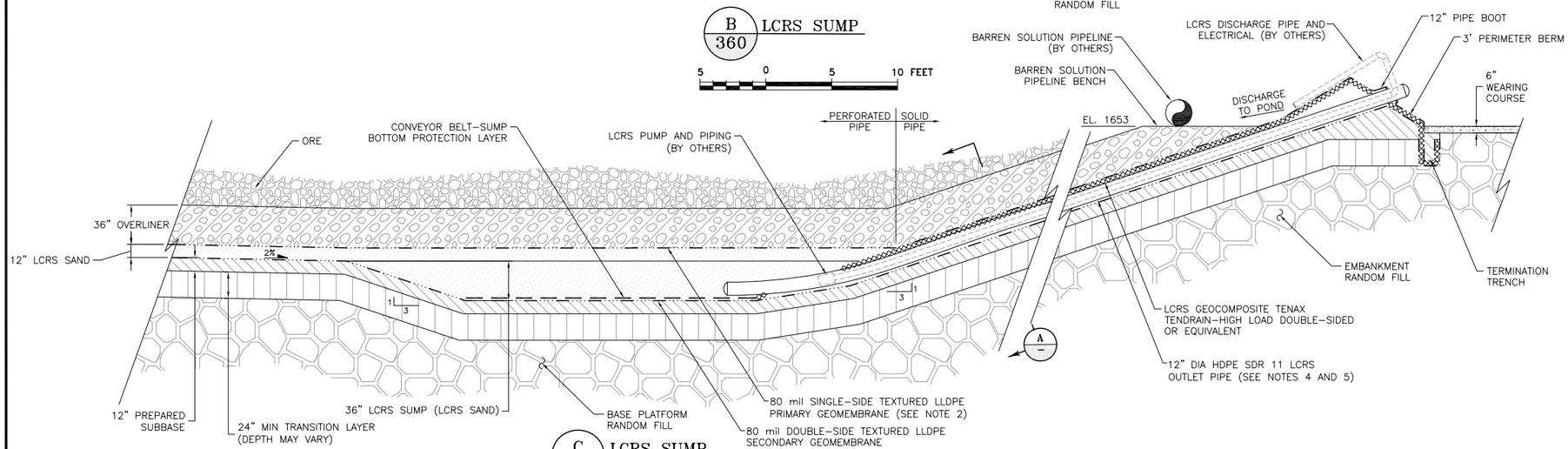
2 360 LCRS SUMP AREA LAYOUT

10 0 10 20 FEET



B 360 LCRS SUMP

5 0 5 10 FEET



C 360 LCRS SUMP

5 0 5 10 FEET

NOTES:

1. ALL PIPE CONNECTIONS SHALL BE FORMED USING MANUFACTURER SUPPLIED TEES, WYES AND COUPLERS. ALL CPT PIPE CONNECTIONS SHALL BE SECURED TO THE PIPE USING WIRE TIES AROUND BOTH ENDS OF THE CONNECTIONS. ALL SOLUTION COLLECTION PIPEWORK CONNECTED WITH SPLIT COUPLERS SHALL HAVE THE COUPLER SEAM ROTATED TO THE SIDE OF THE PIPE.
2. THE 80 mil SINGLE-SIDE TEXTURED LLDPE PRIMARY LINER SHALL BE PLACED WITH THE TEXTURED SIDE ADJACENT TO THE LCRS GEOCOMPOSITE OR LCRS SAND.
3. THREE ROWS OF SLOTS SHALL BE EQUALLY SPACED AROUND THE FIRST 9' OF THE LCRS OUTLET PIPE (WITHIN THE LCRS SUMP). SLOTS SHALL BE 3" x 1/4" ON 2" CENTERS AND THE END SHALL BE CAPPED.
4. THE 12" DIA HDPE LCRS OUTLET PIPE SERVES AS A CONDUIT FOR A SUBMERSIBLE LCRS PUMP. THE SUBMERSIBLE PUMP FOR THE LCRS SHALL BE EQUIPPED WITH DISCHARGE HOSE AND ELECTRICS (BY OTHERS).
5. THE LCRS OUTLET PIPE SHALL BE BOOTED THROUGH THE LEACH PAD PRIMARY LINER AT THE EMBANKMENT CREST TO ALLOW ACCESS FOR PUMPING AND SAMPLING.
6. ABOVE THE LCRS SUMP, SAND SHALL BE PLACED WITHIN THE LCRS SUMP AREA TO CONSTRUCT THE 2% SLOPE ALONG THE PRIMARY GEOMEMBRANE TOWARD THE LEACH PAD SOLUTION COLLECTION LOW POINT LINE.
7. WITHIN THE AREA OF THE LEACH PAD COVERED WITH AN LCRS, WHERE THE PAD SLOPES ARE LESS THAN 10%, THE LCRS GEOCOMPOSITE SHALL BE REPLACED WITH A 12" THICK LAYER OF LCRS SAND CONTAINING A SERIES OF COLLECTION PIPES REPORTING TO THE LCRS SUMP.

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LCRS

SIZE	FGMI NO.	DWG NO. FIGURE 3.4	REV
SCALE		DV101-89-08-166	

consisting of a geocomposite on the steeper slopes and an LCRS sand layer with slotted HDPE collector pipes in the flatter base area of the pad above which the primary geomembrane (80-mil LLDPE) will be installed. The primary LLDPE liner will be textured on the bottom side, and the secondary LLDPE liner will be textured on both sides. The LCRS is described in more detail in Section 3.6. Any drainage captured by the LCRS will report to a sump at the upstream toe of the in-heap storage embankment where it will be returned to the in-heap storage pond.

3.6 Overliner

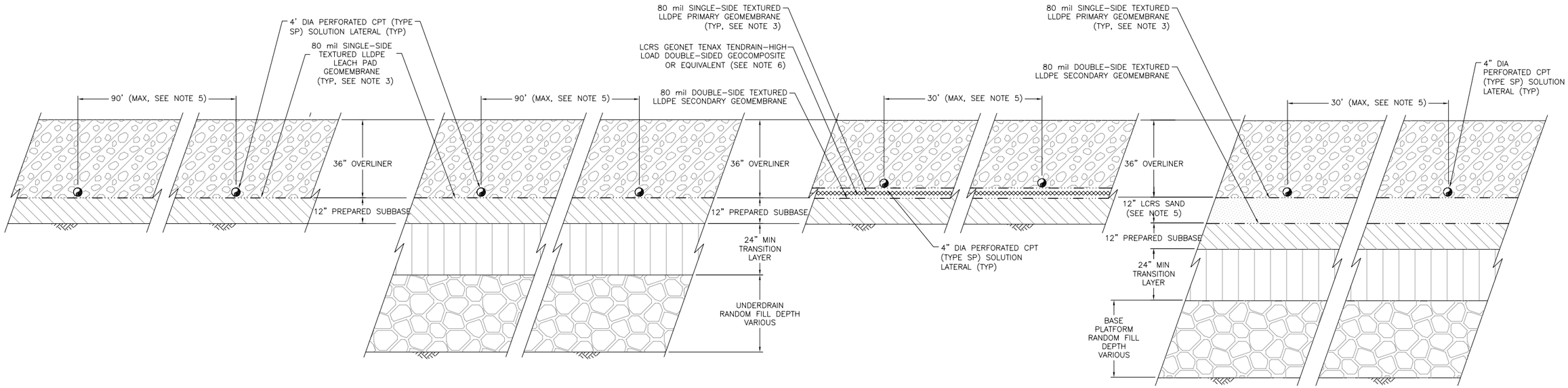
An overliner layer will be constructed over the entire leach pad. The overliner will consist of 3 feet of crushed mill reject material predominantly less than one inch in size with a network of perforated piping embedded in the layer. Drainage collected in the overliner will report to the in-heap storage pond and solution collection wells located upstream of the in-heap embankment. The overliner will serve three purposes: (1) to minimize the head on the liner to reducing the risk of process solution leakage, (2) to protect the synthetic liner from damage during ore placement, and (3) to maximize the return of the gold containing pregnant solution for processing. Crushed reject material from the mill satisfies the requirements for overliner material. Figure 3.5 illustrates the overliner design.

The piping network embedded in the overliner will consist of a series of corrugated, slotted, smooth interior (CPT) collection pipes. Although the overliner material has a significant fluid-carrying capacity, the piping will be included in the overliner to provide for more rapid transport of process solution to the in-heap storage pond and solution collection wells and maintain a lower head on the liner. Figure 3.6 illustrates the layout of the solution collection pipework in the overliner material. The piping will include 6-inch to 24-inch collection pipes in the low areas of the recontoured basin leading to the solution collection wells. A series of 4-inch solution laterals will cover the areas between the collection pipes in a herringbone pattern to transport process fluid to the collection pipes. These will be spaced on varying intervals (20 to 130 feet) depending on the slope on which they are installed.

3.7 Leachate Collection and Recovery System

Beneath the side steeper slopes of the in-heap pond, the LCRS will consist of a geonet underlain and overlain by a non-woven geofabric sandwiched between the primary and secondary LLDPE liners. On the flatter floor of the in-heap pond, the LCRS will consist of a 3-foot-thick layer of minus ½-inch size crushed mill reject. A series of CPT pipes will be included in the base of the LCRS sand to transport solution to the LCRS sump. The bottom side of the primary LLDPE geomembrane liner will be textured, and both sides of the secondary LLDPE geomembrane will be textured. Figure 3.4 provides the construction detail for the LCRS.

The floor of the in-heap storage pond immediately above the top of the base platform will be sloped to drain to the LCRS sump located in the southwest corner of the in-heap storage pond. The LCRS sump will consist of a 40-foot-square, 3-foot-deep sump filled with LCRS drain sand. Monitoring, collection, and return of any collected solutions will be accomplished by pumping



A 540 TYPICAL BASIN LINER SYSTEM ABOVE ELEVATION 1653'

2 0 2 4 FEET

B TYPICAL BASIN LINER SYSTEM OVER UNDERDRAIN RANDOM FILL ABOVE ELEVATION 1653'

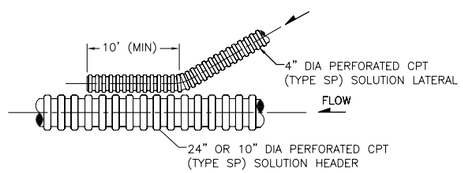
2 0 2 4 FEET

C 540 TYPICAL IN-HEAP SOLUTION POND LINER SYSTEM ON SLOPES OF 10% AND GREATER

2 0 2 4 FEET

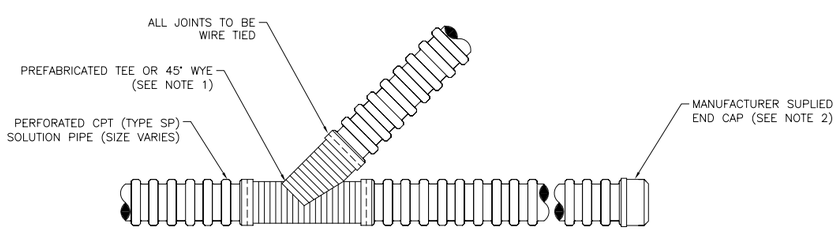
D 540 TYPICAL IN-HEAP SOLUTION POND LINER SYSTEM ON SLOPES LESS THAN 10%

2 0 2 4 FEET



TYPICAL 4" DIA LATERAL TIE-IN TO 24"OR 10" DIA HEADER

NTS



TYPICAL PERFORATED CPT TO PERFORATED CPT CONNECTION

NTS

NOTES:

1. ALL PIPE CONNECTIONS SHALL BE FORMED USING MANUFACTURER SUPPLIED TEES, WYES AND COUPLERS. ALL PIPE CONNECTIONS SHALL BE SECURED TO THE PIPE USING WIRE TIES AROUND BOTH ENDS OF THE CONNECTIONS. ALL SOLUTION COLLECTION PIPEWORK CONNECTED WITH SPLIT COUPLERS SHALL HAVE THE COUPLER SEAM ROTATED TO THE SIDE OF THE PIPE.
2. WHERE A SOLUTION COLLECTION PIPE TERMINATES, IT SHALL BE FITTED WITH A MANUFACTURER SUPPLIED END CAP. PIPEWORK TERMINATING AT THE VALLEY PAD PERIMETER OR INTERMEDIATE BOUNDARY SHALL BE SURVEYED (FOR POTENTIAL FUTURE TIE-IN IDENTIFICATION).
3. THE 80 mil SINGLE-SIDE TEXTURED HDPE LEACH PAD LINER SHALL BE PLACED WITH THE TEXTURED SIDE ADJACENT TO THE LCRS GEOCOMPOSITE OR LCRS SAND.
4. THE 80 mil SINGLE-SIDE TEXTURED LLDPE LEACH PAD GEOMEMBRANE SHALL BE PLACED WITH THE TEXTURED SIDE ADJACENT TO THE PREPARED SUBBASE.
5. THE SOLUTION LATERALS ARE TO BE SPACED ON MAXIMUM 30' CENTERS WITHIN THE AREA COVERED BY THE LCRS (BELOW ELEVATION 1653'), AND SPACED ON MAXIMUM 90' CENTERS ABOVE ELEVATION 1653'.
6. WITHIN THE AREA OF THE LEACH PAD COVERED WITH AN LCRS, WHERE THE PAD SLOPES ARE LESS THAN 10%, THE LCRS GEOCOMPOSITE SHALL BE REPLACED WITH A 12" THICK LAYER OF LCRS SAND CONTAINING A SERIES OF COLLECTION PIPES REPORTING TO THE LCRS SUMP.

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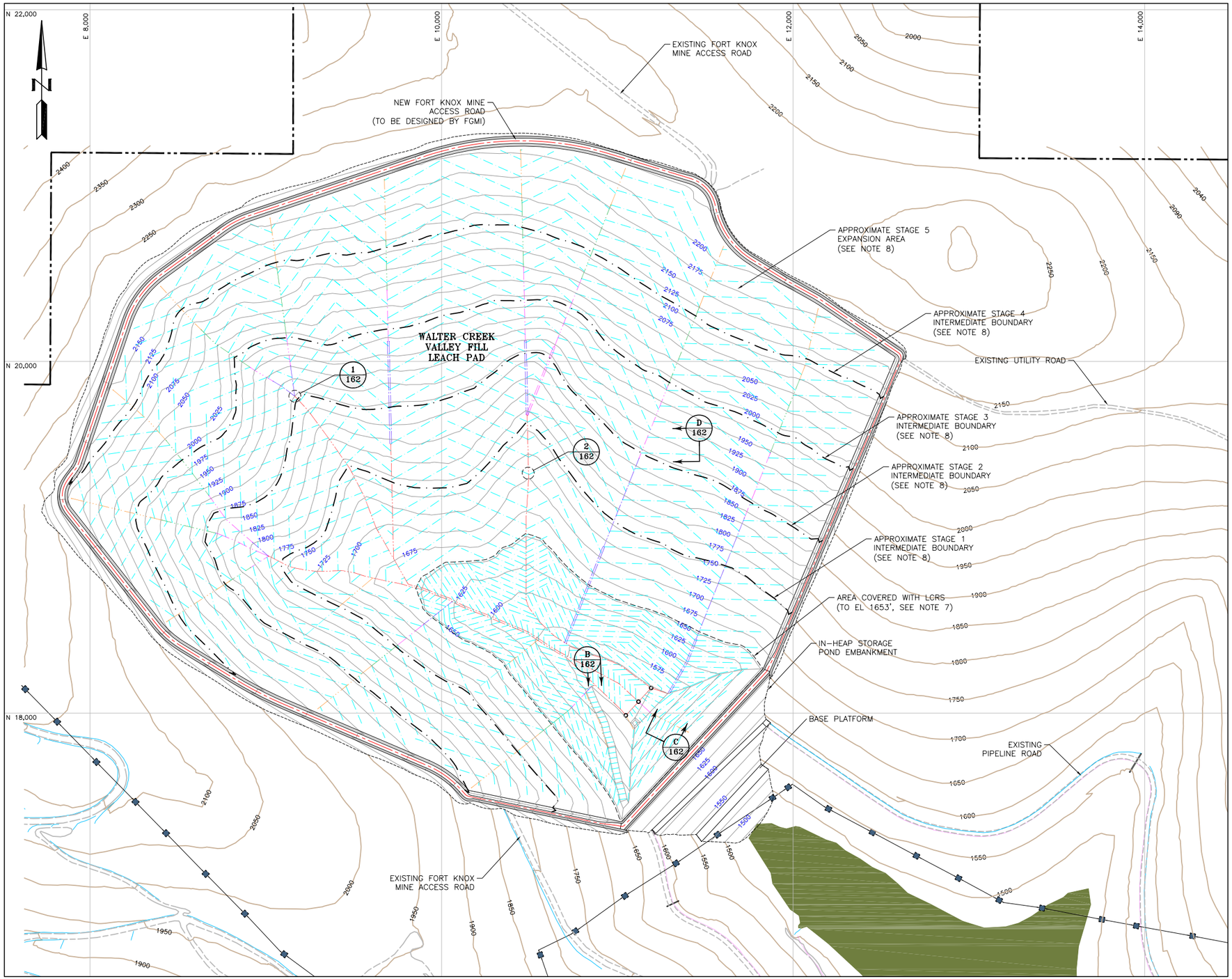
SECTION AND DETAIL OF LINER DESIGN AND OVERLINER

