OCEANAGOLD
Haile Operation

June 18, 2019

Mr. Byron Amick
South Carolina Department of Health and Environmental Control
Industrial Wastewater Permitting Section
Bureau of Land and Waste Management
2600 Bull Street
Columbia, SC 29201

Re: Haile Gold Mine, Inc.
Permit Modification - NPDES Permit #SC0040479
Lancaster County

Dear Mr. Amick,

Oceana Gold – Haile Operation (Haile) has submitted permit modification requests to the U.S. Army Corps of Engineers and DHEC-Mining to optimize our operation. Optimization would involve an increase in permitted acreage, increases in the width and depth of mine pit shells, increases in overburden and tailings storage capacities, increases in mill production and contact water treatment capacities, increases in freshwater and contact water storage capacities, and development of the Horseshoe Deposit by mining underground.

Careful planning and mine sequencing will allow us to implement these changes with minimal changes in the footprint as originally permitted (Figure 1). Mine optimization will entail fourteen (14) years of active mining, and a final two (2) years processing low grade ore stockpiled at West PAG (formerly JPAG) while reclaiming pits and overburden storage areas that were not reclaimed during the active mine life (Table 1).

Haile is requesting to replace 003 Outfall, with 004 Outfall that will be located closer to the Contact Water Treatment Plant (See Map). Haile has enclosed materials in support of this NPDES Permit #SC0040479 modification request, to include:

- Detailed Project Description for the Proposed Haile Gold Mine Expansion, Revision 1
- Haile Gold Mine's Site Wide Water Balance Report dated January 29, 2019
- Haile Gold Mine's Water Management System Diagram dated June 14, 2019
- Haile Gold Mine Monitoring and Measurement Plan dated June 10, 2019
- Site Map depicting the location of the proposed 004 Outfall dated June 18, 2019
- Design specifics of Outfall 004 dated June 18, 2019
- Summary of stream flow data at surface water sampling stations for 2018 dated June 17, 2019

- 2019 1st Quarter Groundwater/ Surface Water Monitoring and Measurement Report dated May 9, 2019
- An updated list of properties contiguous to the proposed property boundary, to include tax parcel identification numbers and the mailing address of property owners.

Past copies of the Quarterly Groundwater / Surface Water Reports for 2015 through 2018 are on file at DHEC.

For your convienence, a compact disk with electronic versions of these materials has also been provided. If you need additional information, or have questions regarding the mine optimization plans, please call me at (803) 475-2943.

Sincerely,

Scott McDaniel
Environmental Manager

Cc: David Thomas – OceanaGold
Jeremy Eddy – SC DHEC Mining
Rusty Wenerick – SC DHEC 401 Manager

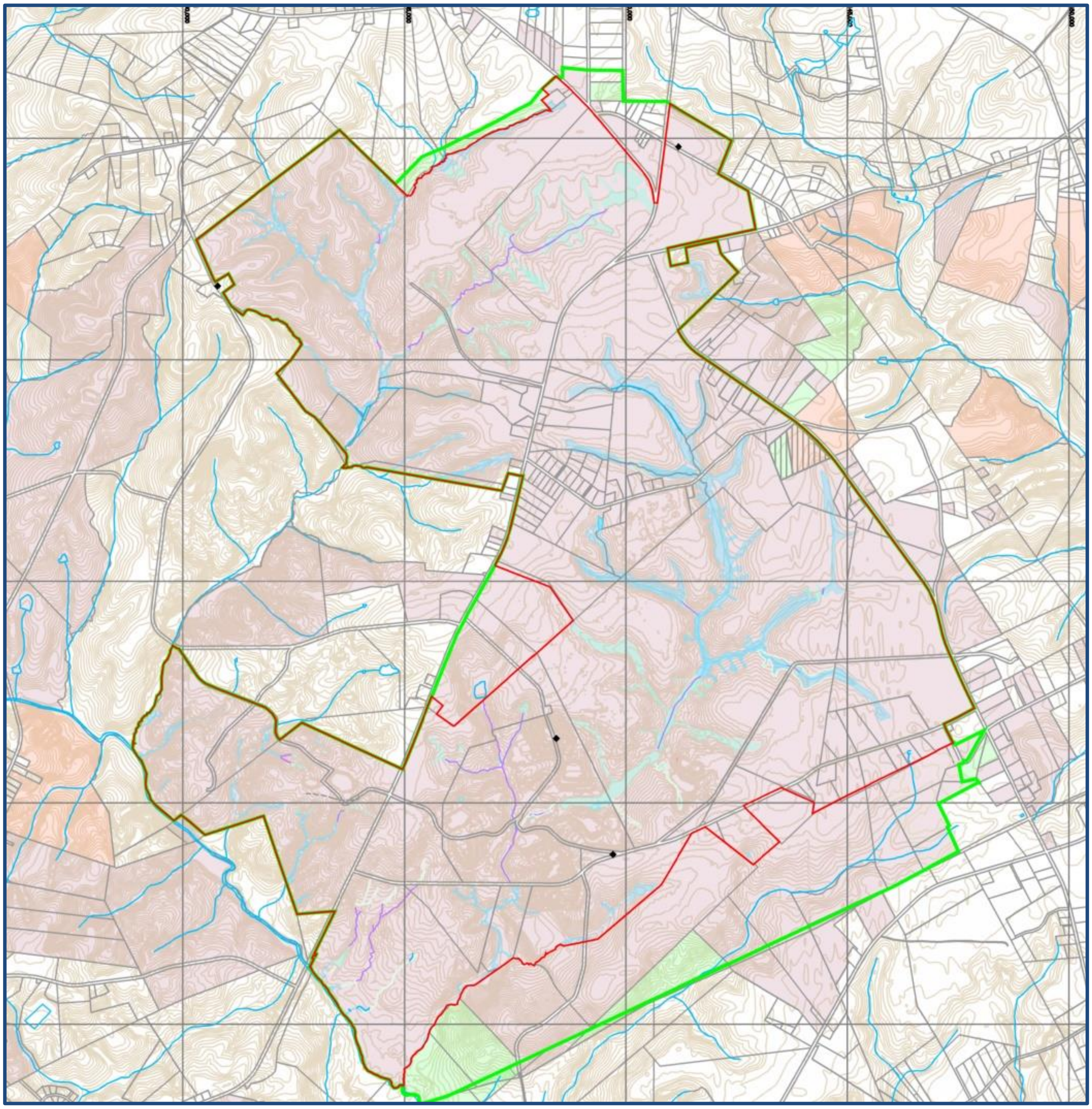

Figure 1: Project Boundary - Original Boundary (2014) – Red, Proposed New Boundary (2018) – Green

Source: Haile 2018

Appendix A

Detailed Project Description

for Proposed Haile Gold Mine Expansion

(Revision 1)

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Table of Contents

List of Tables

List of Figures

List of Acronyms

amsl	above mean sea level
Applicant, the	Haile Gold Mine, Inc.
bmsl	below mean sea level
CIL	carbon in leach

CoG	cut-off grade
CPS	Coastal Plains Sands
CWTP	Contact Water Treatment Plant
cy	cubic yard(s)
CN	cyanide
EAP	Emergency Action Plan
FWSA	Fresh Water Storage Area
FWSD	Fresh Water Storage Dam
gpm	gallons per minute
HDPE	high-density polyethylene
kton	kiloton(s)
kV	kilovolt
Haile	Haile Gold Mine, Inc.
HCO_3	bicarbonate
LCRS	leak collection and recovery system
mil	a mil is one one-thousandth of an inch
MW	megawatt(s)
m	meter
Mt	million tons
NH_4	ammonium
North Fork	North Fork of Haile Gold Mine Creek
NPDES	National Pollutant Discharge Elimination System
OCN-	cyanate
opt	ounces per ton
OSA	overburden storage area
PAG	potentially acid-generating
PMP	probable maximum precipitation
ppm	parts per million
Project	Haile 2018 Mine Expansion Plan
rec oz/t	recoverable troy ounce per ton
SCDHEC	South Carolina Department of Health and Environmental Control
TSF	Tailings Storage Facility

US 601	US Highway 601
UV	ultraviolet
WAD	weak acid dissociable

PROPOSED HAILE GOLD MINE PROJECT DESCRIPTION

This document describes the Haile 2018 Mine Expansion Plan (the proposed Project) in detail, including the ore mining and processing operations that would recover gold and silver[1] by excavating pits and underground deposits, storing excavated soils and overburden, processing the ore, managing surface water and ground water during operations, reclaiming the site at the end of operations, and monitoring site conditions post-mining. The components of the proposed Project are summarized in Section 3, "Overview of the Proposed Project," and each component is discussed in detail in the sections that follow. Imperial units of measure are used throughout this Project Description narrative. Metric conversions are provided in the attached Conversion Chart in Appendix A at the end of the document.

1. SITE DESCRIPTION

The proposed Project is located 3 miles northeast of the Town of Kershaw in southern Lancaster County, South Carolina (Figure A-1). Lancaster County lies in the north-central part of the state. The Haile Gold Mine is approximately 17 miles southeast of the City of Lancaster, the county seat, which is approximately 30 miles south of Charlotte, North Carolina.

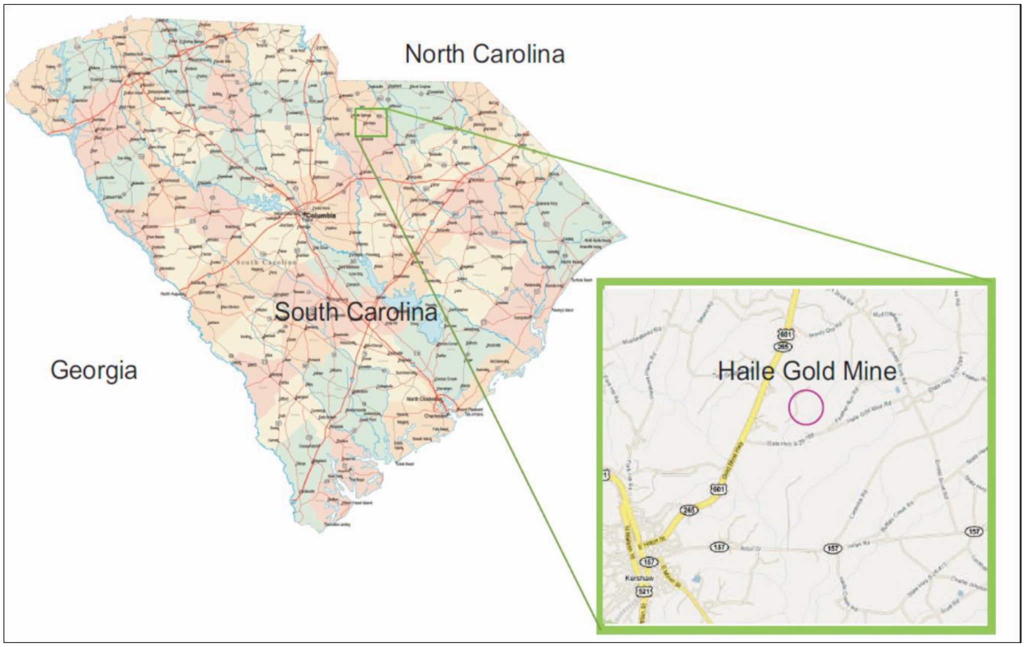

Figure A-1 Vicinity Map of the Proposed Project
Source: State-Maps.org and Google Maps, 2014

Figure A-2 shows the Site for the proposed Project area in greater detail, including the Project Boundary within which mine activity would occur. It also shows the location of specific elements of the currently permitted mining activity and local roads. US Highway 601 (US 601) runs along the west side of the main portion of the Project area; the proposed Tailings Storage Facility (TSF) is located west of US 601 at the north end of the Project area.

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[1] Although approximately 50 percent more silver than gold is extracted from the Haile Gold Mine by volume, Haile Gold Mine is considered a gold mine because the value of the gold exceeds the value of the silver at a general ratio of 50:1 (or more). Thus, the gold reserve is what makes Haile Gold Mine a valuable ore body to mine. For convenience, the supplemental environmental impact statement (SEIS) refers to ore extraction and processing in terms of gold production.

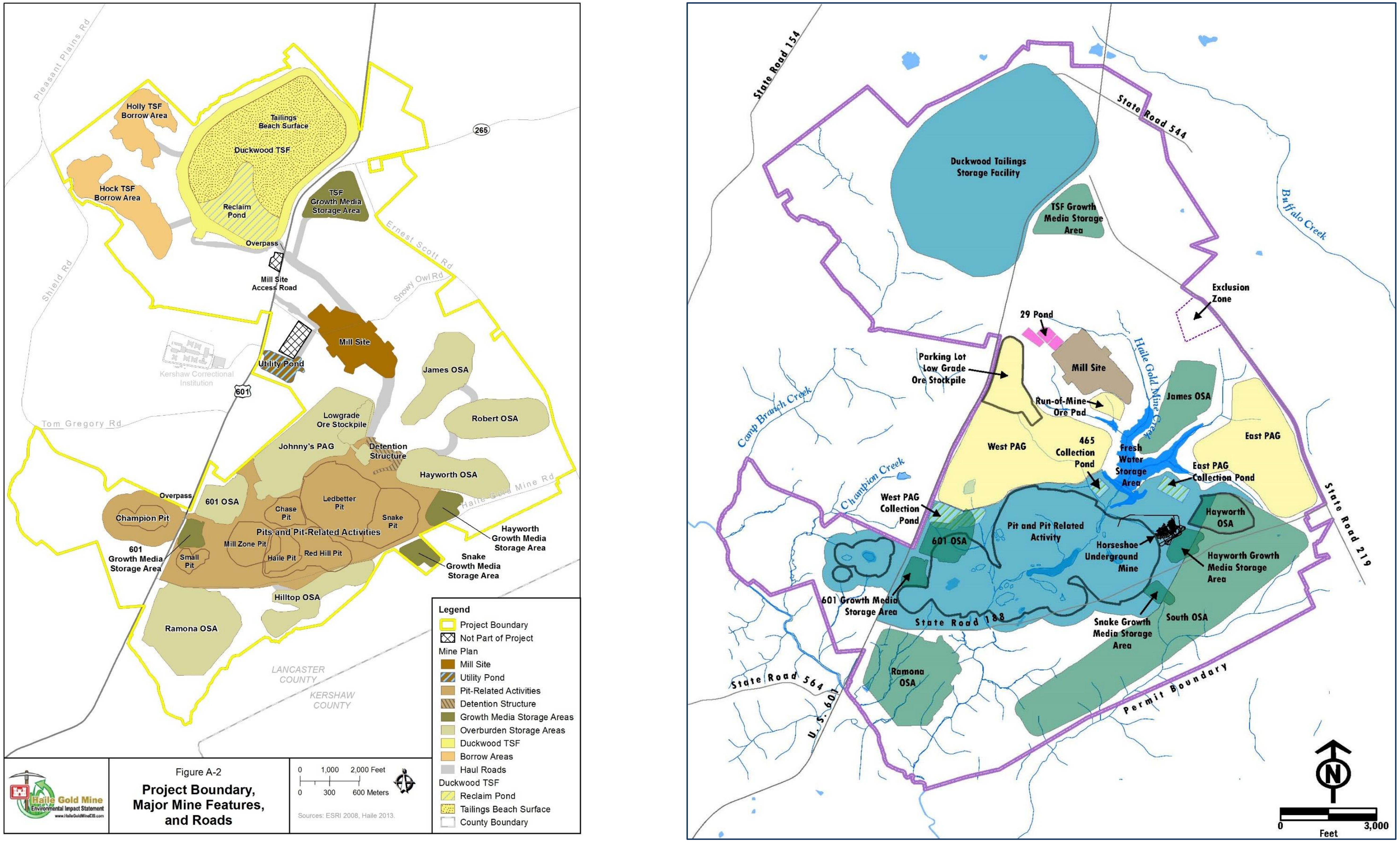

Figure A-2 Project Layout from 2014 EIS and Proposed Haile 2018 Mine Expansion Plan
Source: Haile 2018

Haile initiated its current mining activities in 2015 pursuant to permits issued in 2014. The timeline for the Haile Project is shown in Appendix B. Haile currently is mining in Mill Zone Pit, Snake Pit and Red Hill Pit. Overburden has been placed, depending on its acid generating potential, into Johnny's Potentially Acid Generating (JPAG) Storage Area or into one of two non-PAG (green) overburden storage areas (OSAs), Ramona OSA or Hayworth OSA, with James OSA beginning later in 2018. Growth media has been placed in 601 Growth Media Storage Area (GMSA), TSF GMSA, and Hayworth GMSA. The Mill Processing Plant (Mill) is operating and approaching permitted capacity at 3.3 million tons / year through the crusher and grinding circuits. Gold Dore` bars are being poured, and tailings material is being deposited in the Tailing Storage Facility (TSF).