SIZE	FGMI NO.	DWG NO. FIGURE 3.5	REV
SCALE		DV101-89-08-166	



REFERENCE:
–TOPOGRAPHIC MAPPING PROVIDED BY CLIENT DATA FILE NAMED: FORT_KNOX_2005_LOCAL.DWG. DATED: 07/06/05 RECEIVED BY KNIGHT PIESOLD ON 7/2005. SEE G:\101\00089.08\A\Data_Info\External\TOPO\071505

PLAN

300 0 300 600 FEET

LEGEND:

- EXISTING GROUND SURFACE CONTOUR AND EL, FEET
- REGRADED GROUND SURFACE CONTOUR AND EL, FEET
- PROPERTY BOUNDARY
- EXISTING PIPELINE
- EXISTING DRAINAGE/DIVERSION
- EXISTING POWER LINE
- EXISTING ROADS
- EXISTING CULVERTS
- TAILING (CONFIGURATION AS OF 4/30/2005)
- 4" DIA PERFORATED CPT (TYPE SP) SOLUTION LATERAL
- 6" DIA PERFORATED CPT (TYPE SP) SOLUTION COLLECTOR
- 8" DIA PERFORATED CPT (TYPE SP) SOLUTION COLLECTOR
- 10" DIA PERFORATED CPT (TYPE SP) SOLUTION COLLECTOR
- 12" DIA PERFORATED CPT (TYPE SP) SOLUTION COLLECTOR
- 24" DIA PERFORATED CPT (TYPE SP) SOLUTION HEADER
- PREGNANT SOLUTION COLLECTION WELL

NOTES:

1. THE REGRADED CONTOURS REPRESENT THE TOP OF THE LEACH PAD LINER WITHIN THE PAD, TOP OF WEARING COURSE ON ALL ROADS AND TOP OF CHANNEL EROSION PROTECTION FOR ALL DIVERSION CHANNELS.
2. ALL UNSUITABLE MATERIALS ENCOUNTERED DURING CONSTRUCTION MUST BE REMOVED AND EITHER REPLACED WITH COMPACTED RANDOM FILL, SITE GRADING FILL, OR HAVE THE EXCAVATED SURFACE PREPARED AS THE ROUGH GRADE SURFACE AS REQUIRED BY THE TECHNICAL SPECIFICATIONS.
3. SLOPES OF THE REGRADED PAD GROUND SURFACE CONTOURS SHOULD NOT EXCEED 2.5H:1V.
4. ALL USABLE MATERIALS (PREPARED SUBGRADE MATERIAL, RIPRAP, ETC.) ENCOUNTERED BUT NOT USED DURING CONSTRUCTION OF THE FIRST STAGE OF THE VALLEY PAD SHALL BE REMOVED AND STOCKPILED FOR LATER USE AS REQUIRED BY FGMI.
5. ALL PIPE CONNECTIONS SHALL BE FORMED USING MANUFACTURER SUPPLIED FABRICATED COUPLERS, TEES OR WYES. ALL CPT CONNECTIONS WHICH CHANGE DIAMETER, SLOPE OR ALIGNMENT MUST BE WIRE–TIED AROUND BOTH ENDS OF THE CONNECTIONS.
6. WHERE SOLUTION COLLECTION PIPE TERMINATES, IT SHALL BE FITTED WITH A MANUFACTURER SUPPLIED END CAP. PIPEWORK TERMINATING AT THE VALLEY PAD PERIMETER OR INTERMEDIATE BOUNDARY SHALL BE SURVEYED (FOR FUTURE TIE–IN IDENTIFICATION).
7. THE SOLUTION LATERALS ARE TO BE SPACED ON MAXIMUM 30' CENTERS WITHIN THE AREA COVERED BY THE LCRS (BELOW ELEVATION 1653'), AND SPACED ON MAXIMUM 90' CENTERS ABOVE ELEVATION 1653'.
8. THE INTERMEDIATE STAGE BOUNDARIES ARE APPROXIMATE AND SHALL BE FINALIZED PRIOR TO CONSTRUCTION ON A YEARLY BASIS.

FORT KNOX Gold Mine · Alaska

SOLUTION COLLECTION PIPEWORK WITHIN OVERLINER

SIZE	FGMI NO.	DWG NO. FIGURE 3.6	REV
SCALE		DV101–89–08–166	

using a submersible pump located in a pipe(s) between the primary and secondary geomembranes extending from the LCRS sump to the crest of the in-heap storage embankment.

3.8 Process Component Monitoring System

The PCMS will consist of three lined, buried channels running beneath the main collection pipes in the overliner. The three main collection pipes are located in the three main drainages on the west side of the Walter Creek valley. The main collector pipes will carry process solution on nearly a full-time basis whereas the lateral collector pipes placed in the herringbone pattern will carry process solution generally on a part-time basis related to the time of active leaching in a specific area of the pad. Thus, the PCMS will be located beneath the main collectors where the flow of process solution will be the highest and the most consistent.

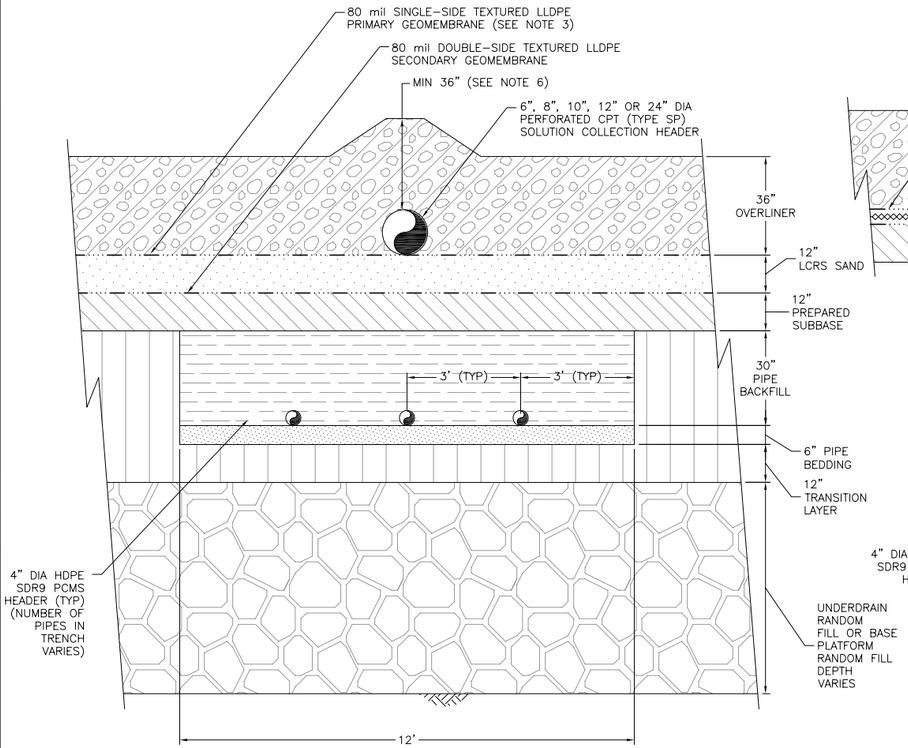
Figure 3.7 illustrates the design of the PCMS. Outside the limits of the in-heap pond, the PCMS monitoring channel will consist of a lined "V" ditch filled with drain gravel. The composite liner for the ditch will include a geosynthetic clay liner (GCL) overlain by an 80-mil LLDPE. The LLDPE will have the bottom side textured adjacent to the GCL. At the edge of the in-heap pond, the "V" ditch will transition into a 4-inch-diameter thick-walled HDPE pipe that will carry any collected flows to the PCMS sumps on the crest of the base platform fill for monitoring and pumping back to the in-heap pond. Separate sumps are provided for each of the three collectors. The locations of the PCMS collector ditches and their respective pipework are shown on Figure 3.8.

3.9 Underdrain System

A number of springs, seeps, and wet areas in the Walter Creek basin feed the stream flow that occurs in the area of the leach pad. A network of underdrains will be installed to collect the flows from the springs, seeps, and wet areas.

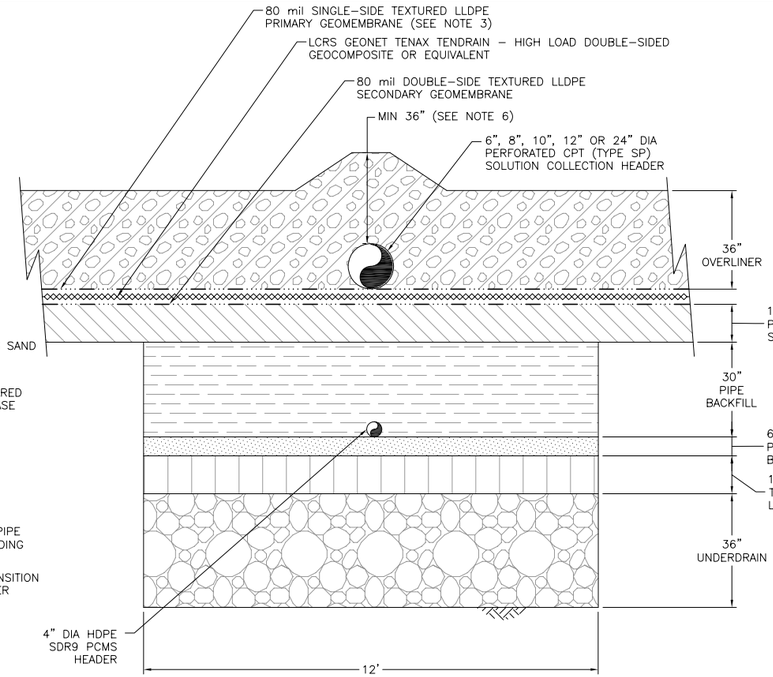
Provision is included in the design to expand the system to collect any flows that are encountered during construction that were not evident at the time of the site investigation. Since the primary function of the underdrains is to remove seepage from beneath the lining system and process solution is not anticipated to reach the underdrains, flows will be released on a continuous basis unless indications of process solution are identified through monitoring.

Discharges from the mill to the tailing impoundment must maintain a monthly average of less than 10 ppm WAD cyanide. If WAD cyanide levels exceeding 10 ppm are identified in the underdrain flows, the underdrain flows will be intercepted and pumped to the in-heap storage pond. In addition to intercepting groundwater, the underdrain system will function as an additional leakage monitoring system for the pad. Since the underdrains will be located in the main drainages at the site and since the groundwater flow directions generally follow the surface topography and the groundwater is at or very close to the surface in the bottom of the valley, the underdrains are anticipated to intercept any small amounts of process solutions should they migrate through the lining system. Thus, the underdrain can be expected to provide a general



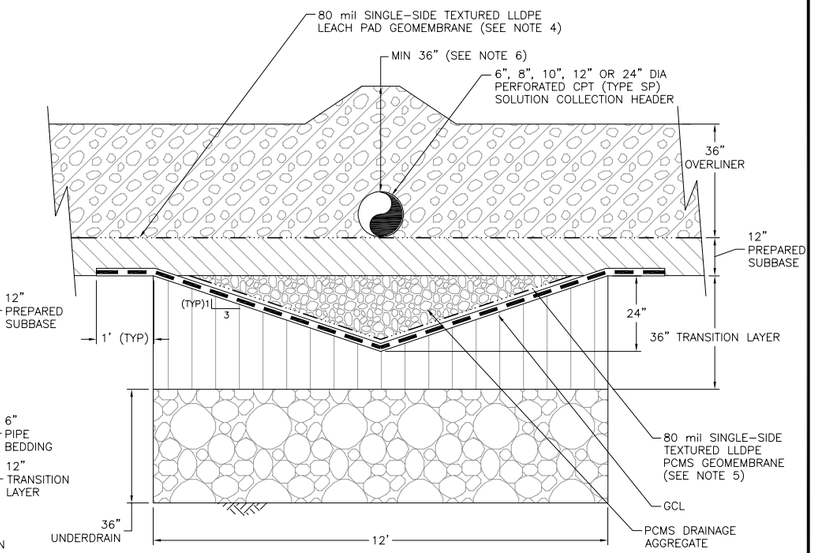
A / – TYPICAL PCMS HEADER PIPE TRENCHOVER UNDERDRAIN RANDOM FILL OR BASE PLATFORM RANDOM FILL

2 0 2 4 FEET



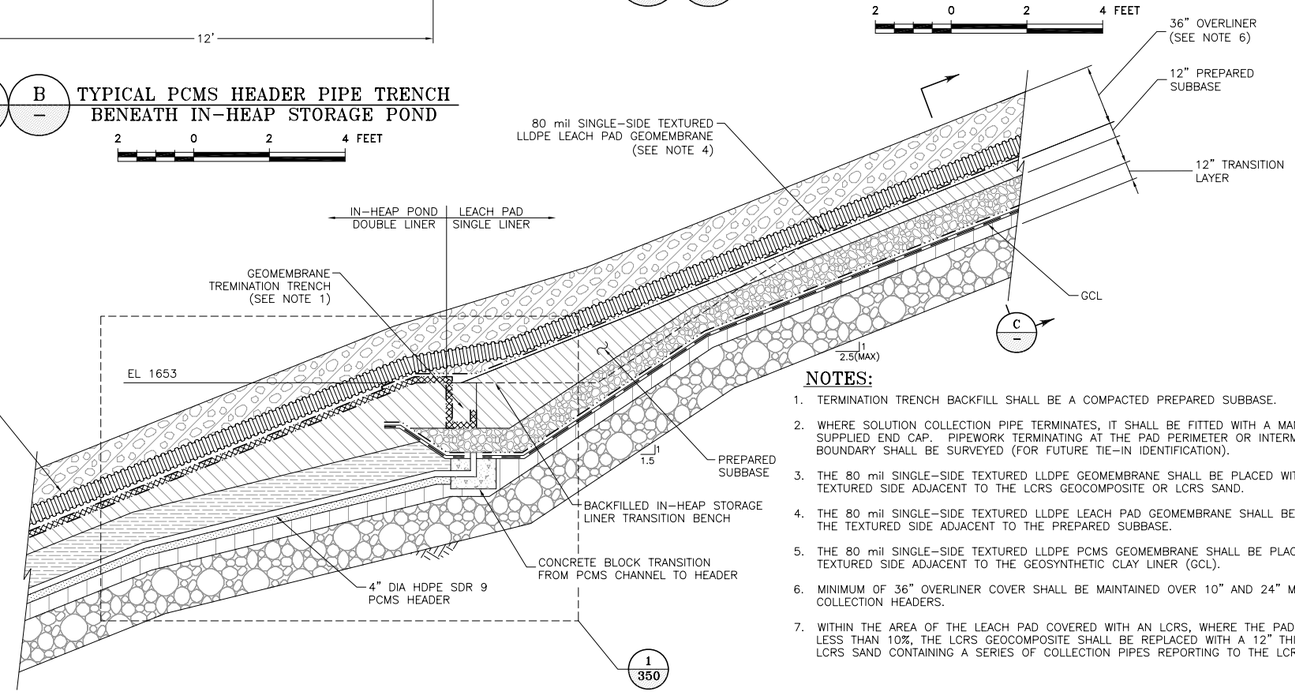
B / 200 B / – TYPICAL PCMS HEADER PIPE TRENCH BENEATH IN-HEAP STORAGE POND

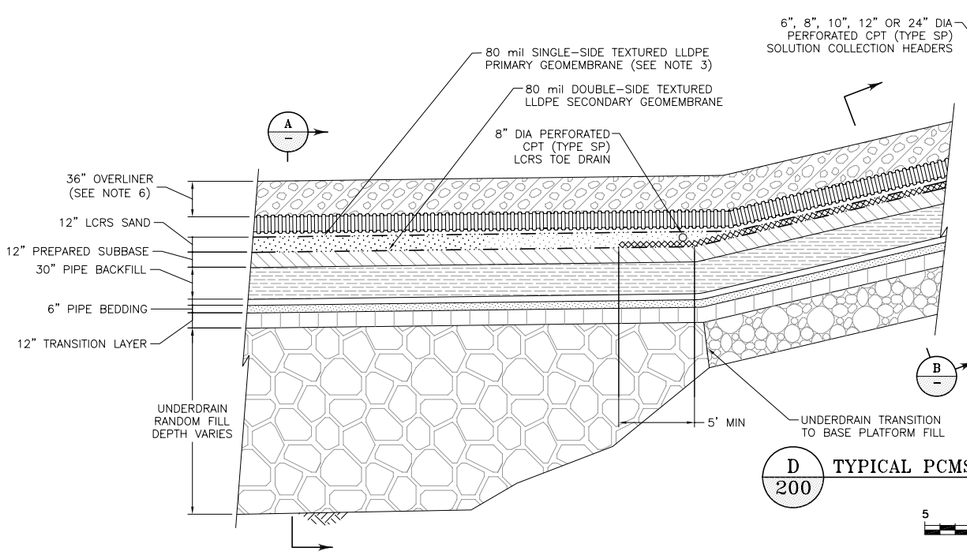
2 0 2 4 FEET



C / 200 C / – TYPICAL PCMS CHANNEL OUTSIDE IN-HEAP STORAGE POND

2 0 2 4 FEET





D / 200 TYPICAL PCMS CHANNEL UNDER IN-HEAP POND

5 0 5 10 FEET

NOTES:

1. TERMINATION TRENCH BACKFILL SHALL BE A COMPACTED PREPARED SUBBASE.
2. WHERE SOLUTION COLLECTION PIPE TERMINATES, IT SHALL BE FITTED WITH A MANUFACTURER SUPPLIED END CAP. PIPEWORK TERMINATING AT THE PAD PERIMETER OR INTERMEDIATE BOUNDARY SHALL BE SURVEYED (FOR FUTURE TIE-IN IDENTIFICATION).
3. THE 80 mil SINGLE-SIDE TEXTURED LLDPE GEOMEMBRANE SHALL BE PLACED WITH THE TEXTURED SIDE ADJACENT TO THE LCRS GEOCOMPOSITE OR LCRS SAND.
4. THE 80 mil SINGLE-SIDE TEXTURED LLDPE LEACH PAD GEOMEMBRANE SHALL BE PLACED WITH THE TEXTURED SIDE ADJACENT TO THE PREPARED SUBBASE.
5. THE 80 mil SINGLE-SIDE TEXTURED LLDPE PCMS GEOMEMBRANE SHALL BE PLACED WITH THE TEXTURED SIDE ADJACENT TO THE GEOSYNTHETIC CLAY LINER (GCL).
6. MINIMUM OF 36" OVERLINER COVER SHALL BE MAINTAINED OVER 10" AND 24" MAIN SOLUTION COLLECTION HEADERS.
7. WITHIN THE AREA OF THE LEACH PAD COVERED WITH AN LCRS, WHERE THE PAD SLOPES ARE LESS THAN 10%, THE LCRS GEOCOMPOSITE SHALL BE REPLACED WITH A 12" THICK LAYER OF LCRS SAND CONTAINING A SERIES OF COLLECTION PIPES REPORTING TO THE LCRS SUMP.

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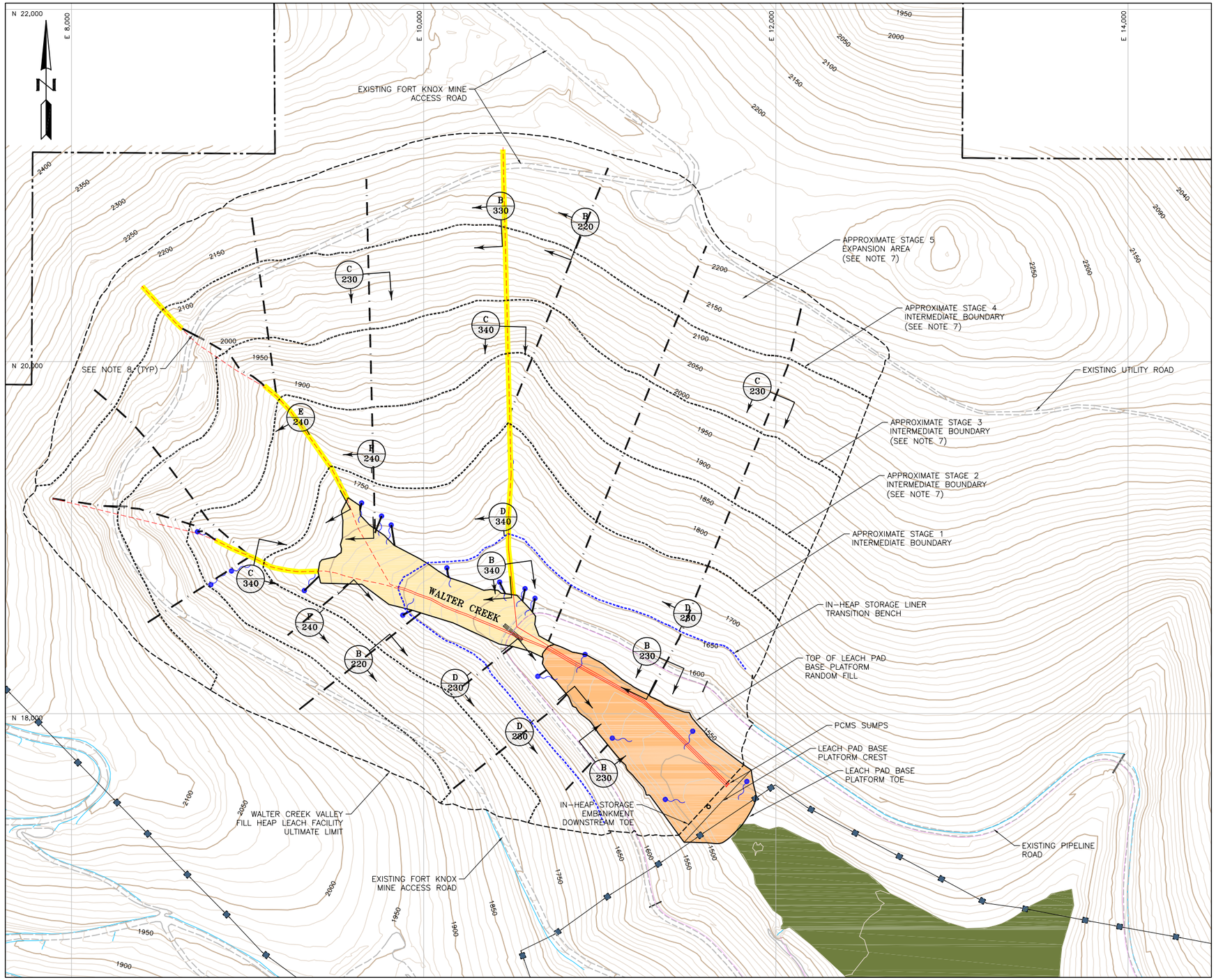
PCMS AND UNDERDRAIN SECTION AND DETAIL

SIZE	FGMI NO.	DWG NO.	REV
		FIGURE 3.7	
SCALE		DV101-89-08-166	



LEGEND:

- EXISTING GROUND SURFACE CONTOUR AND EL, FEET
- PROPERTY BOUNDARY
- EXISTING PIPELINE
- EXISTING DRAINAGE/DIVERSION
- EXISTING POWER LINE
- EXISTING ROAD
- EXISTING SPRING
- EXISTING CULVERT
- TAILING (CONFIGURATION AS OF 4/30/2005)
- BASE PLATFORM RANDOM FILL
- UNDERDRAIN RANDOM FILL
- UNDERDRAIN TRENCH
- UNDERDRAIN TRENCH DIRECTLY BENEATH PCMS CHANNEL
- UNDERDRAIN TRENCH DIRECTLY BENEATH PCMS HEADER TRENCH
- PCMS CHANNEL
- PCMS HEADER TRENCH
- UNDERDRAIN QUALITY MONITORING WELL

NOTES:

1. PCMS – PROCESS COMPONENT MONITORING SYSTEM PROVIDES DETECTION AND RECOVERY OF THE LEAKS LOCATED BENEATH THOSE PORTIONS OF THE LINER WHICH HAVE THE GREATER POTENTIAL FOR LEAKAGE – MAINLY BENEATH THE MAIN SOLUTION COLLECTION HEADERS. THE PCMS COLLECTION AREA IS LIMITED TO THE AREA OUTSIDE THE IN-HEAP STORAGE POND.
2. ALL UNDERDRAIN TRENCHES TERMINATE AT A BOUNDARY OF UNDERDRAIN RANDOM FILL OR BASE PLATFORM RANDOM FILL.
3. THE INTERMEDIATE STAGE BOUNDARIES ARE APPROXIMATE AND SHALL BE FINALIZED PRIOR TO CONSTRUCTION ON A YEARLY BASIS.
4. UNDERDRAIN TRENCH LOCATIONS SHALL BE ADJUSTED IN THE FIELD BY THE ENGINEER DURING PAD GRADING OPERATIONS TO INTERCEPT GROUNDAWATER SEEPS AND SPRINGS.
5. ALL EXISTING CULVERTS WITHIN THE LEACH PAD BASIN AREA SHALL BE REMOVED PRIOR TO THE START OF LEACH PAD REGRADING.
6. SEE DRAWINGS 200 AND 230 FOR UNDERDRAIN TRENCH TEMPOTARY TERMINATION AT AN INTERMEDIATE LEACH PAD BOUNDARY.
7. THE INTERMEDIATE STAGE BOUNDARIES ARE APPROXIMATE AND SHALL BE FINALIZED PRIOR TO CONSTRUCTION ON A YEARLY BASIS.

REFERENCE:

- TOPOGRAPHIC MAPPING PROVIDED BY CLIENT DATA FILE NAMED: FORT_KNOX_2005_LOCAL.DWG. DATED: 07/06/05 RECEIVED BY KNIGHT PIESOLD ON 7/2005. SEE G:\101\00089.08\A\Data_Info\External\TOPO\071505
- THE TOPOGRAPHIC MAP WAS COMPILED FROM AERIAL PHOTOGRAPHY ACQUIRED ON 4-30-2005 AT A NOMINAL PHOTO SCALE OF 1:15000.
- HORIZONTAL PROJECTION COMPLIES WITH A LOCAL COORDINATE SYSTEM THAT ASSUMES THE CHATHAM MONUMENT VALUES ARE: X=7745.58 Y=34802.33 AND THE IOWA MONUMENT VALUES ARE: X=39521.24 Y=8825.48

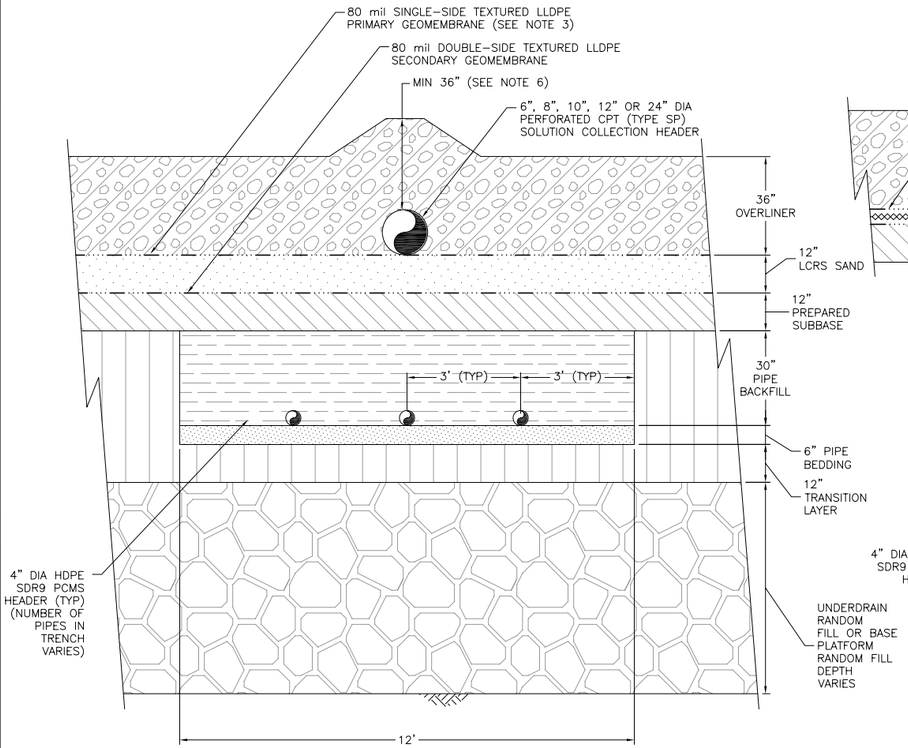
PLAN

300 0 300 600 FEET

FORT KNOX Gold Mine • Alaska

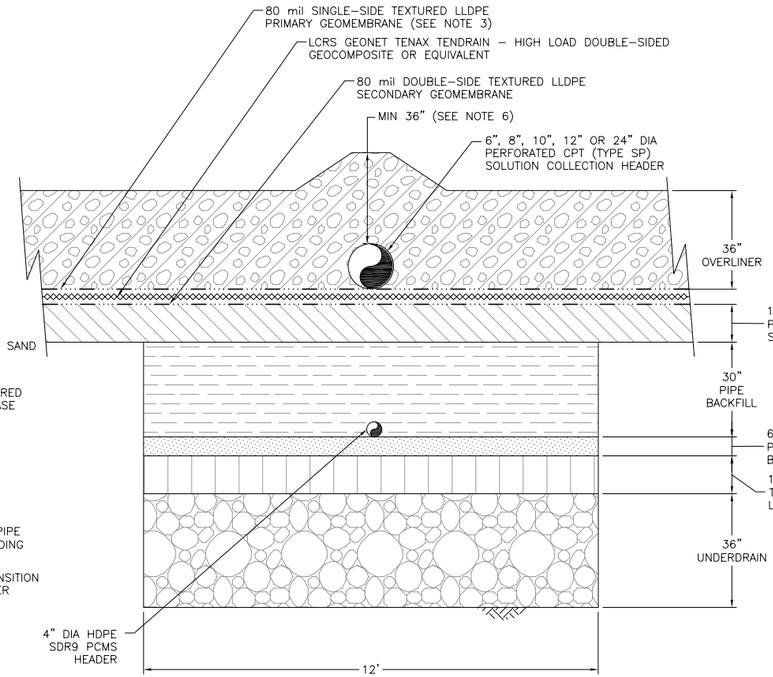
PCMS AND UNDERDRAIN LOCATION

SIZE	FGMI NO.	DWG NO.	REV
		FIGURE 3.8	
SCALE		DV101-89-08-166	



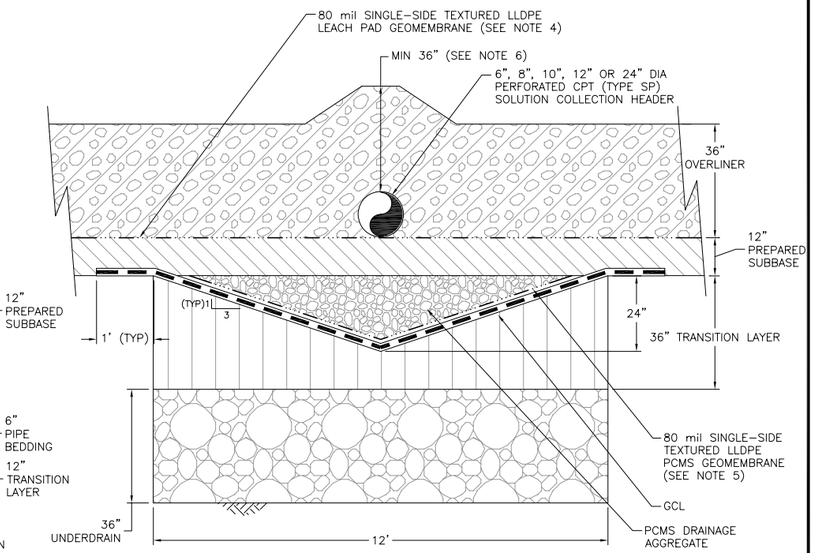
A / – TYPICAL PCMS HEADER PIPE TRENCHOVER UNDERDRAIN RANDOM FILL OR BASE PLATFORM RANDOM FILL