The purpose of this Expansion Plan is to:

- Increase the mine pit shell from $950 to $1,150/troy ounce. This expands the volume of gold-bearing ore that previously would have been uneconomical to mine.
- Perform underground mining operations at Horseshoe Deposit.
- Optimize Mill operations by removing several operational bottle-necks, which increases capacity from approximately 9,100 tons / day to approximately 14,400 tons/day[2] (from about 3.3M tons / year to 4.0 M tons / year).
- Expand the Project Boundary to include adjacent properties which will increase total acreage within the Project Boundary by about 897 acres from about 4,540 acres to about 5,437 acres. See Figure A-3 for a comparison of the currently permitted Project Boundary and the proposed new Project Boundary.
- Increase TSF storage (with HDPE liner and underdrain collection system) from approximately 40 million tons to approximately 72 million tons by adding additional lifts to the existing TSF.
- Increase above ground Potentially Acid Generating (PAG) storage (with HDPE liner and contact water collection system) from approximately 46 million tons to approximately 150.1 million tons by expanding the existing JPAG facility (now called "West PAG") and adding a second PAG facility (East PAG).
- Increase above ground green OSAs from approximately 138.5 million tons to approximately 207.0 million tons primarily by adding a large green OSA facility along the southern border – South OSA.
- Expand Contact Water Treatment Plant (CWTP) capacity from approximately 1,200 gallons per minute (gpm) to approximately 2,000 gpm; and
- Increase primary contact water storage capacity at the 19 Pond (which services the CWTP) from approximately 19 million gallons to approximately 29 million gallons.

As a result of the proposed expansion of mine and process operations, Haile will:

- Increase current employment from approximately 400 to over 650 people at the peak of open pit and underground mining.
- Extend mine life from about 14 years to over 16 years.
- Expand its Project Boundary by less than 20%, as illustrated in Figure A-3.

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[2] The operational rate for the Mill under the Haile 2018 Mine Expansion Plan includes an assumption of 85% equipment availability.

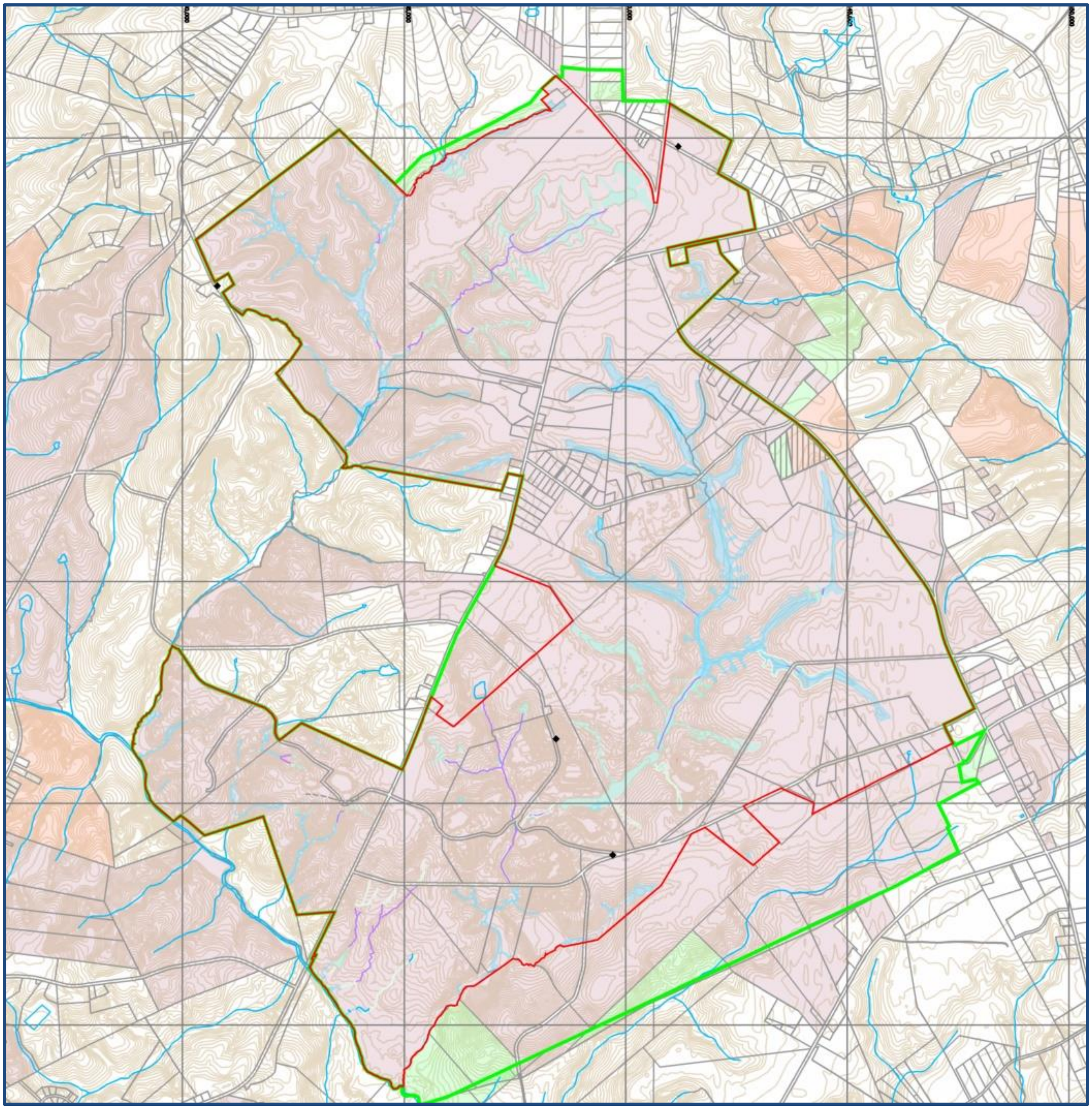

Figure A-3 Project Boundary - Original Boundary (2014) – Red, Proposed New Boundary (2018) – Green)
Source: Haile 2018

2. MINERALIZED ORE TO BE MINED

Haile's most recent Feasibility Study has identified additional gold-bearing minerals that could be economically recovered within the Project area (SRK NI 43-101 Technical Report (August 2017)). These gold-bearing minerals are known as ***reserves***. Use of the term reserves is limited to ore bodies that have been subjected to a thorough analysis of extensive exploratory drilling results and a comprehensive evaluation of technical and economic feasibility based on mining industry investment standards[3]. The plan for mining a defined reserve (the expected pit locations and the depths and pace of mining) is called the mine plan and is set out initially in a feasibility study. Areas that may contain gold-bearing minerals, but that have not been subjected to rigorous subsurface evaluation and feasibility analysis, may be considered ***resources*** and are differentiated from reserves. Resources are not considered for inclusion in a mine plan unless further studies convert the resources into reserves. The term mineralization refers to rock that contains, or is likely to contain, gold. Mineralization or mineralized strata can occur in both reserves and resources, as well as outside of them, as these terms simply indicate the potential for the rock strata to contain precious minerals.

Haile used $950 / troy ounce as the cut-off price to determine economic feasibility in the 2014 EIS. This established the blocks of ore material that would be economical to mine and this led to the original Mine Plan that Haile permitted in 2014. However, the price of gold has been consistently above $950 for the past ten years, as shown in Figure A-4; therefore, the new Mine Plan is based on $1,150 / troy ounce. This results in the Mine Plan's inclusion of some additional reserves shown in Table A-1.

Figure A-4 Gold Price (US$ / troy oz)
Source: www.macrotrends.net, 2018

Table A-1: Open Pit and Underground Mine Plan

Mining Type	2014 EIS		2018 Plan	
	Tons (Mt)	Au Contained (M troy oz)	Tons (Mt)	Au Contained (M troy oz)
Open Pit	40.67	2.13	61.1	2.87
Underground	---		3.4	0.44
Subtotal	**40.67**	**2.13**	**64.5***	**3.31**

Source: Haile, 2014 and 2018 Mine Plan

* Note: By the end of 2017, Haile had placed 2.0 M tons of tailings in the TSF. This brings the total placement in the TSF at 66.5 M tons. The TSF design has been modified to 72.0 M tons to allow additional capacity for operational flexibility and bed densification.

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[3] Declaration of a reserve is governed by public disclosure requirements applicable in the United States and Canada. See U.S. Securities and Exchange Commission *Industry Guide 7* (August 13, 1992); Canadian Institute of Mining, Metallurgy, and Petroleum *Definition of Standards for Mineral Resources and Reserves* (December 11, 2005).

The mine plan identifies the pits where the reserves will be mined. Figure A-5 shows the location and naming convention for each open pit. Haile proposes to mine the pits in the following order (see Section A.4, "Project Sequence" for more details):

- Mill Zone Pit Phase 1 (P1)
- Snake Pit Phase 1 and 2 (P1 and P2)
- Red Hill Pit (P1)
- Haile Pit (P1)
- Horseshoe Underground and Snake Pit Phase 3 (Portal_P1)
- Ledbetter Pit – Phase 1 through 4 (P1 – P4)
- Mill Zone Pit Phase 2 (P2) (includes previously designated Small Pit)
- Champion Pit Phase 1 and 2 (P1 and P2)

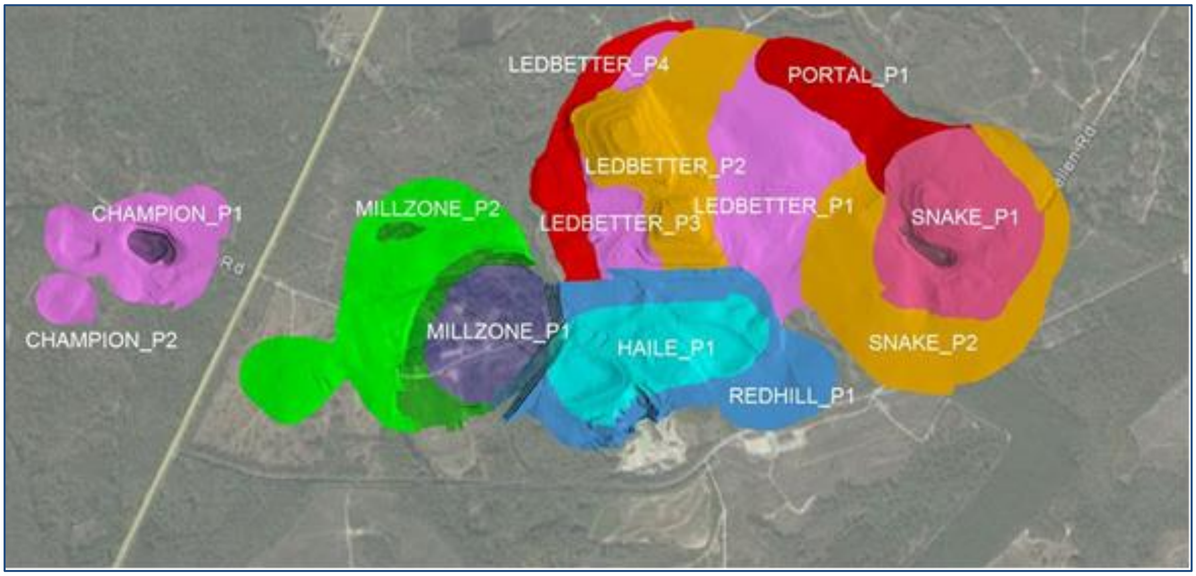

Figure A-5 Open Pit Names and Locations
Source: Haile 2018

Figure A-6 depicts a side view of the reserves, with the open pits identified and the expected zone of mining indicated as the reserve ore. Horseshoe is a reserve that Haile proposes to recover via an underground mine that it will construct from a decline in the sidewall of Snake Pit Phase 2. The cross-section is a view from the surface to depths of more than 2,000 feet. HGM16 refers to the block model name that was used in the August 2017 Feasibility Study. Pits are shown in gray while modeled gold bearing mineralized ore blocks are shown in gold.

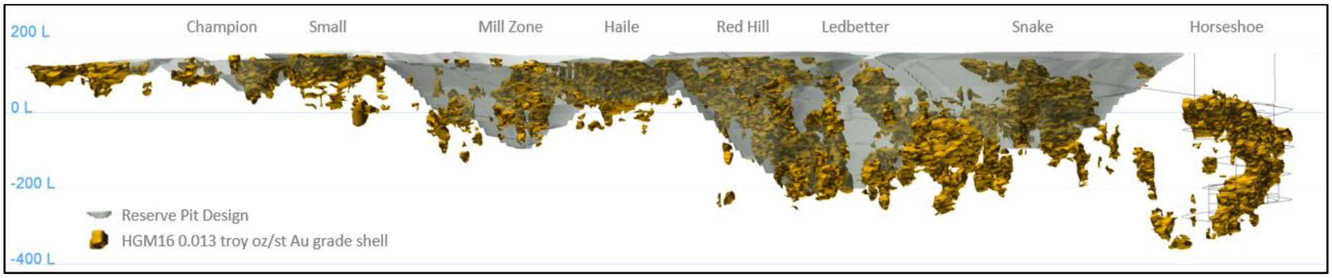

Figure A-6 Cross Section of Mineralized Ore

Source: Haile 2018

3. OVERVIEW OF THE PROPOSED PROJECT

This section provides an overview of the proposed Project. Development and operations of the gold mine will take place over an approximately 16-year period (2017 to 2032). Haile officially began its processing operations in 2017. Thus, Haile's operations currently are in Mine Year 2 (2018) of the 16-year expansion plan that Haile now seeks to permit. Unlike Haile's Project Description used for the USACE's 2014 FEIS, ROD, and 404 Permit, this Project Description refers to calendar years, rather than mine years, in an effort to minimize confusion. Since Haile's ability to pursue its expanded mine plan depends on when a Supplemental EIS (SEIS), ROD, and Amended 404 Permit are issued, all references to calendar years are an approximation based on the assumption that Haile will receive its permitting in early 2020. Fourteen (14) years are spent actively mining, and a final 2 years are spent processing low grade ore that has already been mined while reclaiming pits and OSAs that were not concurrently reclaimed during active mining.