2 0 2 4 FEET



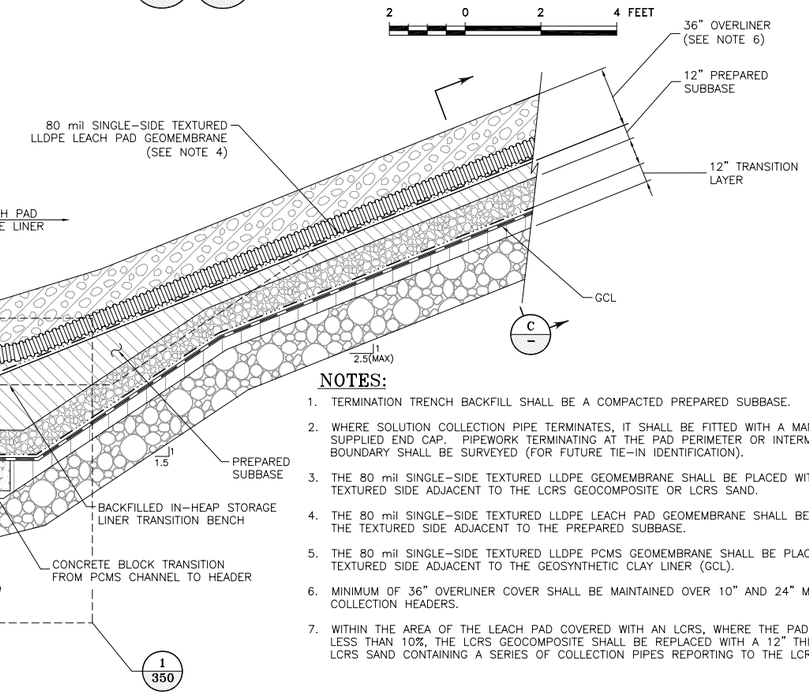
B / 200 B / – TYPICAL PCMS HEADER PIPE TRENCH BENEATH IN-HEAP STORAGE POND

2 0 2 4 FEET



C / 200 C / – TYPICAL PCMS CHANNEL OUTSIDE IN-HEAP STORAGE POND

2 0 2 4 FEET



NOTES:

1. TERMINATION TRENCH BACKFILL SHALL BE A COMPACTED PREPARED SUBBASE.
2. WHERE SOLUTION COLLECTION PIPE TERMINATES, IT SHALL BE FITTED WITH A MANUFACTURER SUPPLIED END CAP. PIPEWORK TERMINATING AT THE PAD PERIMETER OR INTERMEDIATE BOUNDARY SHALL BE SURVEYED (FOR FUTURE TIE-IN IDENTIFICATION).
3. THE 80 mil SINGLE-SIDE TEXTURED LLDPE GEOMEMBRANE SHALL BE PLACED WITH THE TEXTURED SIDE ADJACENT TO THE LCRS GEOCOMPOSITE OR LCRS SAND.
4. THE 80 mil SINGLE-SIDE TEXTURED LLDPE LEACH PAD GEOMEMBRANE SHALL BE PLACED WITH THE TEXTURED SIDE ADJACENT TO THE PREPARED SUBBASE.
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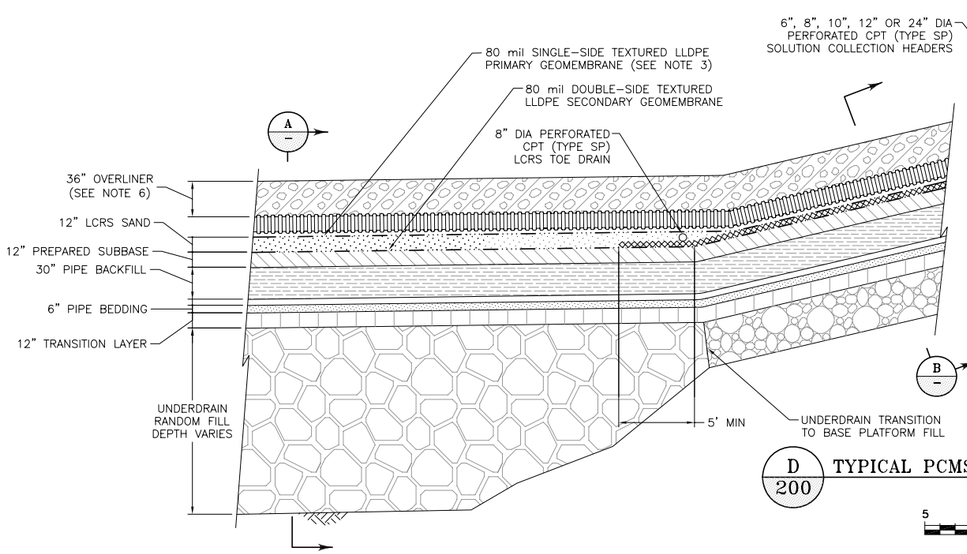
6. MINIMUM OF 36" OVERLINER COVER SHALL BE MAINTAINED OVER 10" AND 24" MAIN SOLUTION COLLECTION HEADERS.
7. WITHIN THE AREA OF THE LEACH PAD COVERED WITH AN LCRS, WHERE THE PAD SLOPES ARE LESS THAN 10%, THE LCRS GEOCOMPOSITE SHALL BE REPLACED WITH A 12" THICK LAYER OF LCRS SAND CONTAINING A SERIES OF COLLECTION PIPES REPORTING TO THE LCRS SUMP.



D / 200 TYPICAL PCMS CHANNEL UNDER IN-HEAP POND

5 0 5 10 FEET

FORT KNOX Gold Mine • Alaska

PCMS

SIZE	FGMI NO.	DWG NO.	REV
		FIGURE 3.9	
SCALE		DV101-89-08-166	

indicator of the overall performance of the lining system in addition to the specific functions of the PCMS and LCRS described in Sections 3.7 and 3.8. Design sections of the underdrain are shown on Figure 3.9, and the locations are shown on Figure 3.8.

The stream flows and surface water above the active stage of the leach pad will be transported around the pad in diversion ditches. The underdrains on the side slopes will be a series of trench drains about 3 feet deep and 12 feet wide excavated with a backhoe. The trench drains will be filled with clean drainage rock. The trench drains will flow into the highly pervious run-of-mine rock used to fill the lower portion of the Walter Creek valley and construct the base platform fill.

3.10 Process Facility

Carbon-in-Columns Plant

The pregnant solution will be pumped from the in-heap storage pond to a train of carbon columns where the gold and silver will be adsorbed on to carbon. Barren solution from the carbon columns will report to the barren tank where the cyanide concentration and solution pH will be adjusted prior to being pumped back to the pad. Figure 3.10 provides a conceptual plan of a CIC plant. The CIC plant will be located at the east side of the existing mill building, abutting the southeast corner of the refinery area and extending to the east approximately 150 feet. Figure 3.11 illustrates the location of the CIC plant adjacent to the mill. Containment will be in the new building with an overflow line extending into the existing building.

The CIC facility consists of equipment and infrastructure that includes:

- The process building enclosure to prevent solutions from freezing in adverse weather conditions during winter months. Building includes foundations, insulated composite metal panels, flashing/trim, heaters, ventilation fans, louvers, and doors.

- A carbon column train consisting of five cascading tanks, structural steel, trash screen, and access walkways. Carbon columns have a capacity to process an 8,000 gpm flow rate with 8-ton carbon capacity in each tank.

- Two (2) carbon safety screens feeding a barren solution tank with five (5) 500 hp vertical turbine barren solution pumps to deliver the barren solution from the process facility to the leach pad.

- Process piping, valves, flowmeter, and solution sampler. The barren solution pipeline shall be equipped with automated valves designed to open and drain the pipeline to prevent freezing.

- A primary transformer, power, lighting, and controls including foundations.

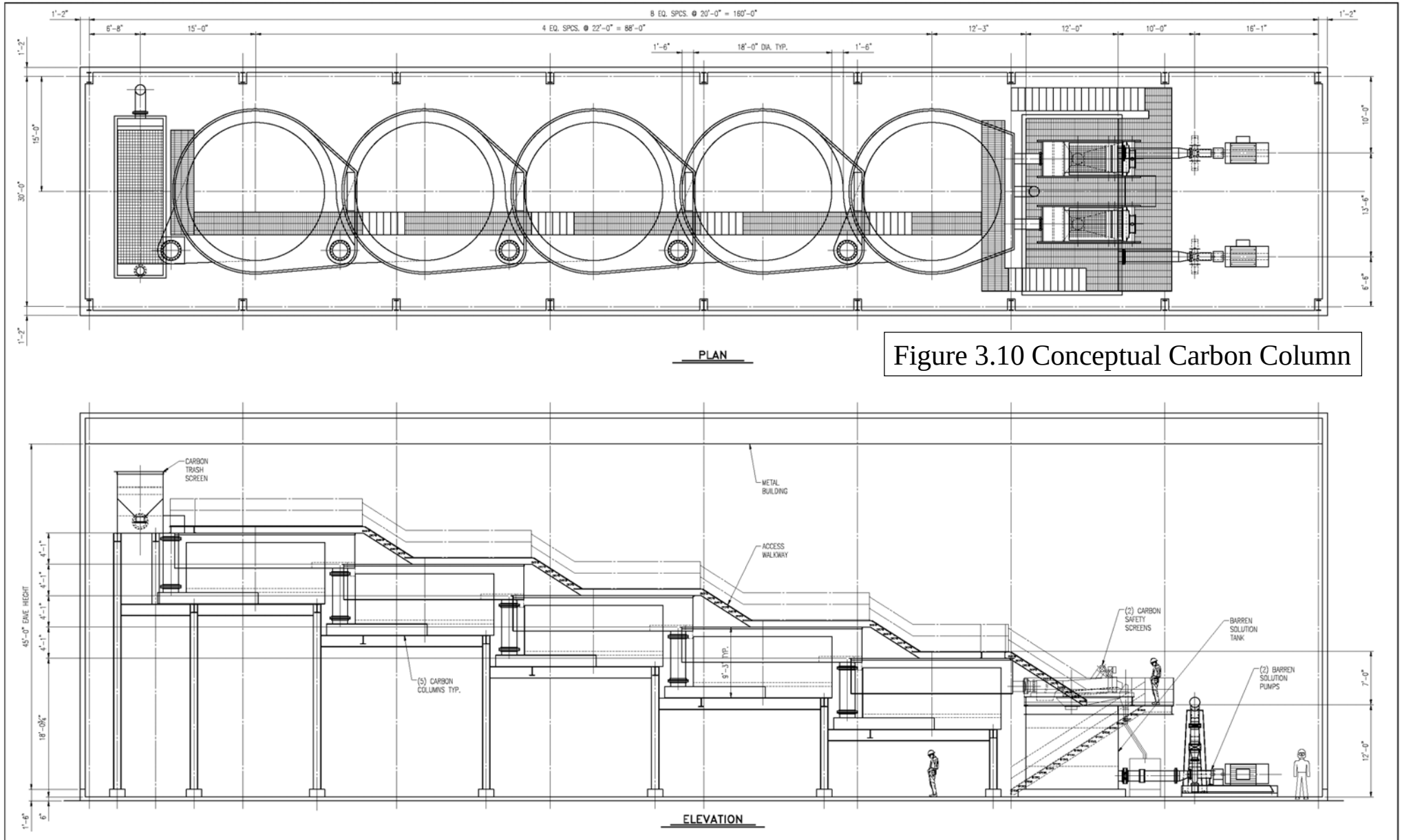
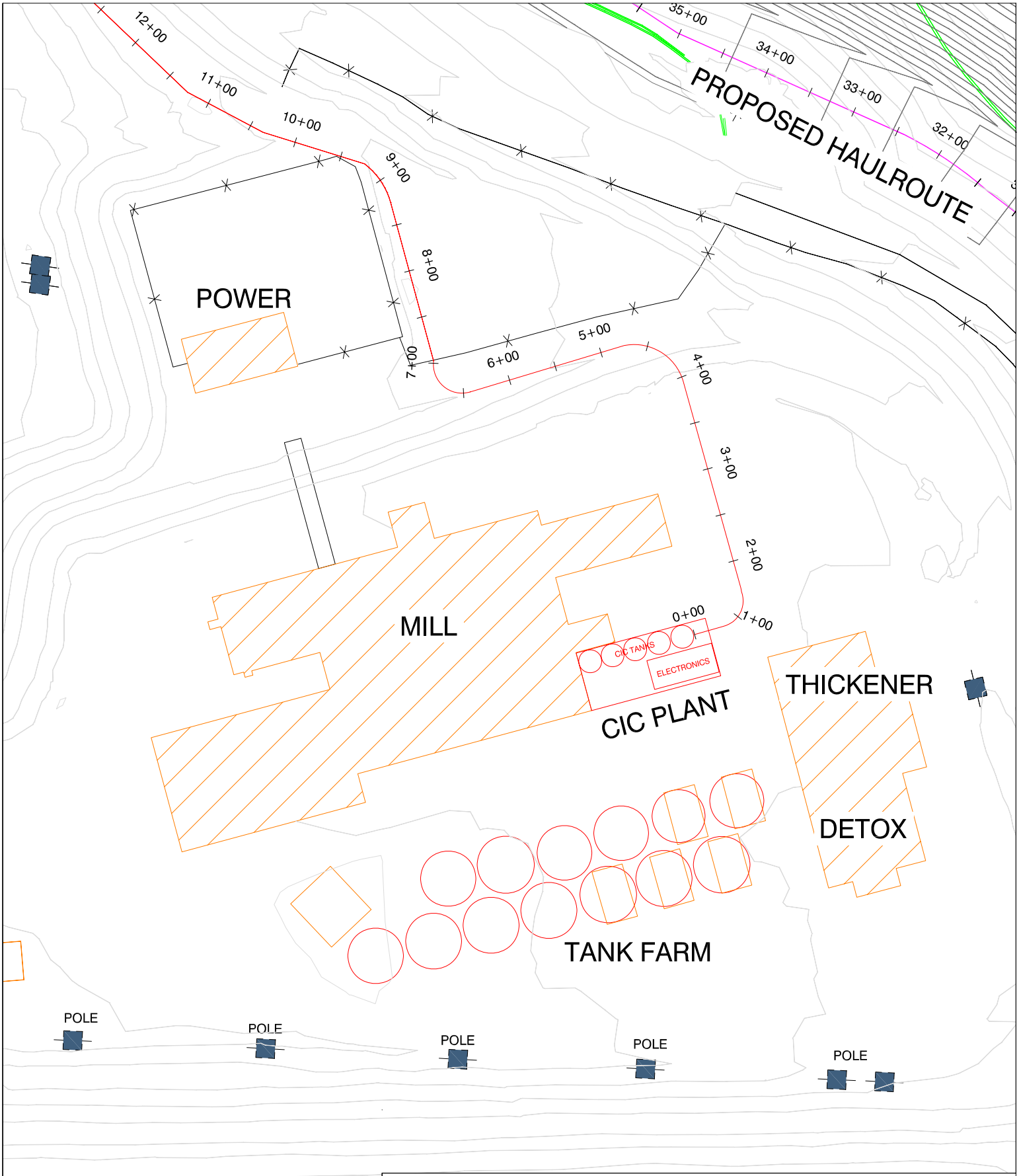


Figure 3.10 Conceptual Carbon Column



FORT KNOX MILL SITE

SIZE	DATE	
	11-14-2005	Figure 3.11 CIC Plant Location
SCALE: NTS		SHEET 1 OF 1

Existing Mill Facilities

After the gold is loaded onto the carbon in the CIC plant, the loaded carbon will be transferred to the existing Fort Knox refinery for further processing. The gold will be stripped from the carbon and recovered from solution by electro-winning. The stripped carbon will be regenerated and cycled back to the CIC plant. The INCO process, currently available in the mill for cyanide destruction when necessary, will remain in place for use with the heap leach project should it become necessary. The INCO process combines ammonium bisulfite and copper sulfate with air, in an agitated tank, to destroy the cyanide.