The major elements are shown in Figure A-7, a plan view of the Project area representing all facilities over the life of the mine, and in Figure A-8, an aerial view of the pit shapes in 2031 without the backfilling. The proposed Project includes the following major components:

1. Open pits and associated haul roads where gold reserves are mined.
2. OSAs for storage of surface soils and overburden removed from the pits to expose the gold reserves, including four Growth Media Storage Areas (GMSAs), four Green OSAs (counting the portion of Hayworth OSA that becomes incorporated into South OSA as one Green OSA) and two PAG facilities, and associated haul roads.
3. A Mill for processing the ore and refining the gold. The Mill Site also includes the CWTP, materials storage, administrative offices, a truck shop, a warehouse, and ancillary facilities.
4. A TSF for permanent storage of tailings (a byproduct of the ore recovery process), a slurry pipeline to transport the tailings from the Mill to the TSF (and to transport reclaimed process water from the TSF to the Mill), and an access road.
5. A Fresh Water Storage Dam (FWSD) on Haile Gold Mine Creek to (i) protect the open pits from flooding in extreme weather and (ii) establish a Fresh Water Storage Area (FWSA) for non-contact water required for operational makeup needs.
6. Diversion of upper Haile Gold Mine Creek into pipes during mining operations that carry a minimum base flow around the open pits to lower Haile Gold Mine Creek.

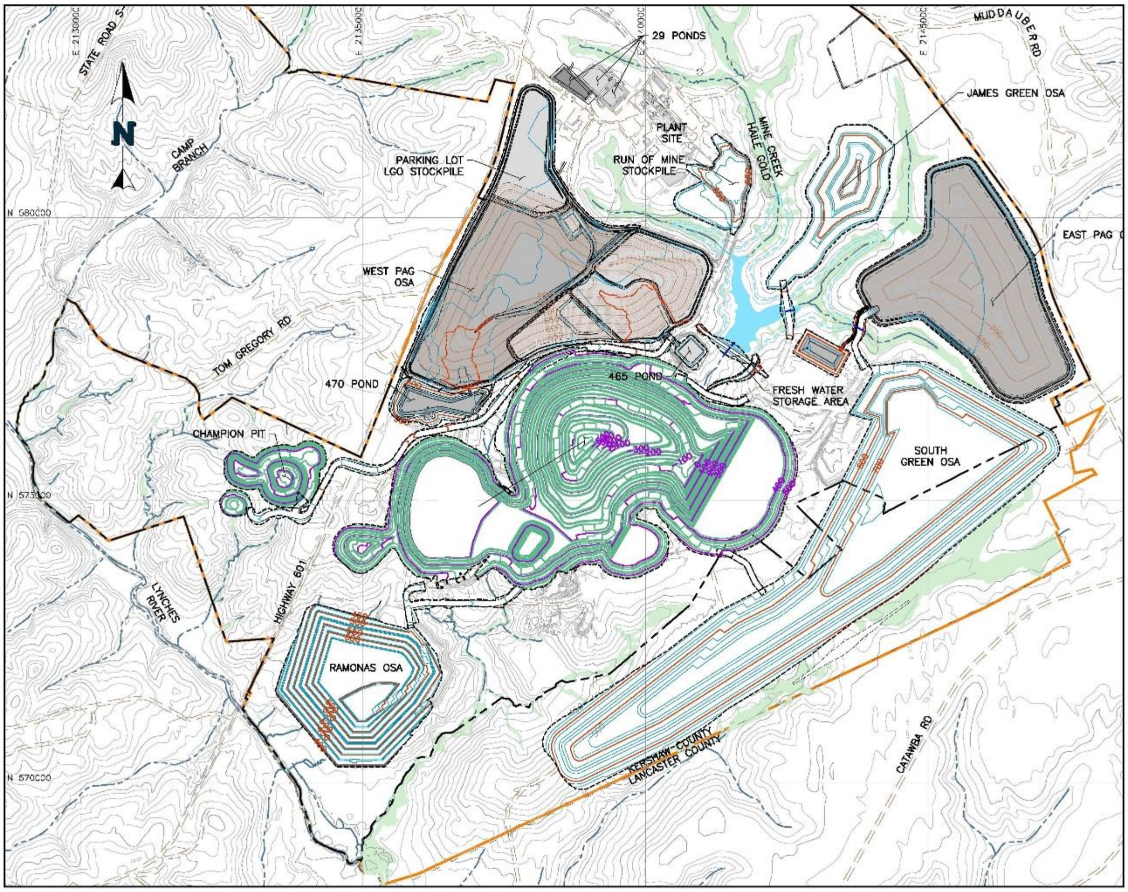

Figure A-7 **Proposed Project – Plan View of the Project Area**

Source: Haile 2018.

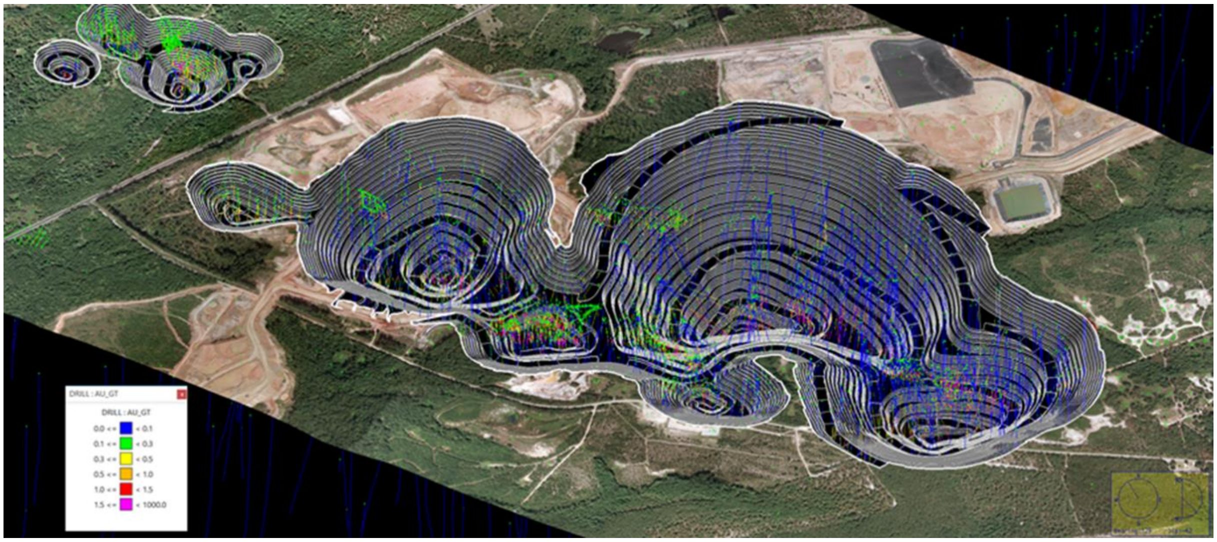

Figure A-8 **Simulated Aerial View of Haile Gold Mine Open Pit Operations (2031)**

Source: Haile 2018.

The area disturbed by each of the Project elements is shown in Table A-2. Project elements would disturb approximately 3,863 acres of the Project area.

Table A-2 Project Footprint by Major Component

Mine Component	Approximate Area (acres)
Mine pits, pit-related activities, and haul roads	1,436
OSAs, GMSAs, and haul roads	1,590
Mill, associated ore storage and support facilities, and haul roads	185
TSF and associated haul road and slurry pipeline	632
FWSA (at 470 ft amsl operating level) including FWSD	15
Site access road and US Highway 601 overpasses	5
Total estimated footprint (of 5,437 acres in the Project area)	**3,863**

Source: Haile 2018.

A few notable aspects of the Project design and operations include:

a. Haile has carefully planned this expansion to avoid and minimize impacts where practicable to do so and will propose mitigation for unavoidable impacts. Proposed reclamation activities include restoration of on-site streams.

b. Water used in the Project area is managed to maximize recycling and reuse:

  - Process water within the Mill and TSF is managed in a closed-loop system (and never discharged to surface waterbodies or groundwater) that continuously reclaims water from Mill operations and the TSF for process use. Once make-up water from other sources (such as groundwater depressurization or contact water collected from PAG facilities or open pits) is introduced into the process system, it never leaves the process loop.
  - The CWTP treats contact water (e.g., water collected in open pits or at PAG facilities), and the discharged effluent is released subject to National Pollutant Discharge Elimination System (NPDES) standards.
  - Only treated water, surface water, or water from the depressurization wells is discharged.

c. In addition to crushing methods, the Mill would use a sodium cyanide chemical extraction process in tanks to refine gold from the ore. Chemicals and reagents (chemicals and solutions used in the processing system) are stored and used within containment structures to protect against their release to the environment. Cyanide is present only in the closed-loop process water used at the Mill. Under normal operating conditions, flow from the Mill is pumped to the TSF through the Cyanide Destruct process to ensure that the effluent leaving the Mill is less than or equal to 50 parts per million (ppm) weak acid dissociable (WAD) cyanide so as to ensure that the level of WAD cyanide in the TSF Reclaim Pond remains below 30 ppm all times (so as to avoid posing a risk to birds and other wildlife that may come in contact with water stored there). In addition, ultraviolet (UV) sunlight and air would naturally decompose cyanide and cyanide complexes to further decrease cyanide levels in the TSF Reclaim Pond, as well.

d. Reclamation occurs concurrently with active mining. Concurrent reclamation includes back-filling and re-grading. Mine pits fill with water to become pit lakes; Ledbetter Reservoir and the Champion and Champion Southwest Reservoirs. Concurrent and post- mining reclamation include grading and revegetation of the Green OSAs, PAG facilities (including HDPE-lined and saprolite cover), and TSF (including HDPE-lined cover). Ongoing maintenance and monitoring of site conditions would continue following completion of reclamation.

4. PROJECT SEQUENCE

The mine is developed and operated over a 16-year lifespan, 14 years of active mining, and 2 years of continued ore processing after mining is completed. Some facilities are reclaimed concurrently with ongoing mining (concurrent reclamation), and final site reclamation would occur after mining and processing of ore ceases.

The total planned footprint for the seven pits is approximately 1,245 acres (including the infrastructure necessary to support mining of the pits, such as haul roads, utility lines, pumping wells, temporary laydown areas, and stormwater management infrastructure). See Table A-3 for the surface area disturbance associated with each pit. During concurrent reclamation (while other pits are being mined), Mill Zone, Snake, Haile, Red Hill and Small Pits will be backfilled. Backfilling is the process of refilling the open pit with the material called overburden (material not sent for processing at the Mill) that is removed from pits being actively mined. (Refer to Section A.6, “Overburden Storage Areas” for details, including a description of which types of overburden can be used as pit backfill.)

Table A-3 Proposed Pit Surface Area and Depth

Open Pit	Approximate Surface Area Disturbance (acres)	Approximate Final Pit Floor Elevation (ft.)
Mill Zone Pit - Phase 1	60.0	30 AMSL
Snake Pit - Phase 1 and 2	88.1	- 20 BMSL
Red Hill Pit - Phase 1	47.5	95 AMSL
Haile Pit - Phase 1	42.5	160 AMSL
Snake Pit - Phase 3	57.3	- 300 BMSL
Ledbetter Pit - Phase 1 through 4	163.46	- 690 BMSL
Mill Zone Pit - Phase 2	65.2	- 310 BMSL
Champion Pit - Phase 1 and 2	41.2	145 BMSL

* *Note: AMSL – Above Mean Sea Level BMSL – Below Mean Sea Level*

Note: Previously designated Small Pit (27.6 acres), is now included in Mill Zone Pit – Phase 2.

The individual mine pits will remain inter-connected to form Ledbetter Reservoir which will be managed during the reclamation period for acidity. Ledbetter Reservoir is expected to take approximately 65 years to fill[4]. (Refer to Section A.11, “Site Reclamation” for additional information.)

Production at Haile Gold Mine consists of the phased mining of multiple open pits to supply the Mill with ore at a planned rate of approximately 14,400 tons per day, 365 days per year. In general, two to three pits are mined simultaneously. At least one pit is in the overburden stripping phase where overburden is

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[4] For Pit Lakes, “full” refers to 95 percent full because these pit lakes are filled with groundwater and stormwater.

removed, and at least one other pit is mined for ore and overburden. This approach would maintain a constant supply of ore to the Mill.

4.1. Mining Schedule

During mining, high grade ore is sent to the Mill while low grade ore is stockpiled at PAG facilities – i.e., either the Ledbetter Low-Grade Stockpile or the Parking Lot Low-Grade Stockpile for later use. (Ultimately the Parking Lot Low-Grade Stockpile will merge with the West PAG facility.) Some low-grade ore is processed concurrently with higher grade ore during mining, but much of the low-grade ore will be processed during post-mining production. Reclamation will commence concurrently with mine operations. Each part of mining includes activities and steps that proceed in a sequence, and some activities will occur concurrently at different locations on site. The order of mining is designed to maintain the steady supply of ore to the Mill and to ensure concurrent reclamation in areas where mining is completed.

Table A-4 illustrates the development of the individual open pits; life of Horseshoe underground mine; loading of the overburden stock piles; and initiation of concurrent reclamation. Stripping, mining, pit backfilling, and reclamation are specific stages that occur during the Project. The Project is proposed to last 16 years, 14 years of active mining (and some concurrent reclamation) and 2 years of processing low grade ore from stockpiles after mining has ended (along with additional reclamation). Overall site reclamation activities, water treatment, and monitoring and maintenance will continue after mining and ore processing has ended. Haile Gold Mine will require maintenance and monitoring at the end of mining and processing operations, as required by the South Carolina Department of Health and Environmental Control (SCDHEC). This will include monitoring surface water and groundwater for at least 10 years following the period when the pit lakes are filled and the TSF and PAG Cells are capped and drained down. During this post-mining period, Haile expects also to perform periodic maintenance of drainage and treatment systems. (Refer to Section A.11, "Site Reclamation" for details.)