4.0 HEAP LEACH OPERATION

4.1 Heap Leach Ore

The ore placed on the heap leach pad will be run-of-mine rock with a size gradation varying from minus 200 mesh up to 48-inch material. The ore for the heap leach will consist almost exclusively of Fort Knox granite with only trace amounts of the Fairbanks schist placed on the pad. The current estimate cutoff grade is 0.0068 ounces per ton (opt), but this may change based on recoveries and economics. The current grade cutoff for the mill is 0.0178 opt for higher grade ore. The following sections provide a description of solution and ore geochemistry based on currently available information. It should be noted that testing is ongoing, and the information discussed below will be updated once the final results become available.

4.2 Leach Solution Chemistry

The pregnant solution returning from the pad is expected to have a pH between 10.5 and 11. The weak acid dissociable cyanide (WAD cyanide) concentrations are expected to range between 30 and 50 mg/l during normal operational conditions. Barren solution going to the pad is expected to have a pH between 10.5 and 11, and the WAD cyanide concentration is expected to range between 100 and 200 mg/l. Based on column testing completed to date, it is expected that WAD cyanide concentrations will decline to levels at or below 0.2 mg/l after approximately one to two years of solution circulation after reagent addition has been stopped.

4.3 Geochemical Characteristics of the Ore

The acid neutralization potential (ANP) values for Fort Knox ore range from 23 to 78 tons $CaCO_3$/kT. The acid generation potential (AGP) values range from below detectable levels to 2.2 tons $CaCO_3$/kT. The ANP:AGP ratios range from 30 to over 300, indicating that the ANP of the ore is significantly higher than the acid-generating potential. In general, ANP:AGP ratio values of 3 or greater are indicative of materials with low net ANP. Based on the results of testing completed, the spent ore has little or no potential for acid generation.

Meteoric Water Mobility Procedure testing is being completed on spent ore samples from several of the metallurgical columns directly after decommissioning. Table 4.0 summarizes the MWMP results to date for the one column completed. These results are considered indicative of the pore-water chemistry that will be present in the heap in the short term, immediately after rinsing is complete. The data indicate that arsenic and aluminum may be mobilized during the rinsing cycle. However, both metals are significantly more mobile at a high pH, and both should reduce significantly in concentration when the pH is lowered and when the residual amount of WAD cyanide becomes further reduced. Additional columns are currently being tested, and when data from these columns become available, the information will be provided to supplement this sample.

Table 4.0: Summary of Spent Ore MWMP Chemistry

Element	Results[1]	Element	Results[1]
Alkalinity	90	Manganese	<0.0050
Carbonate	29	Mercury	<0.00010
Bicarbonate	51	Molybdenum	<0.010
Aluminum	0.33	Nickel	<0.010
Antimony	<0.0025	Nitrate Nitrogen	<1.0
Arsenic	0.24	Nitrite Nitrogen	0.26
Barium	<0.010	pH	9.67
Beryllium	<0.0010	Phosphorus	<0.50
Bismuth	<0.10	Potassium	3.5
Boron	0.21	Scandium	<0.10
Cadmium	<0.0010	Selenium	<0.0050
Calcium	2.2	Silver	<0.0050
Chloride	2.2	Sodium	40
Chromium	<0.0050	Strontium	<0.10
Cobalt	<0.010	Sulfate	6.9
Copper	<0.050	TDS	140
Fluoride	0.27	Tin	<0.10
Gallium	<0.10	Thallium	<0.0010
Iron	0.1	Titanium	<0.10
Lead	<0.010	Vanadium	0.011
Lithium	<0.10	Zinc	<0.010
Magnesium	<0.50	WAD Cyanide	0.038

[1] All results reported as mg/l except pH which is SU

4.4 Solution Management

Pregnant solution will be removed from the heap utilizing three pregnant solution collection wells located at the lowest portion of the in-heap storage pond. Solution collection wells are being used in lieu of a gravity return system to avoid liner penetrations. The pumping rate will approximate the solution application rate of 8,000 gpm. There will be three wells, and each will have a 250 hp pump. Each of the wells will have a capacity to pump 4,000 gpm. In general, two pumps will be operated at a time, and the third will be on standby.

Notwithstanding the above, FGMI will construct the collection wells and piping to accommodate all three wells operating simultaneously in the event that under very wet conditions the return of storm water to the plant for treatment and discharge to the tailing impoundment can be carried out. During wet periods, the inflows to the pad will be reduced by the reduction of the inflow of the barren solution.

Pregnant solution will be pumped directly to the process plant. The average operational level of pregnant solution in the in-heap storage pond is anticipated to be that required for operation of the pumps. In the event of an extended power outage, emergency back-up generators will be available to supply 500 hp to operate the pumps in the solution collection wells and maintain fluid levels within the in-heap storage reservoir.

Barren solution will initially be pumped to the pad using one 500 hp pump. As the heap leach pad grows in size, additional barren pumps will be required to maintain the flow of barren solution to the top of the pad. When the pad reaches its ultimate capacity of 160 million tons, five 500 hp pumps will be required to pump 8,000 gpm to the top of the heap leach pad.

Barren solution will be applied on the heap leach ore at a rate of 0.005 gallons/square foot. Solution will likely be applied using drip emitters, but sprinklers may be used under some circumstances. The total area being leached at any one point in time will be approximately 1,600,000 square feet. Pregnant solution will flow to the in-heap storage reservoir. The pregnant solution that collects in the in-heap storage reservoir will be pumped to the CIC plant by the vertical pumps located in the in-heap storage reservoir.

Barren solution and pregnant solution will be pumped in pipes between the pad and the CIC plant. The pipes will be double walled where buried and in lined ditches when on the surface. Solution will be pumped to and from the pad at an approximate rate of 8,000 gpm. Pregnant solution pumped to the CIC plant will flow through carbon columns where the activated carbon will recover the gold. The barren solution will flow to the barren tank, and reagents will be added as necessary. Reagents in the solution will include sodium cyanide, caustic, lime, and antiscalant. The pH of the solution will be maintained at approximately 10.5 to 11.0. Barren solution will contain 100 to 200 ppm of WAD CN, and pregnant solution will have a WAD CN concentration of 30 to 50 ppm.

The in-heap storage pond will be sized to contain: (1) solution storage for operations, (2) solution from a 24-hour draindown, and (3) the runoff from the 100-year/24-hour storm event and provide 5 feet of freeboard in accordance with the Alaska dam safety requirements. Table 4.1 summarizes the storage volumes for the in-heap storage reservoir.

Table 4.1: Summary of In-Heap Storage Volumes

	Gallons (Millions)	Cubic Feet (Millions)	Vertical Feet
Freeboard	9.5	1.27	5
24 Hour Draindown	11.5	1.54	6
24 Hour/100 year Storm Event	30.2	4.04	17
Operational Flexibility	31.4	4.19	22
Operations	27.4	3.66	50
Total	110	14.70	100

The solution collection wells will consist of vertical turbine pumps placed in 30-inch-diameter, thick wall, slotted steel casings extending from just above the upstream toe of the in-heap storage embankment to a bench on the face of the heap leach pad. Figure 3.1 illustrates the location of a solution collection well. Ultimately, the height of the wells will be about 150 feet. To accommodate the pad loading sequence, the wells will be constructed in stages. The initial stage will be founded on a steel foundation. Once the steel casing is in place, backfill will be carefully placed around the exterior of the casing to the level of the lift of ore being placed for leaching. The steel well casing will be designed with consideration of ore-induced lateral and vertical dragdown forces. Following completion of fill placement, the pumps will be set. For subsequent raises, one well will be taken out of service at a time.

4.5 Reagent Use and Storage

Reagent Usage

Sodium cyanide, lime, antiscalant, carbon, and caustic will be the reagents used in the CIC plant and heap leach process. Hydrochloric acid is currently used in the existing carbon regeneration process. Each of these reagents is currently in use in the mill.

Lime will be added to the ore going to the pad for pH control. Cyanide will be used for the dissolution of the gold in the ore and in stripping the gold from the activated carbon. Activated carbon will be used to remove the gold from the pregnant leach solution. Caustic will be used to strip the gold from the activated carbon in the stripping vessels and for pH adjustments when mixing the cyanide. Hydrochloric acid will be used in regenerating the activated carbon after the gold has been stripped. In the event that the INCO process is required to remove residual cyanide, ammonium bisulfite and copper sulfate will be used.

In addition to the above reagents, antiscalant may be used at times to treat the make-up water. The brand of antiscalant would likely be Millsperse 11-709 or an equivalent. It will be stored in totes, in the mill, next to the barren tank.

Storage of Chemicals

Cyanide is currently stored in a covered, fenced storage dock that has a locked gate. The boxes are unloaded with a forklift onto the storage dock. The cyanide for the heap leach will be stored in the same area. Caustic will be delivered in a liquid form and pumped into an existing holding tank in the mill that is in containment. Carbon will be delivered in ½ metric ton bags that will be stored outside on pallets. Lime will be stored in a silo in proximity of the leach pad. Copper sulfate will be stored inside the mill building in one metric ton bags. Ammonium bisulfite will be stored in an existing tank in containment in the mill. Hydrochloric acid will be stored in an existing holding tank in containment that is separate from the cyanide area.

4.6 Mine Operations

Ore for the heap leach will be mined by the conventional truck and shovel mining method currently used at Fort Knox from the Fort Knox Pit. At this time, no changes in mining methods are anticipated. Current mine plans are for mining to be completed in 2010. Heap leaching increases the number of ounces to be produced from the pit by lowering the grade of the ore that can be processed. Currently, the cutoff grade for high grade ore to the mill is 0.0178 ounces per ton. For heap leach, the cutoff grade is currently 0.0068 opt. The cutoff grade and subsequently the tons mined and processed are continually being revised based upon the economics of mining and processing. The Fort Knox Pit may ultimately increase in size, at least in part, due to heap leaching as mine plans are revised to reflect changes in cost.

4.7 Haulage and Loading

The pad will be constructed in five stages. Stages 1 and 2 construction is planned to begin in 2006 and be completed in 2007. Loading ore on Stage 1 will commence in late summer or fall of 2007. Year-round loading and leaching is planned. Ore will be hauled to the pad at a rate of 40,000 tons per day, 365 days per year. Ore will be hauled directly from the pit when available or from existing stockpiles. A haul road will be constructed from the area of active pit operations to the heap leach pad for haulage of ore. The proposed location of the haul road is illustrated on Figure 4.0. Most of the haul road is located on MHTLO land.

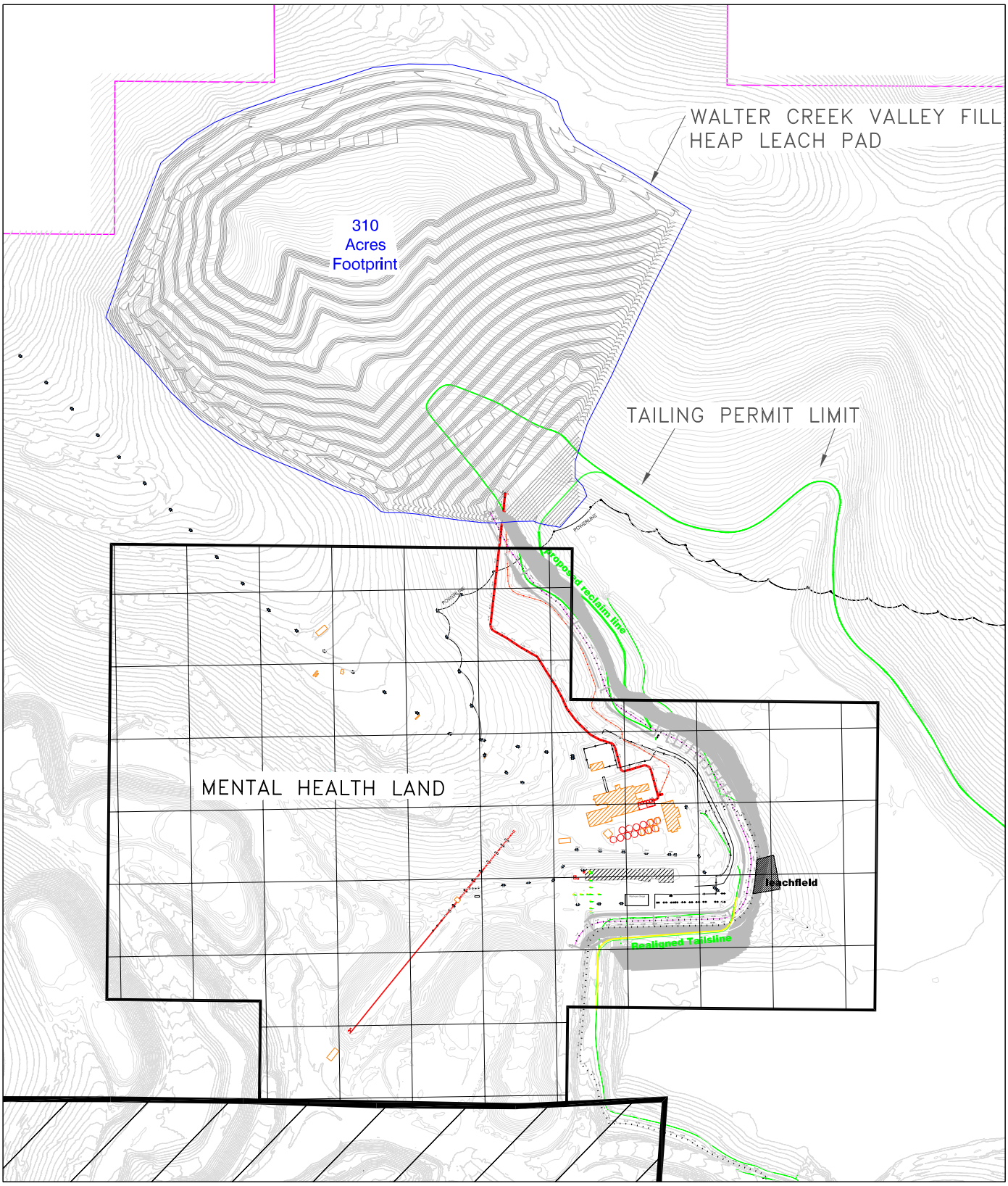
Initially, a lift approximately 100 feet thick will be placed behind the in-heap storage pond to initiate leaching. For subsequent lifts, ore will be placed in 40-foot lifts while maintaining an overall slope of 3H:1V. Figure 4.1 illustrates the ultimate pad configuration.