Table A-4 Proposed General Mining Schedule

		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
Material Extracted from Open Pit and Underground Operations	Open Pit																Total M Tons
	Mill Zone Phase 1	⬛	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.40
	Snake Pit Phase 1	⬛	⬛	-	-	-	-	-	-	-	-	-	-	-	-	-	11.50
	Snake Pit Phase 2	⬛	⬛	⬛	-	-	-	-	-	-	-	-	-	-	-	-	34.00
	Red Hill	-	⬛	⬛	-	-	-	-	-	-	-	-	-	-	-	-	31.90
	Ledbetter Stockpile Pit	⬛	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.90
	Haile Pit	-	-	-	⬛	⬛	-	-	-	-	-	-	-	-	-	-	22.10
	Snake Pit Phase 3	-	-	⬛	⬛	⬛	⬛	-	-	-	-	-	-	-	-	-	66.40
	Ledbetter Phase 1	-	-	-	-	⬛	⬛	⬛	-	-	-	-	-	-	-	-	63.70
	Ledbetter Phase 2	-	-	-	-	-	⬛	⬛	⬛	⬛	⬛	⬛	-	-	-	-	84.50
	Ledbetter Phase 3	-	-	-	-	-	-	-	⬛	⬛	⬛	⬛	⬛	-	-	-	75.60
	Ledbetter Phase 4	-	-	-	-	-	-	-	-	-	⬛	⬛	⬛	⬛	⬛	-	92.60
	Mill Zone Phase 2	-	-	-	-	-	-	-	⬛	⬛	⬛	⬛	-	-	-	-	82.60
	Champion Phase 1	-	-	-	-	-	-	-	-	-	-	-	⬛	⬛	-	-	14.80
	Champion Phase 2	-	-	-	-	-	-	-	-	-	-	-	-	⬛	-	-	1.00
	Underground																
	Horseshoe UG Ore	-	-	⬛	⬛	⬛	⬛	⬛	-	-	-	-	-	-	-	-	3.40
	Horseshoe UG Waste	-	-	⬛	⬛	⬛	⬛	⬛	-	-	-	-	-	-	-	-	0.60
Material to an OSA, PAG Dump or Pit Backfill	Dump																
	TSF	🟩	🟩	🟩	🟩	🟩	🟩	-	🟩	🟩	🟩	-	🟩	🟩	🟩	-	56.60
	Ramona	🟩	🟩	🟩	🟩	🟩	-	-	🟩	🟩	🟩	🟩	-	-	-	-	39.90
	Hayworth (to be inc. into South)	🟩	🟩	-	-	-	-	-	-	-	-	-	-	-	-	-	6.40
	James	🟩	🟩	🟩	-	-	-	-	-	-	-	-	-	-	-	-	14.70
	South	-	-	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	-	-	-	146.00
	Mill Zone 1 In-Pit	-	🟨	🟨	🟨	🟨	-	-	-	-	-	-	-	-	-	-	4.20
	Haile In-Pit	-	-	-	-	🟨	🟨	🟨	-	-	-	-	-	-	-	-	6.20
	Red Hill In-Pit	-	-	-	🟨	-	-	-	🟨	🟨	-	-	-	-	-	-	3.70
	Snake In-Pit	-	-	-	-	-	-	🟨	🟨	🟨	🟨	🟨	🟨	-	-	-	53.80
	Mill Zone 2 In-Pit	-	-	-	-	-	-	-	-	-	-	-	▧	▧	▧	-	45.60
	JPAG (to be inc. into West PAG)	▨	▨	🟥	🟥	🟥	-	-	-	-	-	-	-	-	-	-	14.20
	West PAG (inc JPAG)	-	-	🟥	-	-	-	-	▨	▨	▨	▨	▨	🟥	🟥	-	81.60
	East PAG	-	-	▨	▨	▨	▨	▨	🟥	🟥	🟥	🟥	🟥	-	-	-	54.30
	Surface Ore																
	Stockpiled Low-Grade	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	-	11.70
	High Grade to Mill	▥	▥	▥	▥	▥	▥	▥	▥	▥	▥	▥	▥	▥	▥	-	49.40
	Process Plant																
	Process Mill	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	🟪	
	Water Treatment Plant	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	

🟩	▧	🟨	▨	🟥	🟧	▥	⬛
Green Overburden	Combination Yellow / Green	Yellow Overburden	Combination Yellow / Red	Red Overburden	LG Ore	High Grade Ore	Ex-Pit Material

Source: Haile 2018

4.2. Work Schedule and Personnel

Estimated numbers of personnel needed to operate surface and underground operations; maintain mining and mill equipment; and operate Mill facilities during the life of the Project are shown in Table A-5. These estimates are based on keeping the Mill continuously supplied with ore for the 16 years that ore is processed. Shifts may vary over the life of the mine, but operations for the mine and the Mill will occur 24 hours per day, 365 days per year. Administrative personnel will work during the day shift. Table A-5 lists the estimated number of people by job class that are employed currently; at the peak of production in approximately 2024; at the end of the mine life in approximately 2031; and during post-mine life at Mine Years 17–19, 20–29, 30–40, 41–50, and 51-60.

Table A-5 Project Personnel Estimates for Selected Years

	Number of Personnel							
Job Type	Current	2024 (Peak)	2031	Mine Years 17–19	Mine Years 20–29	Mine Years 30–40	Mine Years 41–50	Mine Years 51–60
Contract	65	80	0	50	2	2	2	2
Mine*	165	378	85	3	2	0	0	0
Process	83	106	90	2	1	0	0	0
Administrative	50	53	45	4	2	1	1	1
Total	**373**	**617**	**220**	**59**	**7**	**3**	**3**	**3**

Source: Haile (2018).

- Mine numbers are for underground and open pit combined.

5. MINING METHODS AND FACILITIES

5.1. Open Pit Development

Gold is produced from ore located at various depths within the designated mining pits. The gold mineralized bedrock is overlain by growth media (including topsoil) that is removed and stored in GMSAs for later reuse. Sand, clay, and heavily weathered bedrock (which together are called “overburden”) are removed and stored. Generally, this material can be excavated without blasting and is removed using hydraulic shovels, excavators and / or wheel loaders and placed into haul trucks. It is transported to other mined out pits for backfill, to Green OSAs or to the PAG storage facilities. Green overburden also may be used for construction of the TSF lifts. Overburden generally is moved only once.

Pit development follows engineering plans that optimize the size and shape of the pit to obtain the most ore and to minimize the amount of overburden that must be removed, considering operational safety and logistics. Mining within the pits progresses in levels - called benches where mining proceeds to a depth then expands the size of a bench and incorporates room to safely operate mining equipment and allow for access roads. Each bench of the mine pit is measured as an elevation. As the mine grows deeper, the benches resemble large steps. The height of each mining bench is approximately 33 feet. The strength of the rock in the pit determines how steep the pit walls can be and still protect workers and equipment from wall instability.

Figure A-9 shows Mill Zone Pit with catch benches along the pit highwall and a truck hauling rock up the haul road. Figure A-10 is an example of a blast hole drill, and Figure A-11 is a typical blast pattern.

Blast holes are drilled approximately 14 feet apart in a blast pattern of typically 50 and 200 holes (Haile 2018). The blast propagation is in a timed sequence to optimize rock fragmentation, minimize low-frequency vibrations, minimize fly rock, and protect the high wall from damage. The size of each blast, and the amount of explosive used in an individual blast, may vary depending on the rock characteristics and the geometry of the available room on a bench. Once an individual blast pattern has been drilled and the explosives are loaded, the pattern is blasted to fragment the rock for subsequent excavation.

Figure A-9 Mill Zone Open-Pit Mine

Notes: A Haul Truck is hauling ore up the access road on the left. Benches are visible along the pit wall in the background, and a blasting pattern has been drilled on the level surface at the base of the pit.

Source: Haile 2018

Figure A-10 **Blast Hole Drill**
Source: Haile 2018.

Figure A-11 **Drill Holes in a Blast Pattern**
Source: Haile 2018.

5.2. Mining Equipment

Hydraulic shovels, excavators, and wheel loaders are used to remove blasted material. Figure A-12 shows a hydraulic excavator loading a haul truck, and Figure A-13 shows a wheel loader in the center. The loading equipment has a typical bucket capacity of approximately 15 cubic yards (cy) and will run on diesel fuel for 24 hours per day. The loading equipment excavates material from the pits and loads it into haul trucks for transport to the Mill, to OSAs, to pits for backfilling, or to GMSAs. The hydraulic shovel was selected for working in poor ground conditions that may impede the ability of a wheel loader to work efficiently. Wheel loaders were selected as they are highly mobile and can quickly move from one working area to another. A hydraulic excavator was selected for the ability to mine the deposit in a more selective manner. Wheel loaders excavate material in the pits and re-handle material in GMSAs and ore stockpiles, as well as in some OSAs.

Haulage equipment consists of 100-ton and 150-ton capacity, off-road haul trucks (shown in Figure A-12). Articulated trucks are used where conditions warrant, such as in poor ground conditions. These trucks are smaller and have a capacity of approximately 25–40 tons. Equipment also is required to build and maintain pits, OSAs, haul roads, and GMSAs and to perform concurrent reclamation. The equipment used for support operations would consist of small loaders, small mining trucks, track dozers equipped with rippers, rubber-tire dozers, motor graders, water trucks, and hydraulic excavators. A track dozer, wheel loader, and motor grader are shown in Figures A-12, A-13 and A-14, respectively. A water truck, primarily used for dust control is shown in Figure A-15. Figure A-16 is a dozer with GPS controls for earthwork orientation, an articulated truck, and an excavator used in project and construction work.

Figure A-12 Hydraulic Excavator, Dozer, and Haul Truck
Source: Haile 2018.

Figure A-13 Example of a Track Dozer (left and in background), Wheel Loader (center), and Motor Grader (far right)

Source: Haile 2015.

Figure A-14 Motor Grader

Source: Haile 2018.

Figure A-15 Water Truck for Dust Control
Source: Haile 2018.

Figure A-16 Dozer with GPS Controls (Foreground), Articulated Trucks and Excavator (Background)
Source: Haile 2016.

Mining equipment is selected to provide efficient operations within the pit design parameters. A schedule of required mine equipment is shown in Table A-6. During years of peak mining activity, major equipment requirements are 27 haul trucks, five blast hole drills, and four track dozers, as well as the smaller support equipment mentioned above. As mining decreases after 2028, the size of the haul truck fleet is reduced, and the total number of units gradually decline. After 2031, excavation equipment no longer is needed.

Table A-6 Major Mining Equipment

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Excavator Cat 6020	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Excavator Cat 6030	-	2	2	2	2	2	2	2	2	2	2	2	1	1	0
Hit Front Shovel	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-
Loader Cat 992 / 993	8	8	6	6	6	6	6	6	6	5	5	5	5	5	5
Trucks 777 – Ore	12	12	3	3	3	4	3	4	4	4	5	5	6	6	4
Trucks 785 - Waste	8	18	22	18	15	21	21	27	27	26	26	23	22	16	13
Ore Drill - Cat 5150C	6	6	10	10	10	12	12	12	10	10	10	10	6	4	3
Waste Drill - Cat MD6290	2	4	4	4	4	3	4	4	4	4	4	3	3	1	2
Dozers (D6 – D10)	4	4	4	4	4	4	4	4	4	4	4	4	4	3	3
Motor Grader	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2
Fuel Truck	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Water Truck	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2

Source: Haile 2018

5.3. Earth-Moving, Geosynthetics, and Pipeline Construction Equipment

During construction of the TSF lifts and PAG Cells, major earthworks, geosynthetic installation, and pipe works construction will take place. General activities for construction include the following:

- Installation of temporary erosion and sediment control features;
- Clearing, grubbing and removal of the growth media material and transporting it to the GMSA for later use at the TSF lifts and PAG Cells;
- Excavation of stormwater diversion channels, sediment detention channels, and basins;
- Excavation of construction material and equipment storage areas, haul and service access roads, and pipeline corridors as well as placement of safety berms;
- Rough grading and foundation preparation for the TSF lifts, PAG Cells, and related ponds;
- Excavation of groundwater drains and placement of drain pipe and drainage aggregate for the TSF lifts and PAG Cells;
- Transport and placement of soil materials, and moisture conditioning and compaction of the low-permeable soil liner material for the TSF lifts, PAG Cells, and related ponds;
- Transport and placement of soil materials, and moisture conditioning and compaction of the TSF embankment materials;
- Placement of geomembrane liner in the beneath the TSF, PAG Cells, and related process water and contact water containment ponds.
- Transport and placement of soil materials for the drainage aggregate and geosynthetic liner protective layer for the TSF lifts and PAG Cells; and
- Final grading.

The earthworks equipment fleet required will consist of scraper, track-type tractors, and hydraulic excavators to excavate various materials. Wheel loaders would load the growth media, low-permeability soil liner, and embankment material into haul trucks that transport materials to respective GMSAs, the TSF lifts, and PAG Cells.

5.4. Access, Roads, and Highway Crossings

5.4.1. Main Entrance at US Highway 601

Currently, the main access to Haile Gold Mine is on Snowy Owl Road which intersects with US 601 approximately 3 miles north of the Town of Kershaw. See Figure A-17 below. At the main entrance, Haile has added a left-hand turn lane on US 601 heading south to alleviate traffic flow on US 601 in immediate vicinity. This access point is improved to include the Guard House where Security personnel sign in all trucks and light vehicles, thereby controlling entrance to the mine. Snowy Owl Road has been improved with duel lanes to accommodate increased traffic flow by mine personnel. Once on site, Security Officers direct visitors to their appropriate destination.

Figure A-17 Main Entrance at Snowy Owl Road and US Highway 601
Source: Haile 2018.

5.4.2. Tailings Storage Facility Overpass on US Highway 601

The TSF is accessed via haul road from the Mill Site. The design of this road is very similar to the mine haul roads because it is used to haul TSF construction materials from the mine to the TSF. The more common use, however, is for the daily trips by light vehicles from the Mill Site to the TSF. To avoid disrupting traffic flow along US 601, an overpass is constructed over US 601 (See Figures A-18 and A-19) and capable of supporting a fully loaded 150-ton class haul truck. This overpass is designed for one-way traffic. There is a section dedicated to carrying the tailings delivery and the tailings reclaim water pipelines. A concrete barrier separates the pipe corridor from the vehicle traffic lanes.

In 2027, during the construction of TSF, US 601 will be realigned, and the overpass will be relocated. The design and safety features of the current overpass will be duplicated at the new location.

Figure A-18 Tailings Storage Facility Overpass on US Highway 601
Source: Haile 2018.