Equipment and Manpower

FGMI is not planning to increase the equipment fleet for the heap leach's operation. One dozer will be dedicated to the heap leach pad for pushing ore and ripping. Ore will be loaded and hauled with the existing truck and shovel fleet. In addition to the currently planned workforce for the mine and the mill, an additional 12 people will be employed for operation of the heap leach pad.

Surface Water Diversion and Access Roads

Surface water diversion around Stages 1 and 2 of the leach pad will be accomplished by temporary diversion channels cut into the basin slope. The diversion channels will be designed to pass runoff from the 100-year/24-hour storm event. The channels will be extended to discharge into downslope diversion channels illustrated on Figure 4.2 and located east of the pad on the north and south sides of the valley. The diversion channels have been designed with a 0.5 percent grade sloping downhill to the eastern perimeter of the pad and then continuing at a steeper grade below the heap leach pad into the tailing impoundment.



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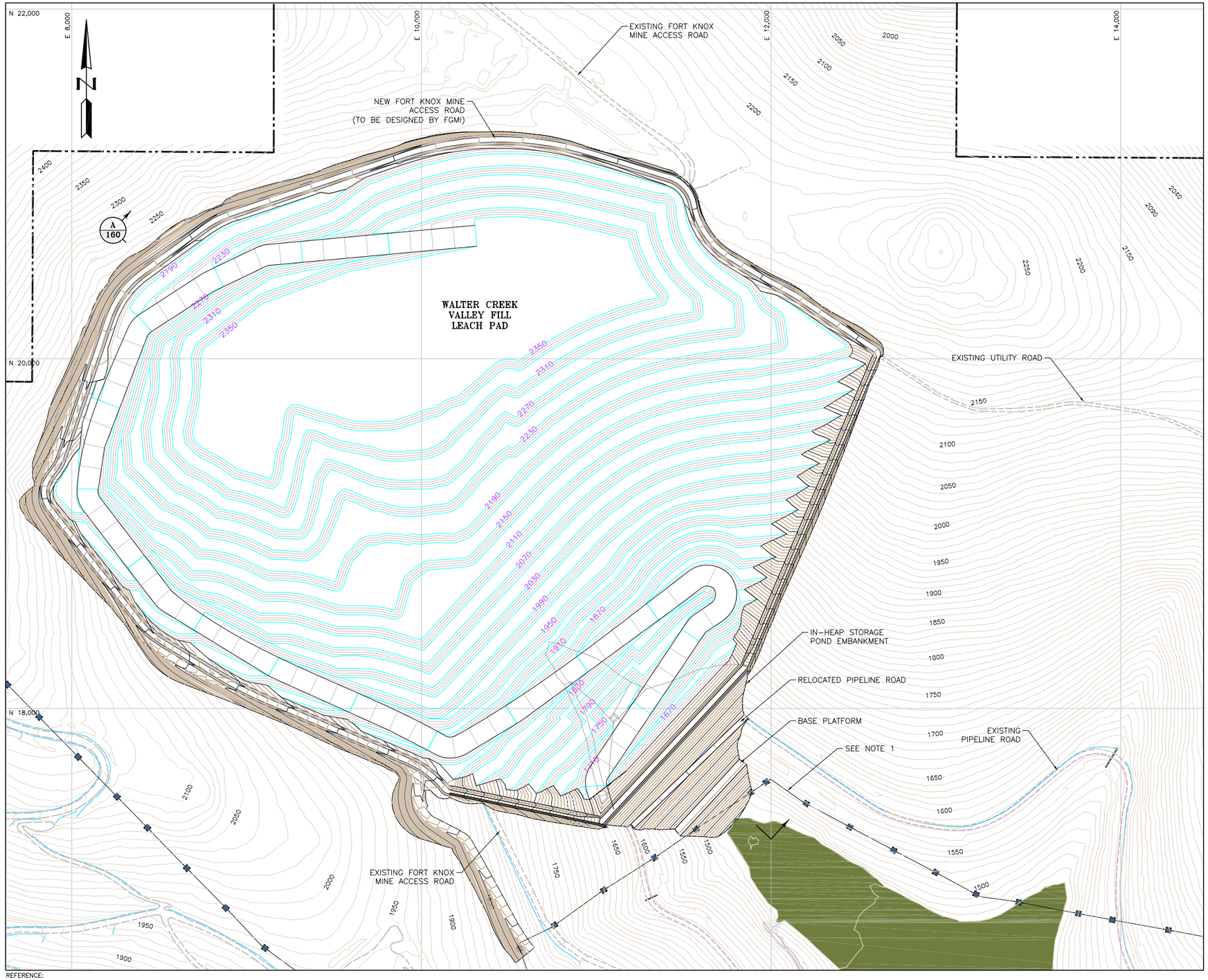
HAUL ROAD AND SURFACE OWNERSHIP

SIZE	FGMI NO.	DWG NO.	REV
		FIGURE 4.0	
SCALE NTS		DV101-89-08-166	



REFERENCE:
-TOPOGRAPHIC MAPPING PROVIDED BY CLIENT DATA FILE NAMED: FORT_KNOX_2005_LOCAL.DWG. DATED: 07/06/05 RECEIVED BY KNIGHT PIESOLD ON 7/2005. SEE G:\101\00089.08\A\Data_Info\External\TOPO\071505

PLAN

300 0 300 600 FEET

LEGEND:

- EXISTING GROUND SURFACE CONTOUR AND EL, FEET
- REGRADED GROUND SURFACE CONTOUR AND EL, FEET
- HEAP LIFT CREST/TOE CONTOUR AND EL, FEET
- PROPERTY BOUNDARY
- EXISTING PIPELINE
- EXISTING DRAINAGE/DIVERSION
- EXISTING POWER LINE
- EXISTING ROAD
- EXISTING CULVERT
- TAILING (CONFIGURATION AS OF 4/30/2005)

NOTE:

1. THE EXISTING POWER LINE SHALL BE RELOCATED IF REQUIRED BY FGMI.

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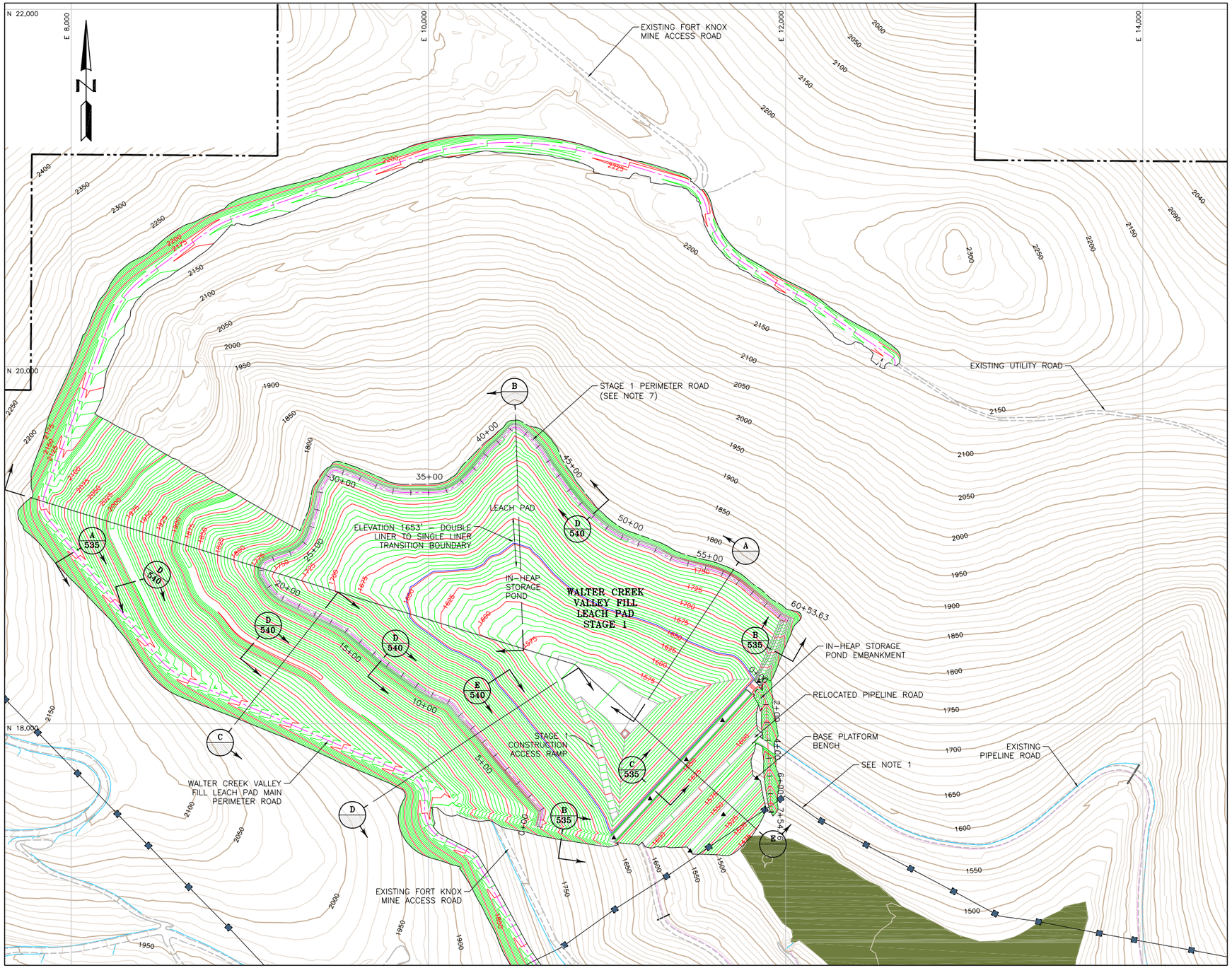
ULTIMATE HEAP LEACH PAD CONFIGURATION

SIZE	FGMI NO.	DWG NO. FIGURE 4.1	REV
SCALE		DV101-89-08-166	



LEGEND:

- EXISTING GROUND SURFACE CONTOUR AND EL, FEET
- STAGE 1 REGRADED GROUND SURFACE CONTOUR AND EL, FEET (SEE NOTE 1)
- PROPERTY BOUNDARY
- EXISTING PIPELINE
- EXISTING DRAINAGE/DIVERSION
- EXISTING POWER LINE
- EXISTING ROAD
- EXISTING CULVERT
- TAILING (CONFIGURATION AS OF 4/30/2005)
- SURVEY MONUMENT (SEE NOTE 8)

NOTE:

1. THE REGRADED CONTOURS REPRESENT THE TOP OF THE LEACH PAD LINER WITHIN THE PAD, TOP OF WEARING COURSE ON ALL ROADS AND TOP OF CHANNEL EROSION PROTECTION FOR ALL DIVERSION CHANNELS.
2. ALL UNSUITABLE MATERIALS ENCOUNTERED DURING CONSTRUCTION MUST BE REMOVED AND EITHER REPLACED WITH COMPACTED RANDOM FILL, SITE GRADING FILL, OR HAVE THE EXCAVATED SURFACE PREPARED AS THE ROUGH GRADE SURFACE AS REQUIRED BY THE TECHNICAL SPECIFICATIONS.
3. SLOPES OF THE REGRADED PAD GROUND SURFACE CONTOURS SHALL NOT EXCEED 2.5H:1V.
4. ALL USABLE MATERIALS (PREPARED SUBGRADE MATERIAL, RIPRAP, ETC.) ENCOUNTERED BUT NOT USED DURING CONSTRUCTION OF THE FIRST STAGE OF THE VALLEY PAD SHALL BE REMOVED AND STOCKPILED FOR LATER USE AS REQUIRED BY FGMI.
5. THE EXISTING POWER LINE SHALL BE RELOCATED AS REQUIRED BY FGMI.
6. ALL EXISTING CULVERTS WITHIN THE LEACH PAD BASIN AREA SHALL BE REMOVED PRIOR TO THE START OF LEACH PAD REGRADING.
7. SEE DRAWING 450 FOR STAGE 1 PERIMETER ROAD PROFILE AND HORIZONTAL CONTROL TABLE.
8. SEE TABLE 1 ON DRAWING 720 FOR SETTLEMENT MONUMENT COORDINATS

REFERENCE:

- TOPOGRAPHIC MAPPING PROVIDED BY CLIENT DATA FILE NAMED: FORT_KNOX_2005_LOCAL.DWG. DATED: 07/06/05 RECEIVED BY KNIGHT PIESOLD ON 7/2005. SEE G:\101\00089.08\A\Data_Info\External\TOPO\071505
- THE TOPOGRAPHIC MAP WAS COMPILED FROM AERIAL PHOTOGRAPHY ACQUIRED ON 4-30-2005 AT A NOMINAL PHOTO SCALE OF 1:15000.
- HORIZONTAL PROJECTION COMPLIES WITH A LOCAL COORDINATE SYSTEM THAT ASSUMES THE CHATHAM MONUMENT VALUES ARE: X=7745.58 Y=34802.33 AND THE IOWA MONUMENT VALUES ARE: X=39521.24 Y=8825.48

PLAN

300 0 300 600 FEET

FORT KNOX Gold Mine · Alaska

STAGE 1 GRADING AND DIVERSION CHANNEL

SIZE	FGMI NO.	DWG NO. FIGURE 4.2	REV
SCALE		DV101-89-08-166	

An access road will be located adjacent to the diversion channel. Soils cut from the diversion channels will be used to construct a fill on the lower side of the channel for the access road and berm. Figure 3.2 illustrates the design for the diversion channels and the perimeter access roads. Stage 2 as currently designed will be slightly modified to remain north of the access road, or a small piece of the road will be relocated south of the Stage 2 perimeter.

During Stage 1 construction, the site access road will be relocated to the south of the ultimate pad perimeter. Included in the design will be a diversion channel to intercept and divert runoff from the 100-year/24-hour storm event around the ultimate limits of the pad. For Stages 3, 4 and 5, temporary diversion ditches will be constructed to divert runoff from the 100-year/24-hour storm event.

5.0 HEAP LEACH CLOSURE

5.1 General Closure Concepts

The proposed method of closure for the Fort Knox heap leach pad is based on site-specific conditions, facility design, currently available test work, technical analyses completed as part of this project, and the closure evaluation for the tailing impoundment (Water Management Consultants, 2005). Key aspects of the site and operation that have been considered in developing the closure plan include the following:

- The climate at the site is characterized by moderate precipitation, moderate evaporation, and cold temperature. As a result, the long-term drainage from the pad after closure is predicted to be minimal.

- Laboratory test work shows that cyanide concentrations will decrease rapidly through recirculation with freshwater if reagents are not added to maintain process-level concentrations.

- The tailing impoundment is located directly downgradient from the proposed heap leach pad and will be an integral part of the long-term solution management scheme.

- To facilitate closure management, a portion of the solution inventory can be directed to the pit or treated once residual leaching is no longer economic. Long-term seepage will be routed to the surface of the tailing impoundment.

- The facility will be re-graded to an overall 3H:1V slope and covered with growth media. The re-grading design will include erosion control measures as necessary to avoid loss of growth media.