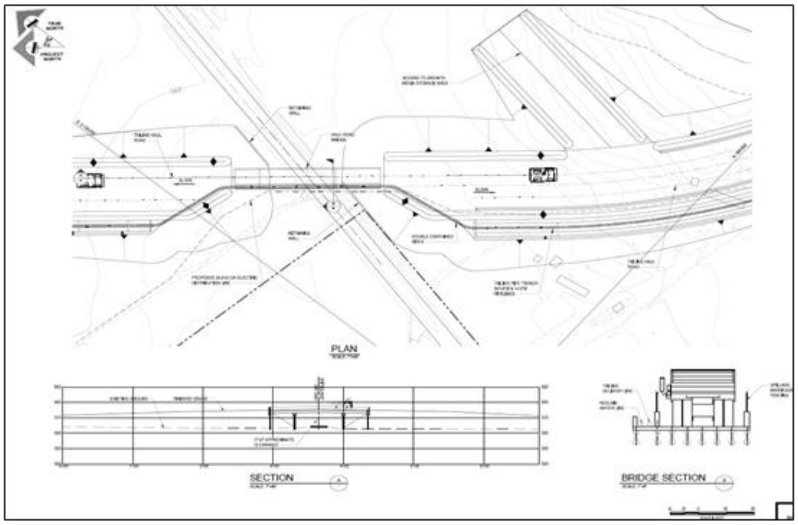

Figure A-19 General Layout of US Highway 601 Overpass
Source: Haile 2016.

5.4.3. Champion Pit Overpass on US Highway 601

Mining of Champion Pit is scheduled to begin in approximately 2029. Champion Pit is on the west side of US 601, making it necessary to haul the ore to the east side of the road. To avoid disrupting traffic on US 601, Haile would install an overpass of similar design as the TSF overpass to cross US 601 at the intersection of US 601 and the Champion Pit haul road.

5.4.4. Mine Haul Roads

Haul roads are used throughout the mine to connect various facilities. Light vehicles, haul trucks, and other mobile mine equipment will use the haul roads to get to and from various facilities for appropriate work. The primary use of the haul roads is for haul trucks to deliver ore and overburden to the appropriate destinations. Roads are constructed from each active pit to the Mill Site and appropriate OSA or PAG Cells. Left-hand traffic is used on all mine haul roads. These haul roads are constructed from mined overburden, and fugitive dust is controlled with water trucks. Haul roads are approximately 110 feet wide, including safety berms and drainage ditches. The maximum haul road design gradient is 10 percent. Figure A-20 illustrates a typical mine haul road cross section (in metric).

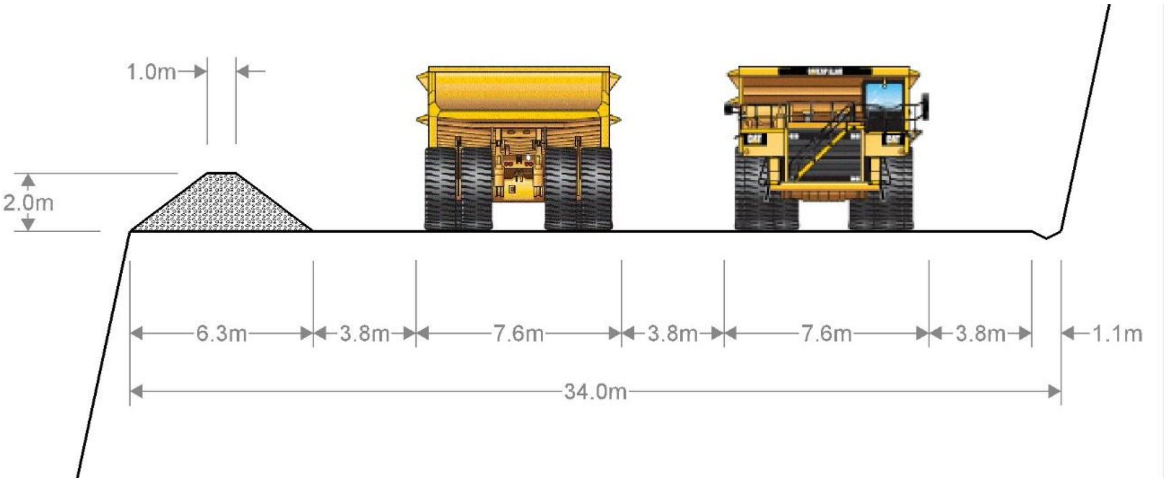

Figure A-20 Typical Mine Haul Road Cross Section (metric)
Source: Haile 2018.

In addition, several service roads are dirt or gravel, typically 15 to 30 ft. wide for light vehicles, and primarily used by process operators and maintenance personnel to move about the mine site. One such service road follows the utility corridor from the Mill Site to the Mill Zone Pit area. Similar service roads are used by light vehicles to access other areas of the mine for operations and maintenance.

Within the Mill Site, only a few small travel ways exist for light vehicles and delivery trucks. These travel ways generally follow each side of the Mill. One segment of the service road would branch off and go to the warehouse, truck shop building, and the fuel station. Figure A-21 illustrates a typical mine service road cross section.

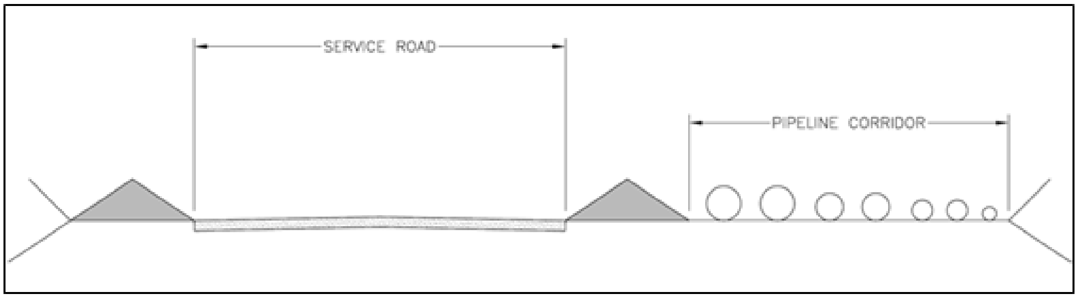

Figure A-21 Typical Mine Service Road Cross Section
Source: Haile 2017.

Figure A-22 shows the accumulation of mine roads that is developed over the course of the mine. The location of mine haul or service roads will change over the course of the mine life as the focal point of the mining work changes. Note that Figure A-22 does not depict mine roads related to pit operations where pit development eventually would consume the haul road.

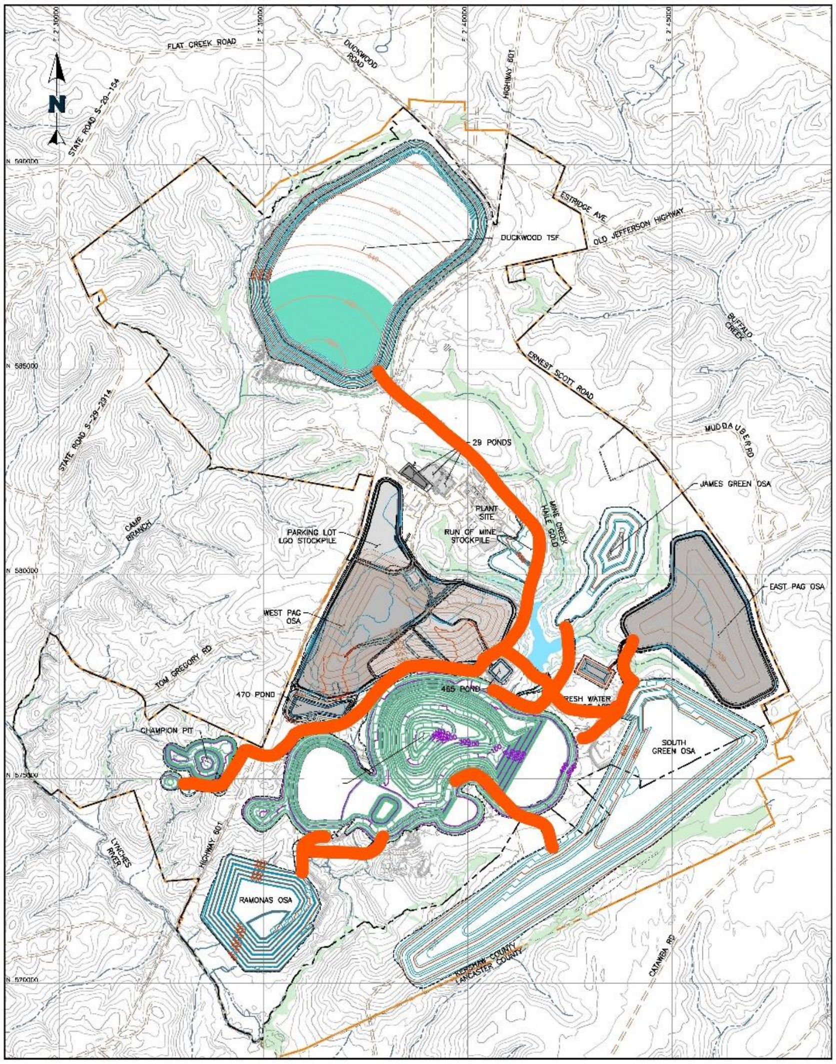

Figure A-22 General Location of Mine Haul Roads
Source: Haile 2018.

5.4.5. Road Construction

Haul roads are constructed with overburden materials placed and maintained by mine personnel and equipment. The gravel (wear surface) used on the haul roads is generated by an on-site mobile crushing plant located near the active mine pit. Construction material is predominately dike material located within each of the mine pits and crushed green overburden material.

6. OVERBURDEN STORAGE AND GROWTH MEDIA STORAGE AREAS

Prior to the start of mining, the growth media is removed from the pit areas, PAG Cells, and TSF and stored in designated storage areas called "growth media storage areas" (GMSAs) for later use in constructing/stabilizing and later reclaiming storage sites (OSAs, PAG Cells, and the TSF). The growth media is stored in four growth media storage areas – TSF GMSA, 601 GMSA, Snake GMSA and Hayworth GMSA.

Once growth media has been removed from the pit areas, overburden is removed. The overburden classification summary is shown in Table A-7.

Table A-7 Overburden Classification Summary

Overburden Classification	Classification	(M tons)	(%)
Overburden Storage Areas	Green	207.0	39.3
Potentially Acid Generating (PAG) Storage	Yellow / Red	150.1	28.5
Backfilled In-Pit	Yellow / Green	113.5	21.5
Tailing Storage Facility	Green	56.6	10.7
Total Overburden Material		**527.2**	**100.0**

Source: Haile

Overburden mined in the pits is classified as potentially acid-generating (PAG) or not potentially acid-generating (non-PAG or "Green") overburden, depending on the amount of acid-generating minerals that occur in the rock.[5] Overburden is tested and classified during ore control sampling (with a sample of the drill cuttings from each blast hole assayed for sulfur and gold) into the following categories based on its acid-generating potential:

- PAG (Red Class) – Net Neutralization Potential (NNP) < -31.25 kg/t as $CaCO_3$
- Moderate PAG (Yellow Class) – Total S greater than 0.2 % or NNP < 0 and NNP $\geq$ -31.25 kg/t as $CaCO_3$
- Non-PAG (Green Class) – Total S less than 0.2 % and NNP > 0 kg/t as $CaCO_3$

The material classified as Red Class overburden is stored exclusively within a facility that is lined with a high-density polyethylene (HDPE) liner. The Yellow Class overburden is stored on a lined facility or may be used for backfilling pits (see Section A.11, "Backfilled Pits" for details). The other four OSAs (601, Ramona, Hayworth / South, and James) receive Green Class overburden. OSAs are constructed and managed as the open pits are developed (see Section A.4, "Project Sequence" for details).

Table A-8 compares the types and amounts of material that is stored in each OSA, and the estimated final capacity of each OSA under the currently permitted mine plan to the proposed mine expansion plan. Low-grade stockpile volume will fluctuate over the life of mine.

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[5] Acid-generating potential refers to a material's potential to generate acid and produce acid rock drainage. Acid rock drainage is produced by the oxidation of sulfide minerals, chiefly iron pyrite or iron disulfide (FeS2). Ferrous iron can be further oxidized, producing additional acidity. This is a natural chemical reaction when minerals are exposed to air and water that produces acidity and dissolves metals in water; however, it can impair water quality. Acid rock drainage can mobilize and transport the heavy meals that occur in metal deposits. Acid mine drainage is the outflow of water from mines, underground workings, waste rock, and tailings after sulfide minerals have been exposed to air and water, oxidizing metal sulfides (often pyrite, which is iron-sulfide) within the surrounding rock and overburden.

Table A-8 Overburden Comparison Bridge from 2014 EIS to 2018 SEIS

	EIS (2014)				SEIS (2018)			
Overburden Storage Area	**Potential Acid Generation Class**	**Planned Loading (M Tons)**	**Base Foot Print (acres)**	**Notes**	**Potential Acid Generation Class**	**Planned Loading (M Tons)**	**Base Foot Print (acres)**	**Notes**
JPAG	Yellow / Red	46.3	159	1				1
West PAG	--	--	--		Yellow / Red	95.8	370	
East PAG	--	--	--		Yellow / Red	54.3	145	
601 OSA	Green	7.2	42		Green	2.2	42	6
Ramona	Green	57.8	150		Green	39.9	150	2
Hayworth	Green	21.3	86					
Hilltop	Green	12.6	63		--	--	--	3
James	Green	17.8	66		Green	14.7	66	
Robert	Green	14.8	81		--	--	--	4
South	--	--	--		Green	152.4	442	5
Pit Backfill	Yellow / Green	66.7	N/A		Yellow / Green	113.5	N/A	7
TSF Growth Media	Green	3.3	56		Green	3.3	56	10
601 Growth Media	Green	1.2	15		Green	1.2	15	10
Snake Growth Media	Green	1.0	13		Green	1.0	13	10
Hayworth Growth Media	Green	1.5	19		Green	1.5	19	10
TSF	Green	--	N/A	7	Green	56.6	153	8/9
Total		251.5	750			527.2	1,590	

Notes:

1. JPAG is being consumed into West PAG.
2. Ramona height is reduced after performing additional geotechnical stability studies.
3. Hilltop OSA is eliminated.
4. Robert OSA is converted into East PAG.
5. Hayworth OSA is consumed into South OSA in 2020.
6. 2.2 M tons of Green overburden has been placed on 601 OSA. This OSA will be partially mined during Mill Zone Phase 2, therefore no additional material has been planned for this facility.
7. Pit Backfill has no additional foot print other than the individual Mine Pits.
8. TSF lifts will be green material generated from active mine pits.
9. Disturbance Area is only for the extended TSF footprint.
10. GMSAs are not accounted for in TOTAL line as material will be re-handled onto OSAs and is already accounted for in those tonnages.

Source: Haile 2018.

Any water that encounters the Red and Yellow Class overburden material in the PAG Cells is managed as contact water, meaning that it is water that has come in contact with PAG material and cannot be discharged to surface waters without treatment. PAG Cells are constructed with an 80-mil (a mil is one one-thousandth of an inch) HDPE geomembrane liner underlain with low- permeability soils to contain and route seepage and runoff waters to collection ponds (465 and 470 Collection Ponds are on the West PAG and 500 Pond is on East PAG) for water treatment. The proposed 470 Pond would replace 469 Pond identified in the currently permitted mine plan.

Seepage is water that may collect within the stored material and seep to the collection system above the HDPE liner. Runoff is rain water that may land on the stored material and run off the surface. Collection channels built within the HDPE-lined facility, surrounding the PAG Cells divert untreated surface runoff and seepage from the PAG to HDPE-lined collection ponds that have been sized to capture the 100-year 24-hour precipitation event. The 100-year 24-hour precipitation event is defined by the American Meteorological Society as, “the storm precipitation that has a 1 percent chance of being equaled or exceeded in a 24-hour duration during a given year” (AMS 1959). The 100-year 24-hour event for the Project site is calculated as 8.59 inches. This contact stormwater runoff and seepage is used in the Mill or treated at the Contact Water Treatment Plant (CWTP) (see Section A.10, “Surface Water Management” for details). Contact water is not released to the environment without treatment.

Groundwater is routed under the PAG Cells to avoid contact via collection pipes installed below the HDPE and low-permeability soil liner. Groundwater is routed to a tributary of Haile Gold Mine Creek. See Figure A-23 for a typical cross section of the (1) HDPE / lower permeability soil liner and underdrain collection system and (2) of the groundwater drain piping placed below the HDPE and low-permeability soil liner.

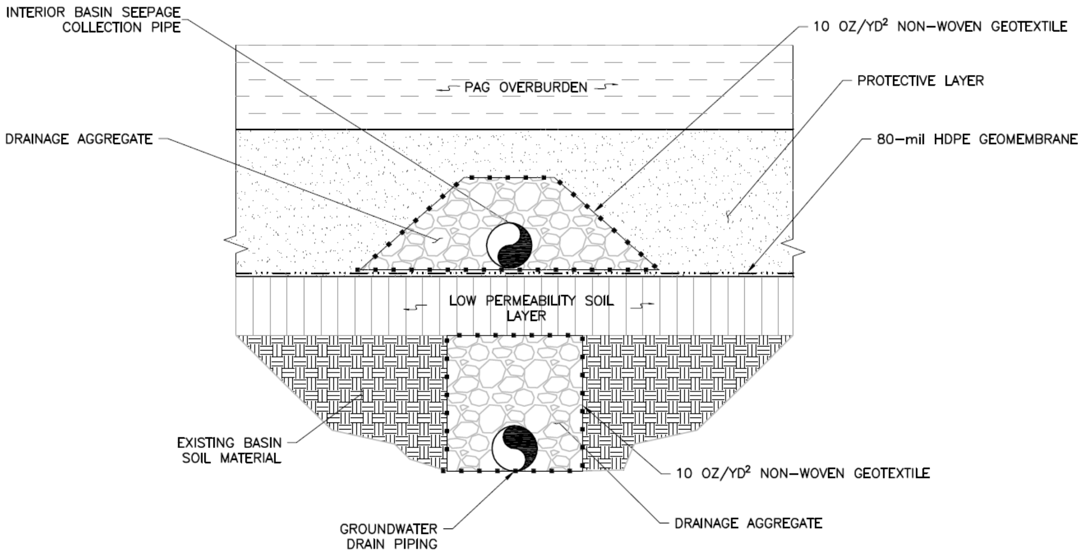

Figure A-23 Cross Section of PAG Groundwater Drain and Seepage Collection System
Source: Haile 2018.

Green Class OSA’s are developed with 3:1 side slopes. Channels to collect stormwater and sediment are constructed around the footprint of each OSA (see the example provided in Figure A-24) with such runoff managed as non-contact storm water.

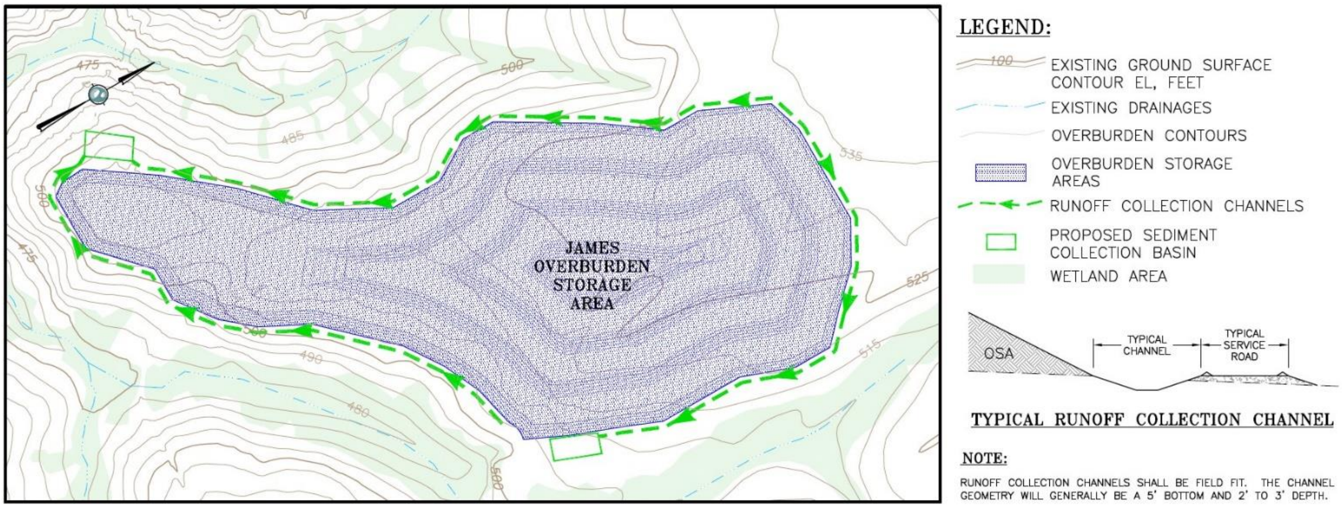

Figure A-24 Example of a Green Overburden Storage Area with Runoff Collection Channels and Sediment Collection Basins

Source: Haile 2018

Sediment control structures are constructed at the outfall of the stormwater runoff control channels for each facility. After the sediment settles out, water retained within the ponds is discharged to an adjacent drainage, consistent with Haile’s NPDES General Permit for Stormwater Discharges Associated with Industrial Activities (Except Construction) regulated by the SCDHEC, Bureau of Water, Stormwater Permitting Section (Haile’s Industrial General Permit). The sediment also is managed in accordance these standards.

7. UNDERGROUND MINING AT HORSESHOE DEPOSIT

The Project is currently being mined as an open pit mine; however, economic mineralization extends below and outside of the pit extents in an underground mine deposit referred to as Horseshoe. The upper portion of the Horseshoe mineralization is wider and localized in planar zones that strike NE-SW, but dip at 40º to 45º NW. The lower zone is localized in deformed zones within the meta-sediment parallel to the meta-volcanic contact. This zone strikes NE-SW and dips vertically. Figure A-25 shows the Horseshoe upper and lower mineralized zones.

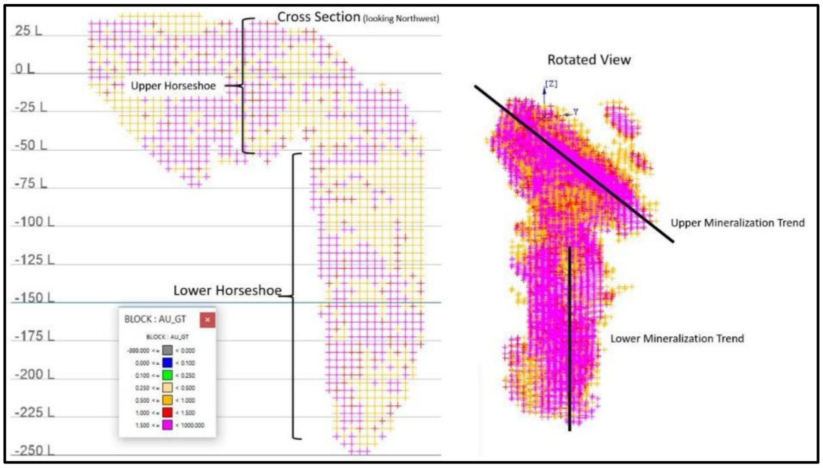

Figure A-25 Horseshoe Deposit Upper and Lower Mineralized Zones (Metric)

Source: Haile 2017.

Based on the orientation, depth, and geotechnical characteristics of the mineralization, a transverse sublevel open stoping method (long hole) has been selected. The stopes will be 50 ft. wide, and stope length will vary based on mineralization grade and geotechnical considerations. A spacing of 80 ft. between levels is used. Cemented Rock Fill (CRF) will be used to backfill 75% of stopes and non-cemented waste rock will be used in the remaining stopes. The CRF will have sufficient strength to allow for mining adjacent to backfilled stopes. Figure A-26 shows the Horseshoe Exploration Drill Pattern, and Figure A-27 shows the Horseshoe Underground Block Model and Mineralization Extents.

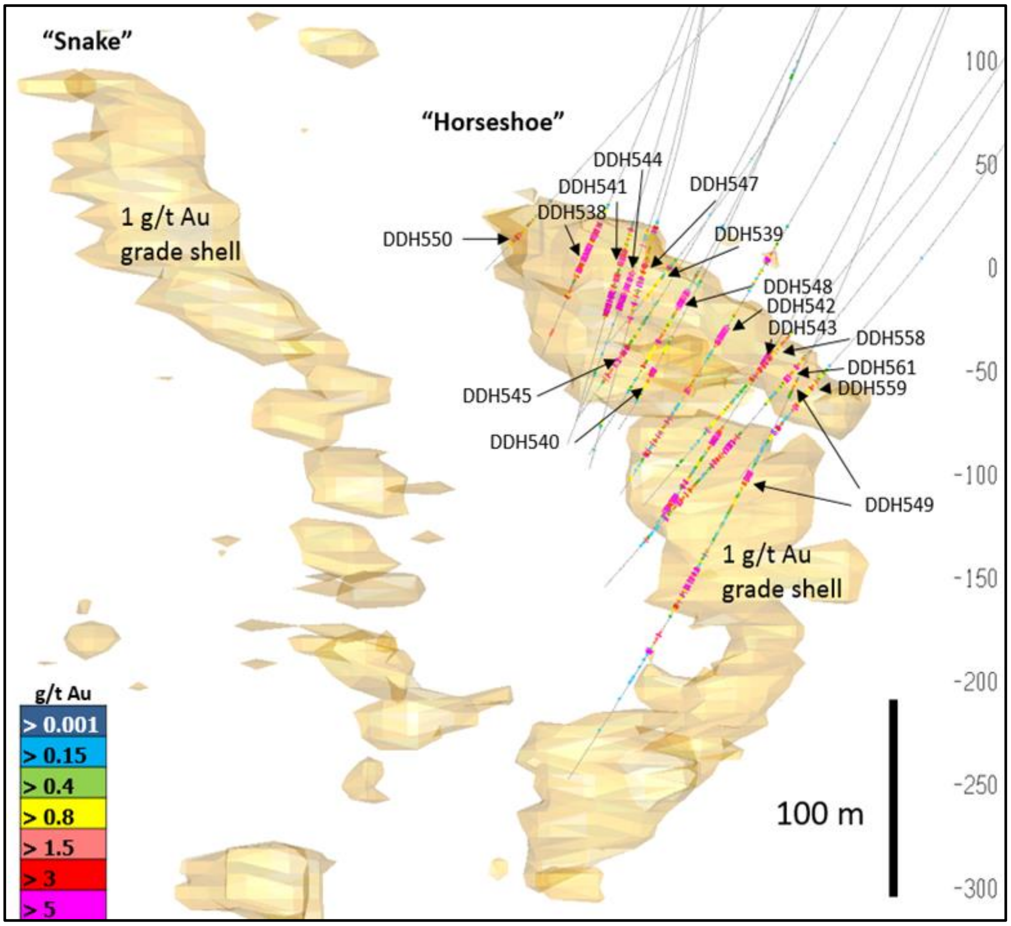

Figure A-26 Horseshoe Exploration Drill Pattern (view to NW in meters)

Source: Haile 2018.

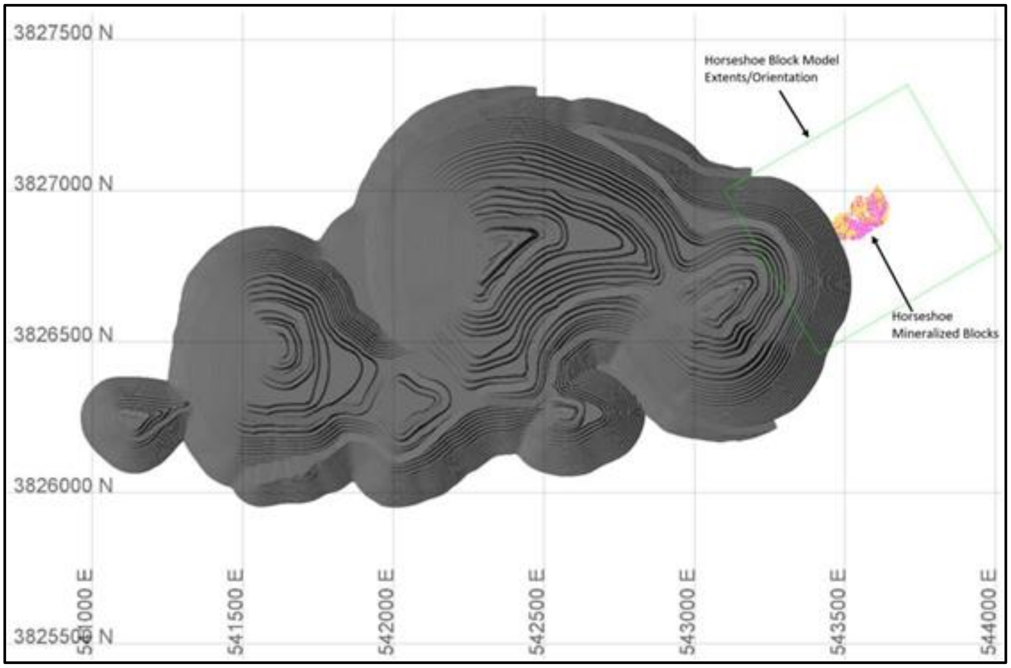

Figure A-27 Horseshoe Underground Block Model and Mineralization Extents
Source: Haile 2017.

7.1. Mine Design

Stope optimization results were used as a basis for the underground mine design. The top of the Horseshoe mineralization is approximately 450 ft. below surface and extends to a depth of approximately 1,315 ft. below surface.