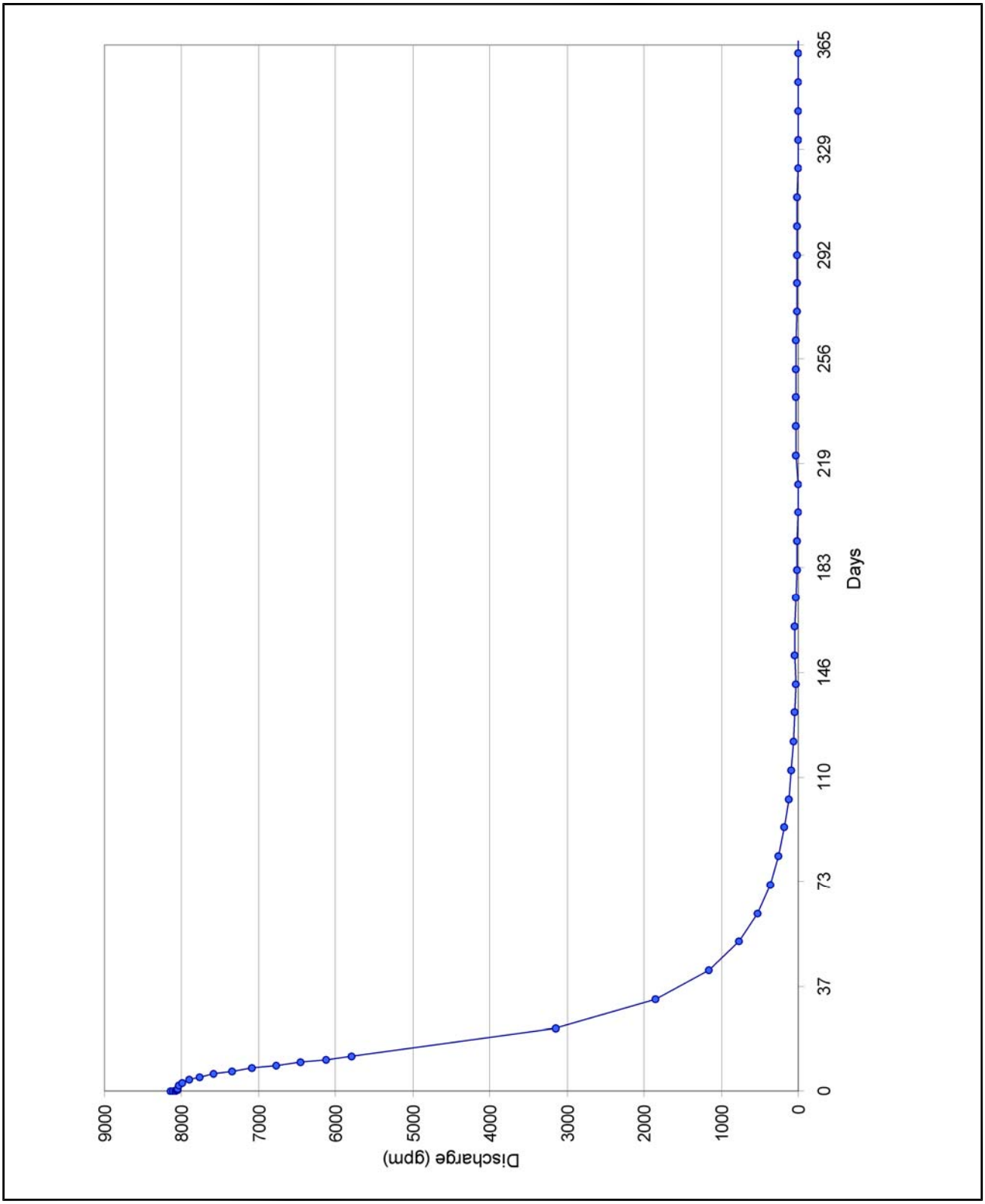
- Due to the presence of the tailing directly downgradient of the heap leach facility, no suitable locations for groundwater monitoring wells exist. The presence of tailing likely has interfered with local water quality that would limit the effectiveness of monitoring wells in detecting potential seepage. Therefore, monitoring will occur in the PCMS and underdrain systems during operation and closure of the pad.

5.2 Draindown

A water balance model was developed to project draindown conditions for the ultimate heap configuration (Water Management Consultants, 2005). Figure 5.0 illustrates the predicted short-term draindown curve for the final heap leach pad (161 million tons) over a period of years following cessation of solution application. The initial discharge of 8,000 gpm is based on an active leaching area of approximately 1,600,000 ft^2 and an application rate of 0.005 gpm/ft^2. The

WATER MANAGEMENT CONSULTANTS

Figure 5.0 Short term draindown curve



D:\PROJECTS HOT LIST\HEAP LEACH PROJECT\WM DRAWINGS\FIGURE 5.0 SHORT TERM DRAINDOWN 2.DWG

model incorporates residual draindown from the other portions of the facility that will have been leached prior to the time of closure.

After 90 days of draindown, the discharge rate is predicted to decrease to approximately 170 gpm. After one year, the discharge component from draindown is predicted to decrease to approximately 3 gpm. This draindown will decrease with time.

Long-term Drainage

The overall short- and long-term drainage from the final life of mine heap leach pad will be largely a function of infiltration of melting snow and direct precipitation. From a practical standpoint, once the heap leach pad is closed, the long-term flows at the toe of the base platform will be similar to those from the drainage in its natural condition.

5.3 Closure Sequence

The closure sequence will include the following activities:

- Residual leaching until uneconomic.
- Solution recirculation/rinsing to destroy cyanide and meet compliance standards
- Controlled release of draindown to the tailing impoundment
- Release of minor long-term seepage to the tailing impoundment
- Re-grading and growth media placement

Residual Leaching

Following completion of mining in the pit and final placement of ore on the pad, it is anticipated that leaching and gold recovery will continue from the pad for several years. As the recovery of gold begins to decline, the addition of cyanide will be discontinued. Heap leach pads often continue to economically recover gold for a number of years after the addition of cyanide is discontinued. During this period, barren solution will be applied to recover gold held in inventory. The exact duration of residual leaching will be dependent on continuing gold recovery.

Solution Recirculation/Rinsing

After economic leaching has been completed, solution will continue to be re-circulated on the pad to promote cyanide destruction. No cyanide will be added to the solution during this step. Fresh water will be added to the system as required to facilitate rinsing and removal of metals. During the rinsing, it may be necessary to direct solution to the pit or to a treatment facility in order to manage the water balance and remove chemical mass from the system. Routing solution

to the pit will improve the effectiveness of rinsing by minimizing the influence of evapo-concentration and reducing cyanide and metals concentrations. Although the chemical mass to be pumped to the pit from heap leach and the tailing is believed to be less than the amount that would compromise the water quality in the pit long term, the chemical mass pumped will be monitored closely, and if necessary, a treatment system will be implemented to reduce the chemical mass going to the pit. Some of the treatment options being investigated include engineered wetlands, reverse osmosis, oxide scavenging, chemical reduction, and biologically mediated reduction.

Since there is anticipated to be an extended period of residual leaching without the addition of cyanide and considering the high permeability of the heap leach ore, rinsing may require less than one year. Rinsing will be completed at a rate of up to 8,000 gpm. However, the actual duration of this step will be controlled by the time required for the water quality to achieve compliance standards. If the tailing facility is still an operating facility at the completion of draindown, the heap leach water will be released to the tailing impoundment when the quality meets the criteria for discharge to the tailing.

Release of Draindown to the Tailing Impoundment

When water quality criteria for discharge are achieved by rinsing, solution will be released to the tailing impoundment. The heap leach pad is designed with a drainage system that will, upon opening, allow the solution to drain by gravity to the tailing impoundment. The system will prevent significant amounts of water from accumulating in the heap leach facility following closure. The conceptual design of the closure drainage system includes penetrating the base of the solution collection well or drilling a series of holes through the liner in the vicinity of the solution collection wells.

The long-term seepage will be directed to the tailing impoundment and managed according to the closure plan for that facility. The surface of the tailing impoundment will be a combination of impounded water, wetland, and upland vegetation (Water Management Consultants, 2005). Discharge from the heap leach pad will mix with the water impounded on the surface of the tailing impoundment, and in time, flows down the Fish Creek drainage.

Re-grading, growth media and revegetation

Once the water quality is suitable for release, the heap will be re-graded to an overall 3H:1V slope. Approximately 12 inches of soil cover will be placed on the re-graded surface. The soil material will be sourced from stockpiles created during foundation preparation. Following growth media placement, the cover layer will be ripped on the contour to create a seedbed and to provide erosion control. The heap leach pad will be evaluated prior to closure to assess the need for additional erosion control measures. Ripping has proven to be an effective erosion control measure in areas with annual precipitation similar to Fairbanks and in particular when the underlying material is highly permeable.

The cover layer will be vegetated once growth media has been placed and ripped. Prepared seedbeds will be fertilized. Specific fertilization requirements will depend on the quality of

growth media used. Growth media will be tested for standard soil agricultural constituents including nitrogen, phosphorus, and potassium. Based on limited field testing and soil test results at Fort Knox, the general recommended rate of fertilizer application will range from 100 to 300 pounds per acre of 20N-20P-10K for a spring seeding or 10N-20P-10K for a fall seeding.

The grass seed mix planned for revegetation of the heap leach pad is listed in Table 5.1. However, the seed mix may vary depending upon the availability of seed. The initial objective of the seed mix is to establish a quick vegetative cover that will help minimize soil erosion. Test plots are being established to identify desirable forbs to include in the seed mix. Forb species currently being considered for revegetation include Silverberry, Lupin, Oxytropis, Wild Sweet Pea, Sweetbroom, Burnet, Siberian Aster, Goldenrod, Alpine Milk Vetch, Wild Sage, Dragonshead Mint, and Wild Rhubarb. These varieties are not currently available commercially, and a commercial source must be located if they are to be incorporated in the seed mix. The seed mix may change over time in response to such factors as internal and external research results, changes in technology, changes in land management philosophy, and commercial availability of seed. Native species are preferred. Other species may be used some years due to availability or if deemed to better meet the revegetation objectives. Any use of non-native species in the seed mix will be subject to agency approval.

Table 5.1 Seed Mix

ARCTARED RED FESCUE	50%
GRUENING ALPINE BLUEGRASS	20%
TUNDRA GLAUCOUS BLUEGRASS	20%
NORTRAN TUFTED HAIRGRASS	10%

Seeding and fertilizing will be accomplished using broadcast methods that may include hand, dozer, or off-road vehicle-mounted broadcasting and aerial broadcast application. The application rate for broadcast seeding using the presently proposed grass seed mix will be 11 to 18 pounds of pure live seed per acre. Fertilizer will be applied at a rate of 100 to 300 pounds per acre.

In some instances, mulch has been found to be useful in conserving moisture, moderating soil temperatures, and improving erosion control. The cool moist summers of the interior generally bring adequate rainfall to achieve a high seed germination rate. The practice of ripping the seedbed on the contour prior to seeding minimizes the potential for erosion. The use of mulch will be evaluated if seed germination or erosion becomes an issue in the establishment of vegetation.

6.0 MONITORING

Monitoring Points and Frequency

Monitoring of the heap leach facility during operation will include the barren solution, pregnant solution, LCRS, PCMS, and the underdrain system due to their potential for detecting process fluids in the event of leakage (Table 6.1). The LCRS and the PCMS will be monitored for flow weekly. If flow occurs in the LCRS, an estimate of the quantity will be determined. If flow occurs from the PCMS, a sample will be analyzed for WAD CN and pH. The underdrain system will be sampled quarterly and analyzed using the Profile II list of analytes (Table 6.2). Pregnant solution will be sampled quarterly and analyzed for Profile II analytes. The elevation of the in-heap storage pond will be continuously monitored using a telemetry system with installed piezometers.

Monitoring of rinse solution chemistry will begin after economic leaching has been completed and rinsing of the heap leach is in progress. During this period, samples will be collected on a quarterly basis to evaluate the rate at which the solution chemistry is improving. Rinsing may require less than one year but will continue until water quality is suitable for discharge to the tailing impoundment.

After the bottoms of the solution collection wells are penetrated or drill holes used to penetrate the liner, the solution will be directed to the tailing impoundment. Quarterly sampling of the drainage from the heap leach pad will continue for two years or until the quality becomes stable. Once the discharge quality stabilizes, sampling will be conducted on a semi-annual basis for a period of two years. Annual sampling will be conducted thereafter.

Monitoring results will be submitted quarterly to ADEC, ADNR, COE, and EPA. All quarterly reports will be submitted on or before the 15th day of the month following the quarter. The monitoring frequency and parameter suite will be re-evaluated after five years of monitoring. Long-term monitoring will occur downgradient of the facility at the surface water and groundwater monitoring points established as part of the Fort Knox closure plan (Water Management Consultants, 2005). Figure 6.0 illustrates the location of the long-term groundwater and surface water monitoring locations.

Table 6.1: Summary of monitoring requirements

Source	Parameter	Frequency
LCRS	Flow/WAD CN/pH	Weekly/Monthly*
PCMS	Flow/WAD CN/pH	Weekly/Monthly*
Underdrain	WAD CN/pH Profile II	Monthly Quarterly
Barren Solution	Profile II	Quarterly
Preg Solution	Profile II	Quarterly
In-Heap Storage Pond	Elevation	Continuous Automatic Monitoring
Rinsing Solution	Profile II	Quarterly**

* Flow will be measured weekly, samples will be taken monthly if there is flow.

** Begins after economic leaching is completed.

Wildlife Protection

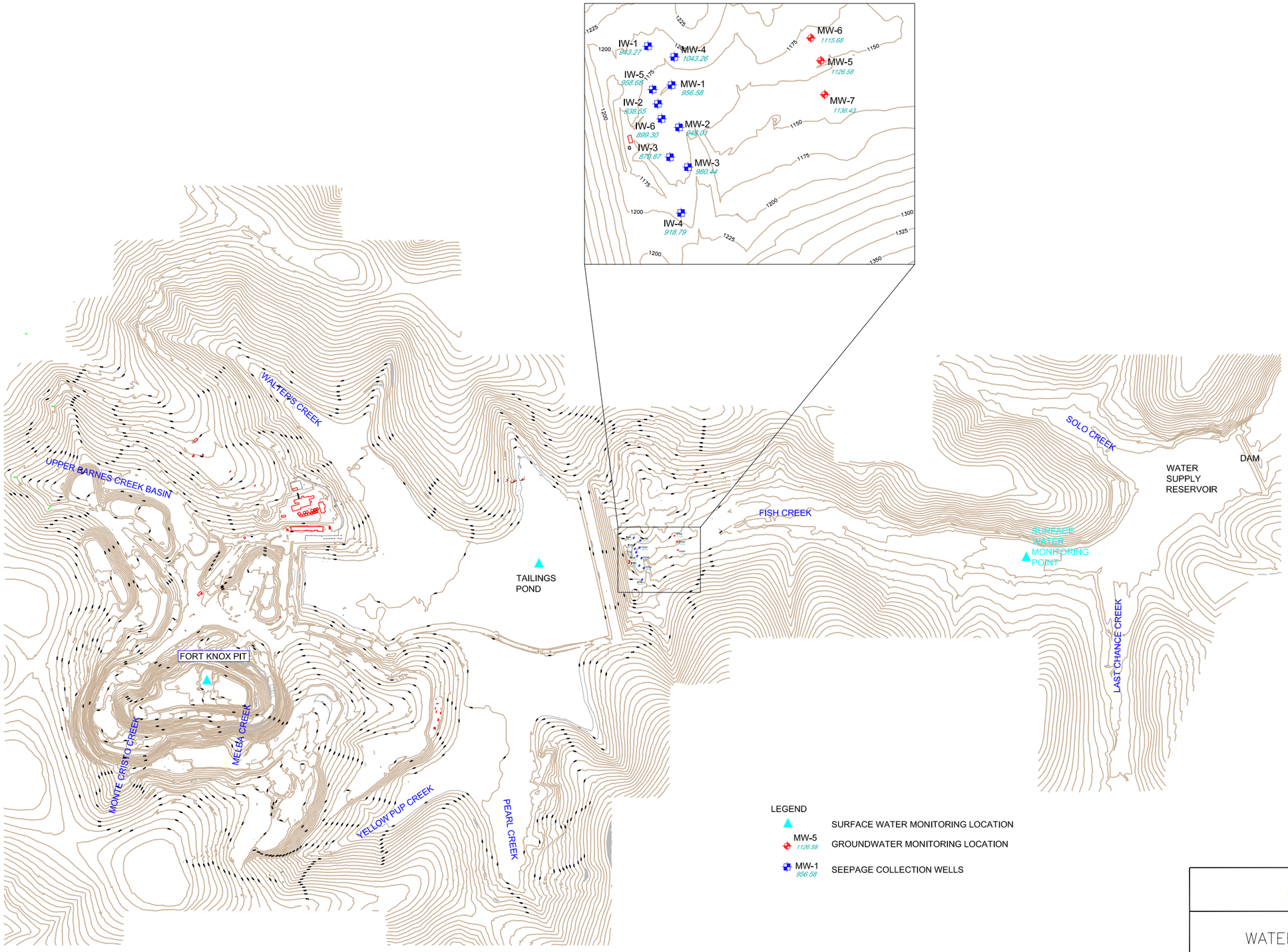
The heap leach facility has been designed to have no process solution exposed where it can be accessed by wildlife. During the cold months, the solution will be applied with drip emitters buried under 5 feet of ore, and in the summer months it will be applied from drop emitters or possibly sprinklers if enhanced evaporation is needed. Pregnant solution will be collected within the ore in the in-heap storage reservoir. Pregnant solution and barren solution will be transported between the pad and the CIC plant in pipes. The pad and piping will be visually inspected at least once each shift.