7.1.1. Stope Design

Stope optimizer shapes were used as a basis for the design work. Stope centerlines were generated, and both top and bottom stope accesses are designed, as mucking will occur from the lower access, and drilling/backfilling will occur from the upper access. Stope accesses are expected to be in waste until they intercept the stoping block, but grade control will be used to determine the exact ore/waste boundary during mining.

A typical level in the upper zone is made up of approximately ten stopes across, while the lower zone has approximately five stopes across. The length of stopes is limited by geotechnical stability, and often several stope cuts are taken as shown in Figure A-28. Backfilling will be an integral part of the mining cycle as there is a limited quantity of stopes available on each level. Where possible stope cuts were aligned to minimize the requirement for CRF.

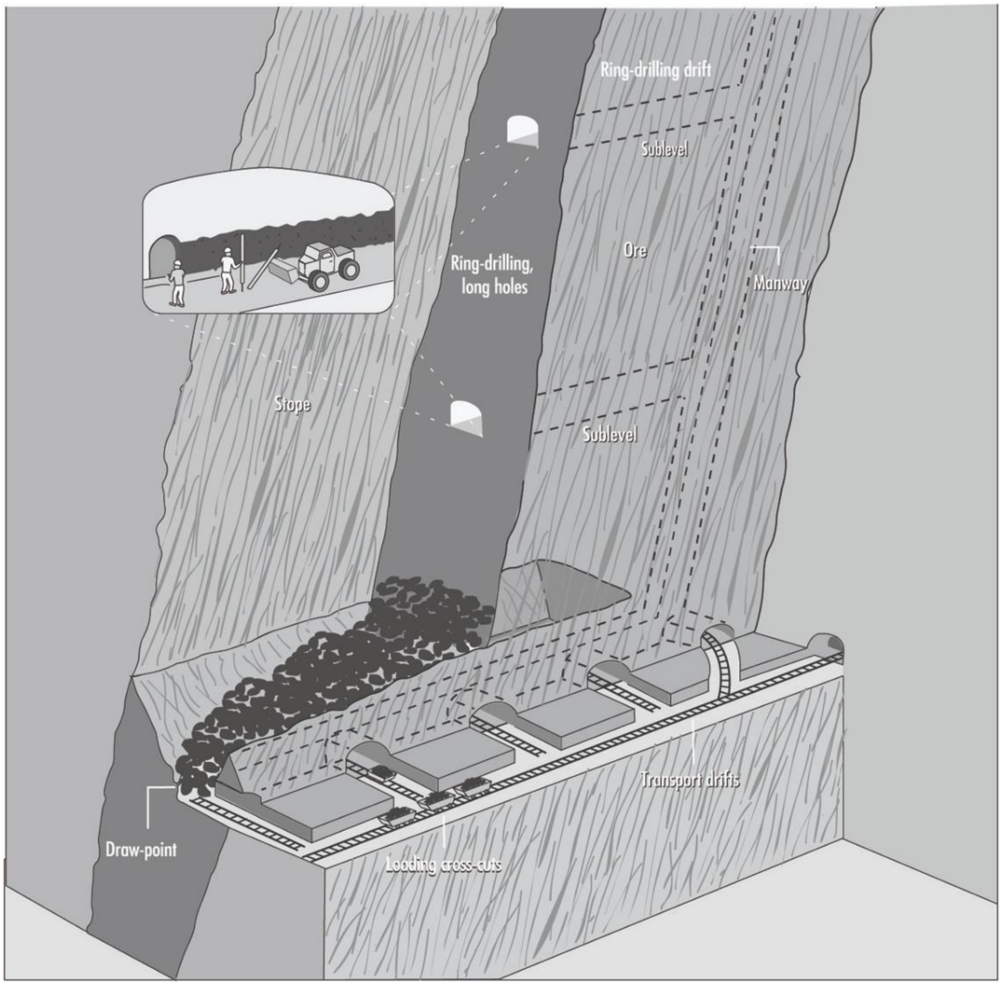

Figure A-28 Transverse Sublevel Open Stoping Mining Method (with long holes)
Source: US Bureau of Mines

Figure A-29 shows a cross section of the stopes.

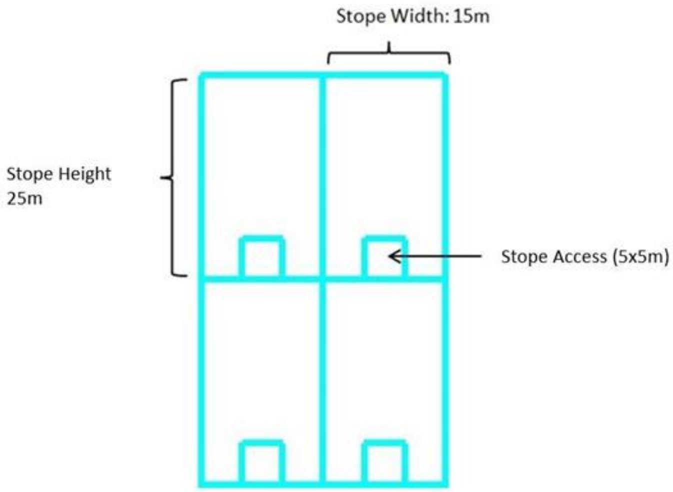

Figure A-29 Stope Cross Section (Metric)
Source: SRK 2017.

Stopes are developed using a slot. Separate slot triangulations were not constructed for each stope, but the slot tonnage of each stope is separated out, and a slot activity is used for scheduling.

The underground mine is accessed via a decline from the surface. The decline portal is located on an open pit bench approximately 260 ft. below the natural surface as shown in Figure A-30 and Figure A-31.

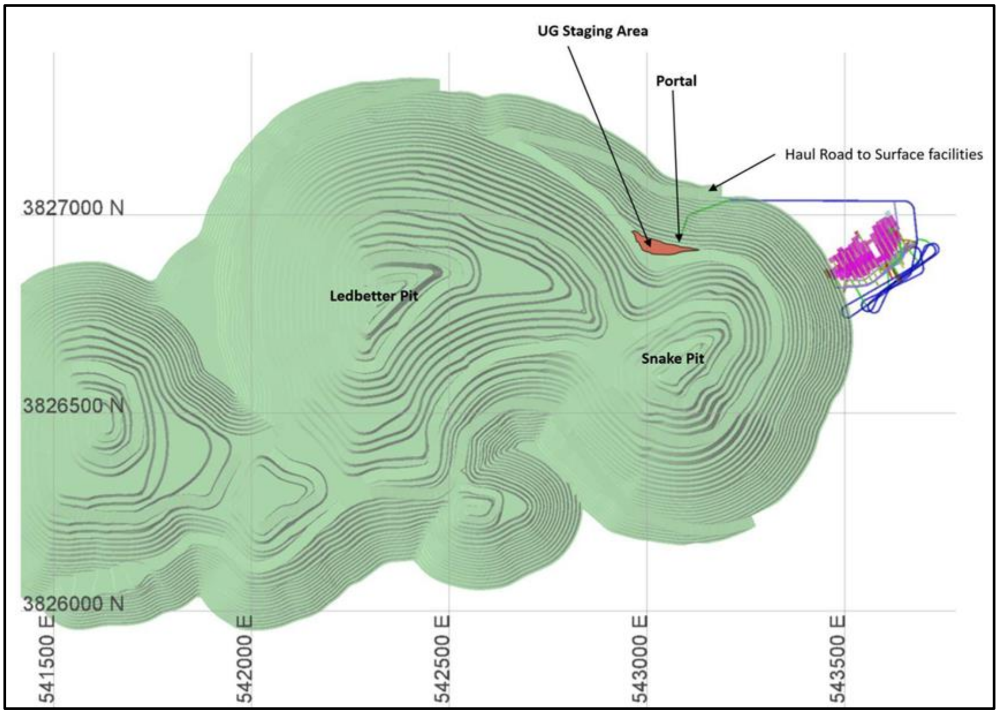

Figure A-30 **Portal Location**
Source: SRK 2017

Figure A-31 **Typical Underground Portal with Articulated Truck**
Source: OceanaGold – Waihi Operation

The stope accesses are connected to a level access located in the footwall in waste material. The level accesses are offset a minimum of 80 ft. from the stopes. The level accesses connect to the inter-level ramp system which is in the footwall and is offset approximately 250 ft. from the stopes. On the southwest end of each level access there is a connection to a fresh air intake raise and on the northeast end the level access connects to an exhaust air raise. Figure A-32 shows a typical level section.

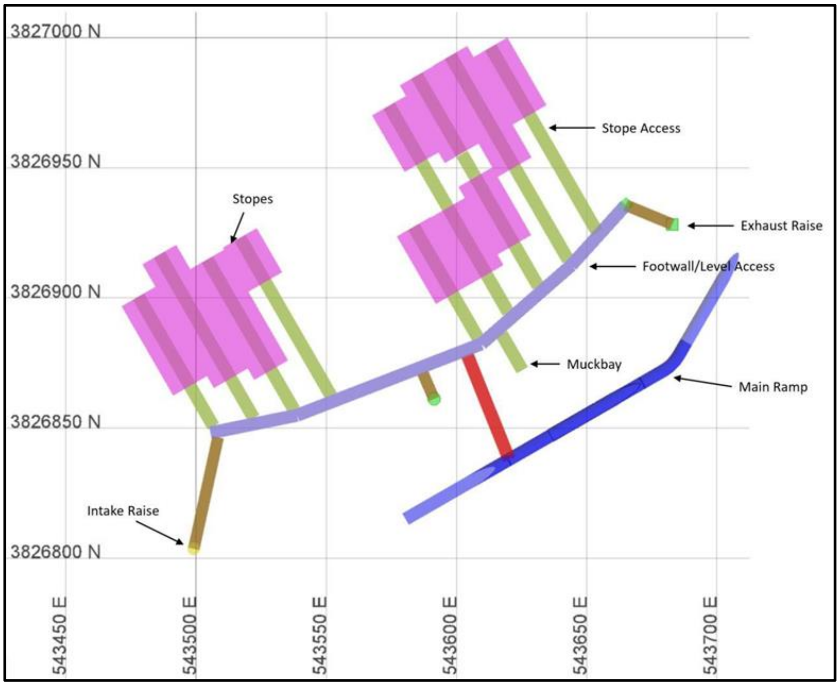

Figure A-32 **Typical Level Section**
Source: SRK 2017.

An additional development allowance was used for main ramps and level accesses to account for detail currently not in the design. Where possible, muck bays are re-used to minimize additional development. All planned maintenance will be on the surface, and underground shop facilities are not included in the design. The CRF facilities are also located on the surface and no additional infrastructure is required underground.

Where possible accesses/ramps are in the metavolcanics and away from known dikes. Where ramps must cross a fault/dike, the crossing is designed perpendicular to the structure to minimize the length of development through these structures. Figure A-33 shows the completed mine design colored by activity type and gold mineralization blocks, respectively.

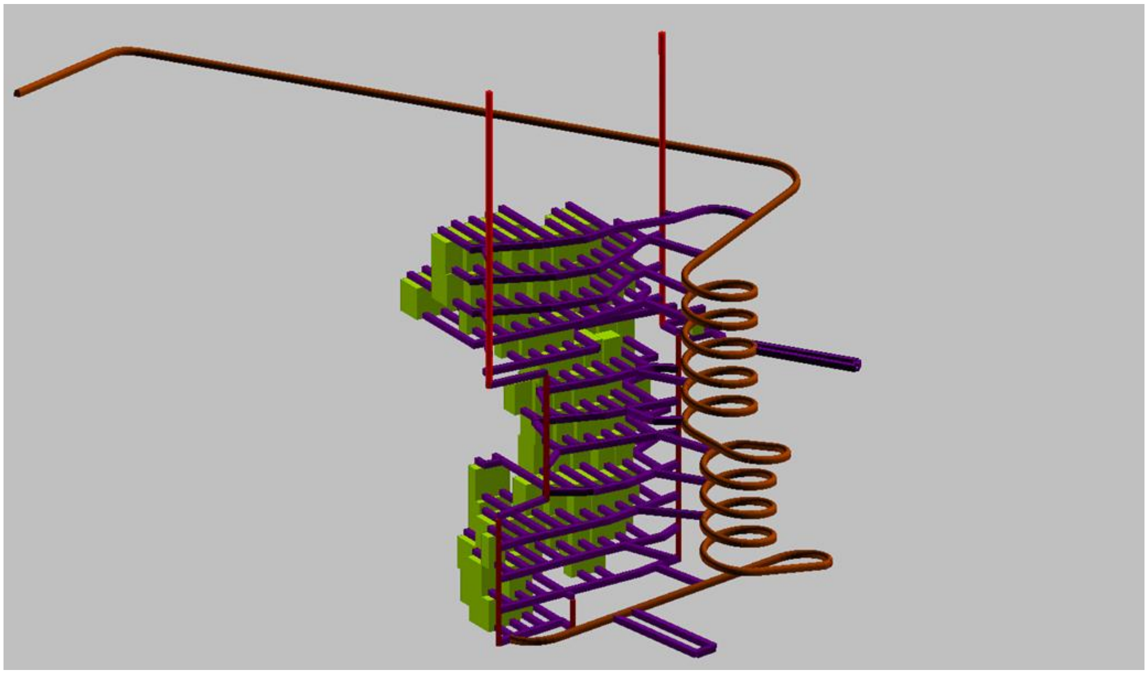

Figure A-33 Horseshoe Completed Mine Design (and looking North)
Source: SRK

Table A-9 summarizes the Horseshoe mine design by activity type.

Table A-9 Horseshoe Mine Design Summary – by Activity Type

General Summary	(M tons)
Ore Tons	3.44
Waste Tons	0.64
Total Tons Moved	4.08

Ore Summary	(M tons)
Development Ore	0.307
Stope Slot Development	0.970
Stope Production	2.157

Horizontal Development Summary	(ft.)
Main Ramp Length	9,334 ft.
Footwall Access Length	6,752 ft.
Stope Access Drift Length in Ore	12,985 ft.
Stope Access Drift Length in Waste	8,093 ft.
Ventilation Drift Length	1,844 ft.
Total Development Length	**39,009 ft.**

Vertical Development Summary	(ft.)
Raise bore Length	1,570 ft.
Ventilation Slot Raise Length	840 ft.

Source: SRK

Waste material within the design was characterized geochemically based on the block model. All rock characterized as Red PAG had sufficient grade to be considered ore. Only Green and Yellow Overburden are generated as summarized in Table A-10.

Table A-10 Horseshoe Mine Design Geochemistry Summary

Geochemical Breakout	(M tons)
Green Overburden	0.53
Yellow Overburden	0.12
Total Waste	**0.64**

Source: SRK

7.1.2. Main Ramp Development (long-term development openings)

The main ramp is 16.5 ft. wide by 18.0 ft. high with an arched back. The drill pattern provides for 62 charged blast holes and five uncharged relief holes. Blasting will be a bulk emulsion explosive like the explosive used in open pit operations.