In the event of a wildlife mortality, it will be reported to the U.S. Fish and Wildlife Service (USFWS), OHMP, and ADEC within 24 hours or during their next scheduled workday. A written follow-up report will be submitted to USFWS and OHMP.

Table 6.2: Profile II Inorganic Parameters

Major Ion Chemistry	Minor Ion Chemistry	Trace Ion Chemistry
Lab Conductivity	*Arsenic	*Antimony
Temperature (field)	Total Cyanide	*Barium
	WAD Cyanide	*Bismuth
Turbidity	Fluoride	*Cadmium
Total Suspended Solids	*Iron	*Chromium
Total Dissolved Solids	*Manganese	*Copper
*Calcium	Nitrogen, Ammonia	*Lead
*Magnesium	Nitrate as Nitrogen	*Mercury
*Potassium	Nitrite as Nitrogen	*Selenium
*Silicon	Total Phosphorus	*Silver
*Sodium	TPH	*Zinc
Chloride		
Alkalinity (as $CaCO^3$)		
Bicarbonate		
Total		
Calcium Hardness		
Magnesium Hardness		

*Dissolved



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WATER MONITORING LOCATIONS

SIZE	FGMI NO.	DWG NO. FIGURE 6.0	REV
SCALE		DV101-89-08-166	

7.0 ESTIMATE OF RECLAMATION COSTS

The total estimated cost to reclaim Stage 1 and 2 of the Fort Knox Valley Fill Heap Leach is $2,793,074. The calculations for this cost are summarized in Appendix A. FGMI will reclaim the heap leach pad as contemporaneously as practicable. The plan and cost estimate are for the first two stages of development of the heap leach pad. The remaining three stages will have cost estimates prepared and the reclamation financial assurance in place prior to initiating construction. The Millsite Lease and the Solid Waste Disposal Permit provide opportunity for ADNR, ADEC, and FGMI to review and, if necessary, modify the reclamation plan and associated costs. The estimated cost presented herein was prepared for budgetary purposes associated with this permit and should be reviewed and revised prior to the completion of the permit.

Under the provisions of 11 AAC 97.320 (a), FGMI will file an Annual Activity Report and include the volume of material loaded on the heap leach pad in that year, the total acreage reclaimed in that year, and a statement as to whether the reclamation plan is on schedule.

The costs provided in Appendix A represent the total cost for reclamation and closure of the first two stages of heap leach development. As plans develop for the three remaining stages, the disturbance will be permitted and financial assurance provided.

This application is for the total facility, and FGMI proposes to initially provide financial assurance for disturbance of the total area (310 acres). However, financial assurance is proposed for constructing liner and loading with ore only the first two stages of the pad. Financial assurance for each of the additional three stages will be in place prior to initiating construction of the liner.

8.0 PERMITS AND AUTHORIZATIONS

Presented below is a list of permits and authorizations required to operate the Walter Creek Valley Fill Heap Leach Facility.

State of Alaska Permits and Authorizations

Department of Natural Resources
Amendment to the Fort Knox Plan of Operations
Modification of the Fort Knox Millsite Lease
Fort Knox Reclamation & Closure Plan Approval
Monitoring Plan Approval

Department of Environmental Conservation
Inclusion in Fort Knox Solid Waste Permit
Certificate of Reasonable Assurance for COE 404 Permit
Permit to Appropriate Water
Emergency Response Plan

Mental Health Trust Land Office
Right–of–Way for Access Roads

Federal Permits and Authorizations

Corps of Engineers
404 Wetlands permit

9.0 REFERENCES

America North/EMCON, Inc. (1992). *Fort Knox Project Jurisdictional Wetland Survey November.*

1992. American North/EMCON, Inc., Anchorage, Alaska with assistance from Resource Data, Inc. and Three Parameters Plus.

Anonymous (1916). *Descriptive of Fairbanks "Alaska's Golden Heart.*" The Fairbanks Commercial Club, Fairbanks, Alaska, 63 pp.

Boswell, J.C. (1979). *History of Alaskan Operations of the United States Smelting, Refining, and Mining Company*. Mineral Industries Research Laboratory, Fairbanks, Alaska, 126 pp.

Brooks, A.H. (1915). *Gold, Silver, and Copper in Alaska in 1915*. In Minerals Report of the United States 1915, Part I – Metals. Government Printing Office, Washington, D.C.

Brooks, A.H., and others (1914). *Mineral Resources of Alaska. Report on Progress of Investigations in 1913.* USGS Bulletin 592. U.S. Government Printing Office, Washington, D.C.

Cashen, W.R. (1971). *A Brief History of Fairbanks*. Copyright by W.R. Cashen, Fairbanks, Alaska, 18 pp.

CH2MHill (1993). *Fairbanks Gold Mining, Inc.'s Fort Knox Mine Environmental Assessment, August 1993.* CH2Mhill, Anchorage, Alaska.

Cobb, E.H. (1973). *Placer Deposits of Alaska*. U.S. Geological Survey Bulletin 1974, Washington, D.C., 213 pp.

Cooley, R.A. (1954). *Fairbanks, Alaska, A Survey of Progress*. Alaska Development Board, Juneau, Alaska, 78 pp.

EBA Engineering (1990). *Prefeasibility Studies Report, Fairbanks Gold Mining Inc., Fort Knox Project.* EBA Engineering Inc., Anchorage, Alaska.

FGMI (2005). *Quality Assurance/Quality Control and Field Procedures Manual, March 2003*. Fairbanks Gold Mining Inc., Environmental Department, Fairbanks, Alaska.

GEO-SLOPE International Ltd., 2004, "User's Guide - SLOPE/W for Slope Stability Analysis," *Version 4.23*, Calgary, Alberta, Canada.

Hill, J.M. (1933). *Lode Deposits of the Fairbanks District, Alaska*. USGS Bulletin 849-B. U.S. Government Printing Office, Washington, D.C., 163 pp.

JCHA (1992a). *Summary of Preliminary Operational Study Runs for a Surface Water Storage Facility to Meet the Fort Knox Project Water Demands*. John C. Halepaska and Associates Inc., Consulting Ground Water Engineers, Littleton, Colorado.

JCHA (1992b). *Surface and Ground Water Hydrology for the Fort Knox Project*. John C. Halepaska and Associates Inc., Consulting Ground Water Engineers, Littleton, Colorado.

JCHA (1996). *Tailings Storage Facility Interceptor Well Collection System, Fort Knox Mine*, John C. Halepaska and Associates Inc., Consulting Ground Water Engineers, Littleton, Colorado.

Knight Piésold and Co. (2005). *Fairbanks Gold Mining, Inc. Walter Creek Valley Fill Heap Leach Facility Design Report Issued for Agency Review*. Knight Piesold & Co. Denver, Colorado.

Parker, G.A. (1929). *The Evolution of Placer Mining Methods in Alaska*. B.S. Thesis, Geology and Mining, Alaska Agricultural College and School of Mines, College, Alaska, 64 pp.

Water Management Consultants (2005). *Fort Knox Mine Closure Management Plan for the Proposed Heap Leach Facility*, Water Management Consultants, Inc. Denver, Colorado.

Wold, J.A. (1971). *Fairbanks the $200 Million Gold Rush Town*. Wold Press, Fairbanks, Alaska, 42 pp.

APPENDIX A

Reclamation and Closure Cost Estimate

Ft. Knox Reclamation Plan

Heap Leach

Grade to 3:1 or flatter & establish drainage	$	456,730
Load, haul, dump and spread 12 in. growth media	$	485,865
Rip on the contour	$	45,272
Revegetation (Seeding and fertilization)	$	92,566
Supervisor	$	31,033
Drainage Construction	$	401,465
	$	1,512,931

Heap Phase III Footprint (costs included in rip, reveg and supervisor above 193.4 acres

Estimated Reclamation and Closure Cost	Walter Heap Phase I & II		Heap Phase III - V Footprint		Heap Leach
	Quantity	Units	Quantity	Units	Totals
Acres	116.6	ac	193.4	ac	310
Top slope	14.9	ac		ac	15
Side slope	101.7	ac		ac	102
Grading and Recontouring					
Equipment	**D9 Dozer**				
What is the total volume of material to be recontoured?	933,587.05	cy			933,587
Cut/fill volume of top slopes	89,199.00	cy			89,199
Cut/fill volume of side slopes	844,388.05	cy			844,388
What percentage of material will be dozer-pushed?	100%				1
Calculated quantity of dozer-pushed material	933,587.05	cy			933,587
Top slope	89,199.00	cy			89,199
Side slope	844,388.05	cy			844,388
What is the weighted average push distance?	150.00	ft			
What is the productivity of the equipment?					
Top slope	296.89	cy/hr			
Side slope	475.02	cy/hr			
How many hours will the job take?	2,078.0	hrs			2,078
What is the equipment cost per hour?	$ 171.00	$/hr			
What is the labor cost per hour?	$ 48.79	$/hr			
What is the overall cost per unit (i.e. cubic yards, acres)?	$ 0.49	$/cy			
Cost per cubic yard top slope	$ 0.74	$/cy			
Cost per cubic yard side slope	$ 0.46	$/cy			
Cost for Top Slope	$ 66,035.24				$ 66,035
Cost for SIde Slope	$ 390,695.00				$ 390,695
What are the total labor costs	$ 101,387.09				$ 101,387
What is the total cost for grading and recontouring?	$ 456,730.23		$ -		$ 456,730

Load, haul, dump and spread growth media							
Equipment - 988, Euclid B-70 Haul Truck, Water Truck, G16 Grader, D8							
What is amount of topsoil to be loaded with loader?		188,115	cy				188,115
Volume to Top Slope		23,984.62	cy				23,985
Volume to Side Slope		164,130.05	cy				164,130
What is wtd avg haul distance one way from TS Pile?			ft				
What is amount of topsoil to be hauled by truck?		188,114.67	cy				188,115
What is the productivity of the loading equipment?		547.80	cy/hr				548
How many hours will the job take?		343.40	hrs				343
What are the estimated hours for haul and support equipment?							0
Estimated hours for Loader		343.40	hrs				343
Estimated hours for Truck		1,373.60	hrs				1,374
Estimated hours for Grader to support hauling effort		343.40	hrs				343
Estimated hours for Water Truck to support hauling effort		343.40	hrs				343
Estimated hours for Dozer to spread topsoil		338.92	hrs				339
Top Slope dozer productivity		373.44	cy/hr				
Side Slope dozer productivity		597.51	cy/hr				
What is the equipment cost per hour?							
Loader	$	132.00	$/hr				
Truck	$	150.00	$/hr				
Grader	$	119.75	$/hr				
Water Truck	$	60.92	$/hr				
Dozer	$	114.00	$/hr				
What is the labor cost per hour?							
Loader	$	48.79	$/hr				
Truck	$	48.79	$/hr				
Grader	$	48.79	$/hr				
Water Truck	$	48.79	$/hr				
Dozer	$	48.79	$/hr				
What is the overall cost per unit (i.e. cubic yards, acres)?	$	2.58	$/cy				
Cost per cubic yard to doze top slope	$	0.44	$/cy				
Cost per cubic yard to doze side slope	$	0.27	$/cy				
What are the total equipment costs	$	352,047.51				$	352,048
What are the total labor costs	$	133,817.19				$	133,817
What is the total cost for growth media placement?	$	485,864.70		$	-	$	485,865
Rip on the contour							
Equipment - D8 dozer							
How many acres are to be ripped?		116.6	ac		193.4	ac	310
What is the productivity of the equipment?		1.1	ac/hr		1.1	ac/hr	
How many hours will the job take?		104.6	hrs		173.5	hrs	278
What is the equipment cost per hour?	$	114.00	$/hr	$	114.00	$/hr	
What are the labor costs per hour?	$	48.79	$/hr	$	48.79	$/hr	
What is the cost per unit (i.e. cubic yards, acres)?	$	146.04	$/ac	$	146.04	$/ac	
What are the total equipment costs	$	11,924.48		$	19,778.69		$ 31,703
What are the total labor costs	$	5,103.47		$	8,464.93		$ 13,568
What is the total cost for ripping?	$	17,027.95		$	28,243.62		$ 45,272

Revegetation								
How many acres are to be vegetated?		116.6	ac		193.4	ac		310
What is the cost per acre?	$	298.60	$/ac	$	298.60	$/ac		
What is the total cost of seed, fertilize and mulch?	$	34,816.76		$	57,749.24		$	92,566
Supervision								
Hours		421.01	hrs		28.92	hrs		450
Equipment	$	15.58	$/hr	$	15.58	$/hr		
Supervisor	$	53.39	$/hr	$	53.39	$/hr		
Supervision Costs	$	29,038.41		$	1,994.47		$	31,033
SUBTOTAL - GRADE, COVER & REVEG COSTS	$	1,023,478.05		$	87,987.32		**$**	**1,111,465**
Drainage (See Details in Supporting Information)								
Excavation								
Quantity		6,222	cy					6,222
Unit Cost	$	1.75	$/cy					
Subtotal	$	10,888.89					$	10,889
Geofabric								
Quantity		177,088	sqft					177,088
Unit Cost	$	0.15	$/sqft					
Subtotal	$	26,563.13					$	26,563
Riprap								
Quantity		9,838	cy					9,838
Unit Cost	$	35.00	$/cy					
Subtotal	$	344,336.90					$	344,337
Place riprap								
Quantity		9,838	cy					9,838
Unit Cost	$	2.00	$/cy					
Subtotal	$	19,676					$	19,676
Drainage Construction Costs	$	401,465		$	-		$	401,465
Total Labor Costs	$	1,263,786		$	96,452		$	1,360,238
TOTAL COSTS	**$**	**1,424,943**		**$**	**87,987**		**$**	**1,512,931**

Ft. Knox Reclamation Plan

Heap Leach Rinse

Rinse at 8,000 gpm for 6 months following termination of production.
Pump draindown water to pit
Draindown and pump to pit with 2 pumps 20 days
Draindown and pump to pit with 1 pump 160 days

Labor	$	654,319
Pumping	$	550,824
Contractor	$	75,000
	$	1,280,143

Labor

	No. of Personnel	Days	Hours /Day	Total Hours	Cost/ Hour	Total Cost
Pad Operators - 8	8	180	8	11520	$ 48.79	$ 562,060.80
Supervisor - 1	1	216	8	1728	$ 53.39	$ 92,257.92
Total Labor						$ 654,318.72

Pumping Cost

	KWH	GPM	Power $/KWH	Number Pumps	Pump Maint. $/Hr	Cost/ Hour	Total Hours	Total Cost
Pump to Rinse	373	2,000	$ 0.10	2	$ 0.57	$ 75.74	4320	$ 327,196.80
Pump Makeup water	298	2,500	$ 0.10	1	$ 0.57	$ 30.41	4320	$ 131,371.20
Draindown to Pit	187	3,500	$ 0.10	2	$ 0.57	$ 38.44	480	$ 18,451.20
Draindown to Pit	187	3,500	$ 0.10	1	$ 0.57	$ 19.22	3840	$ 73,804.80
Total Pumping								$ 550,824.00

Contractor

Open Heap Leach Drain Pipes						Total Cost
Drilling to Puncture Liner	3 Wells	250	feet	$ 100.00	/ft	$ 75,000.00
Total Labor						$ 75,000.00

Total Cost	$ 1,280,142.72