Loading will be performed with a 14-ton load-haul-dump unit (LHD) (See Figure A-34) that will transport blasted rock to muck bays. Units were selected for excellent load, maneuver and dump times. Rock in the muck bay will be loaded into trucks and hauled to the surface.

Figure A-34 Typical Load-Haul-Dump Unit (LHD)
Source: Caterpillar

Ground support will be installed concurrently with each stage. This includes mobilization and setup, scaling, bolting/meshing/shot creating as required, and demobilization. Cable bolts will be installed at intersections. Utility installation includes piping lines, ventilation tube, electrical cable, messenger cable, and leaky feeder. Piping, ventilation and electrical utilities will be installed at the end of every other round.

7.1.3. Level Access Drifts (medium-term development openings)

The level access drifts will be 16.5 ft. wide by 16.5 ft. high. They will be developed with a twin-boom jumbo drilling 1.6 in. diameter blast holes and 4 in relief holes. The anticipated drill pattern provides for 63 charged blast holes and five uncharged relief holes. Loading will be performed with a LHD that will transport blasted rock to muck bays that will be located, on average, 250 ft. from the advancing face.

7.1.4. Stope Development Drifts (short-term development openings)

The stope development drifts will also be 16.4 ft. wide by 16.4 ft. high. Productivity parameters for drilling, blasting, mucking, ground support, and utilities are the same as for the level access drifts.

7.1.5. Slots – Stope Development

After top and bottom stope development drifts are established, a slot will be developed at the far end of the stope. The slot consists of a conventionally blasted drop raise and 28 fan-drilled holes that will be slashed into the void that is created by the drop raise. The fan drilled holes are created by a Down-the-Hole (DTH) drilling unit as shown in Figure A-35. Including the fan-drilled holes, the overall dimensions of the slot will be 49.2 ft. wide by 19.7 ft. long by 82 ft. high.

Figure A-35 Typical Down-the-Hole (DTH) Drilling Unit
Source: Atlas Copco

All blast hole drilling for the slot will be at a diameter of 4.5 in. using a DTH drill. It is anticipated that a total of 50 holes will be required for the slot (22 holes for the drop raise and 28 holes for slashing). The slot will be removed in a series of four blasts using a bulk emulsion product. The first two blasts will remove the bottom 46 ft. of the drop raise. The third blast will remove the remaining six meters at the top of the drop raise along with 14 of the fan-drilled slash holes on one side of the drop raise. The fourth and final blast will remove the remaining fan-drilled slash holes on the opposite side of the drop raise.

Slot ore will be mucked with a LHD that will transport blasted ore to muck bays that will be located, on average, 328 ft. from the stope. Ore that is placed in a muck bay will be loaded into trucks and hauled to the surface.

7.1.6. Stoping

Stopes will be 80 ft. high by 50 ft. wide and will have varying lengths based on the mineralization. Blast holes will be 4.5 inch in diameter. Stope blasting will be performed in a series of three-ring blasts, the number of which will be a dictated by the length of the stope. Each three-ring blast will have a total of 39 charged holes (13 holes per ring). A bulk emulsion product will be used.

Stope ore will be mucked with a LHD that will transport blasted ore to muck bays that will be located, on average, 325 ft. from the stope. Ore that is placed in a muck bay will be loaded into trucks and hauled to the surface.

7.1.7. Main Ventilation Openings – Raise Bored Raises

Raise boring and blind sinking will be used for the main ventilation openings. The one blind sink and two raise bored raises will each have a diameter of 16 ft. and will have the following lengths.

- Exhaust raise from Level 1 to the surface: 410 ft.
- Intake raise from Level 5 to the surface: 710 ft.
- Intake raise between Level 12 and Level 5: 455 ft.

7.1.8. Ventilation Connections Between Levels – Drop Raises

Conventional drop raising will be used to establish ventilation connections between level access drifts. The ventilation connections will be 15 ft. wide by 15 ft. long by 65 ft. high.

All blast hole drilling for the ventilation connections will be at a diameter of 4.5 inch using a DTH drill. A total of 22 holes will be required for the drop raise (16 charged blast holes and 6 uncharged relief holes). The drop raise will be removed in a series of three blasts using a bulk emulsion product. The first two blasts will remove the bottom 45ft. of the drop raise. The third and final blast will remove the remaining 25 ft. at the top of the drop raise.

7.1.9. Mine Production Schedule

The Horseshoe schedule is based on mining operations occurring 365 days/year, 7 days/week, with two 12-hour shifts each day. Figure A-36 shows the mine production schedule by year.

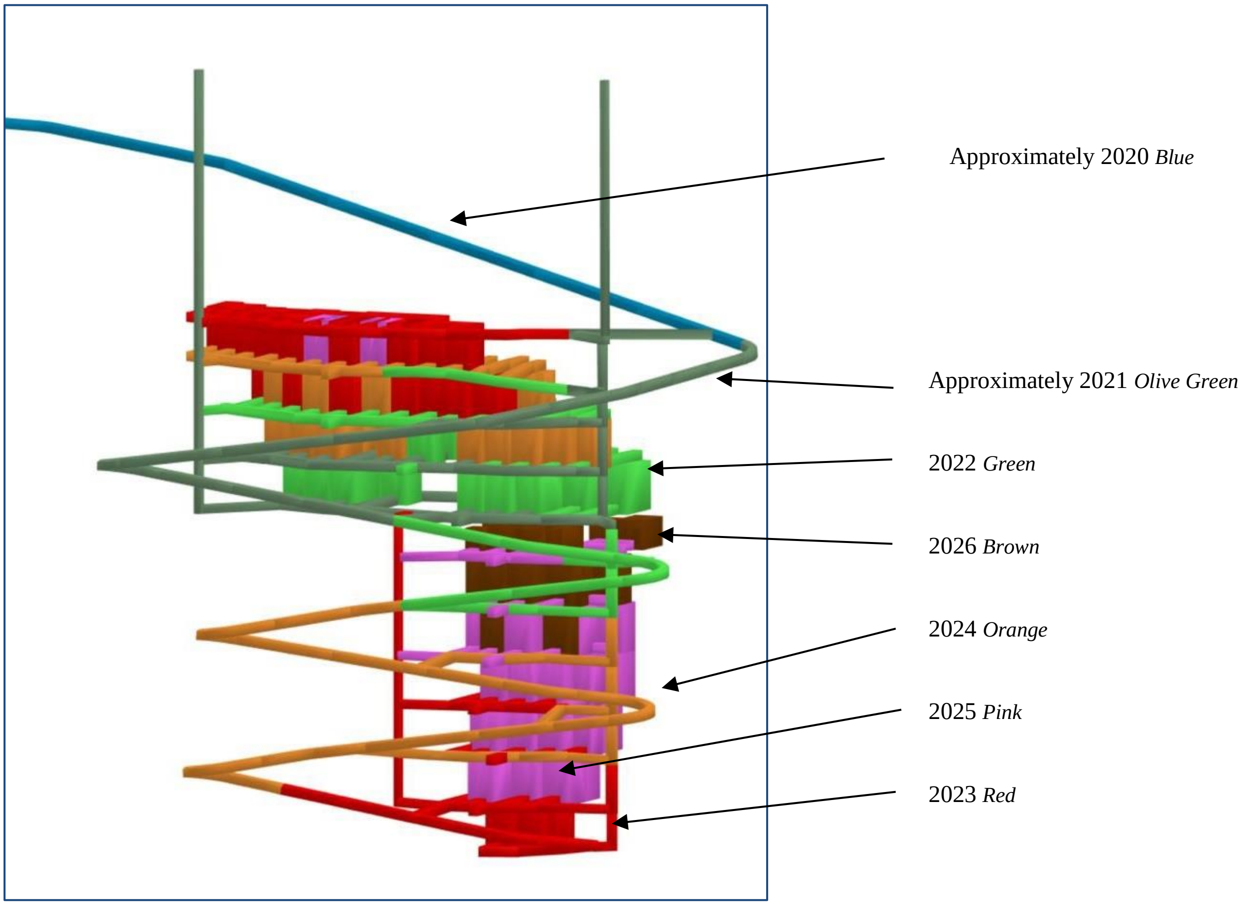

Figure A-36 Mine Production Schedule Colored by Year
Source: SRK

Level naming nomenclature is shown in Figure A-37. Elevations for level are shown in Table A-11.

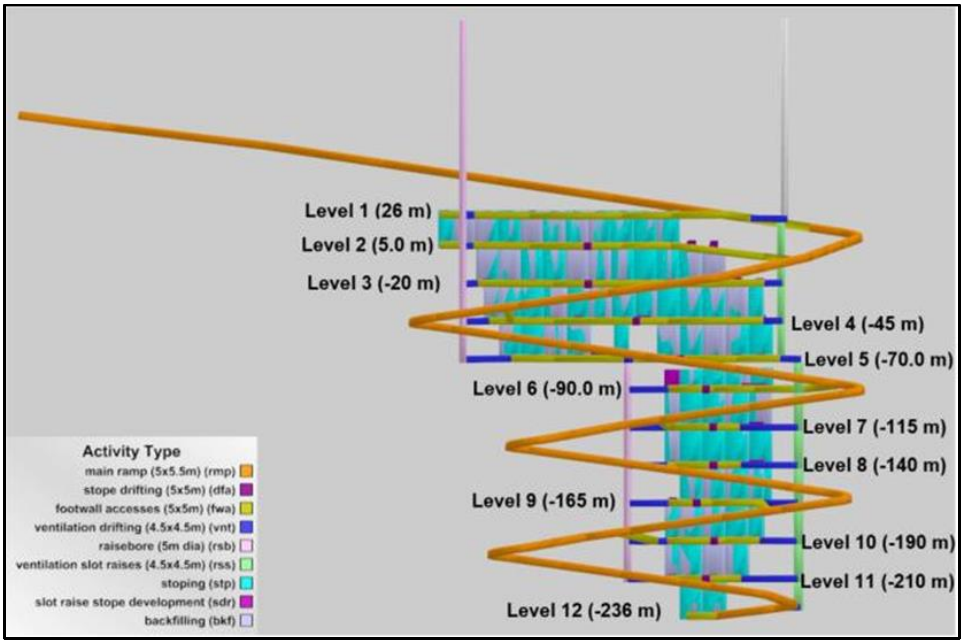

Figure A-37 Level Nomenclature (Metric)
Source: SRK

Table A-11 Horseshoe Mine Level Summary

Level	Elevation amsl / bmsl (ft.)
Surface	540
Portal	477
Level 1	85
Level 2	16
Level 3	-66
Level 4	-148
Level 5	-230
Level 6	-295
Level 7	-377
Level 8	-459
Level 9	-541
Level10	-623
Level 11	-689
Level 12	-774

Source: SRK

7.2. Mine Access

The upper portion of the 16.5 ft. wide by 16.5 ft. high access decline is expected to be in weathered rock and therefore will require an increased level of ground support. After the decline has passed through the weathered rock, a less intensive level of ground support will be required. The decline is designed at a maximum gradient of 14%. A turning radius of 80 ft. is suitable for the underground haul trucks contemplated for the operation.

The portal for the access decline will be located on an open pit bench approximately 265 ft. below the natural surface, thereby eliminating the need to develop the access decline through saprolite. The portal construction will consist of scaling and bolting/screening and application of shotcrete as necessary to support and create a safe surface above the mine portal. A structurally sound corrugated pipe style liner with supports as necessary will be constructed for the first 200 ft. of portal or as dictated by the rock conditions. Ventilation, power, water discharge, supply water, and communications will be installed at the portal and carried down the decline to support the development operation. An all-weather gravel surface will be established at the portal and portal bench area, and drainage will be maintained away from the portal entrance to minimize water entering the portal and decline from the bench area.

Secondary egress will be via 20 ft. diameter raise bored ventilation raises equipped with emergency hoisting.

7.2.1. Stoping

Stopes will be mined using the sublevel open-stoping method. Individual stope blocks are designed to be 50 ft. wide by up to 100 feet long and will have a transverse orientation. Levels are spaced 75 feet apart, and each stope block will have a top and bottom access.

Stopes will be drilled downward from the top access using 4.5” diameter holes. (Stope slots will be drilled with a DTH drill, and stope production rings will be drilled with a top hammer drill.) A bottom up, primary/secondary extraction sequence will be followed. Primary stopes will be backfilled with CRF, and secondary stopes will be backfilled with overburden from the underground and open pit operations.

Stope extraction will occur in two steps. During the first step, a slot will be mined at the far end the stope using a drop raise and 28 fan-drilled slash holes. The slot is required to create sufficient void space for the remainder of the stope to be blasted. During the second step, production rings will be blasted three rows at a time (13 blast holes per ring) until the stope is completely extracted. The number of three-row blasts in each stope will depend on the length of the stope. All blasting will be performed with bulk emulsion.

Ore will be remotely mucked from the bottom stope access using a 14-ton LHD. Cable bolts will be installed at the stope brow to ensure stability. The LHD will transport the ore to a muck bay to maximize the efficiency of the stope mucking operations. A second LHD and a fleet of 40-ton haul trucks will be used to transport ore from the muck bays to the surface. Multiple muck bays will be used on each level to avoid interference between the stope loader and the haul trucks.

At the surface, the haul trucks will dump onto an ore stockpile and will then travel to an adjacently located backfill plant to be loaded with CRF. After being loaded, the haul trucks will return to the underground mine and will dump the CRF into a muck bay near the top of an empty primary stope. After dumping the load of CRF at the muck bay, the haul truck will return to the producing level to once again be loaded with ore. A 7-ton LHD will be used to transport the CRF from the muck bay to a dumping point at the top access of the empty stope.

7.2.2. Truck Haulage

The mine plan assumes that 14-t LHDs will load 40-t haul trucks from muck bays that will be strategically located throughout the development workings.

7.3. Backfilling

The mine will utilize CRF in the primary stopes and either rock fill or low strength CRF in the secondary stopes. CRF will be generated in a surface plant located at the underground storage yard that includes a 160 t/hr portable crushing/screen plant that will create two specification grade aggregate piles and an oversize pile. The specification grade aggregate will be transported to the CRF plant by a front-end loader where it will be loaded into one of two hoppers, a large aggregate (4 inch to 3/16-inch) hopper or fine aggregate (3/16-inch minus) hopper, that will in turn batch feed into a mixer that combines specified quantities of cement, water, and aggregate to create the required high strength CRF (4% cement on a dry basis). A conveyor moves the CRF mixture to a bin that stores the CRF for loading of the underground trucks. The CRF plant has a capacity of 100 yards^3/hr with a batch mixer, cement silo with screw conveyor and weigh hopper, water weigh hopper, and two loss-in-weight aggregate bins. The 40-t underground haul truck pulls under the bin after dumping its ore on the stockpile and loads the CRF. Once loaded, the truck hauls the CRF underground to an open stope where backfilling is taking place. The truck dumps the load either directly into the stope or in a staging area where an LHD hauls the CRF to the stope for placement. Figure A-38 shows the CRF Backfill Plant cross-section.

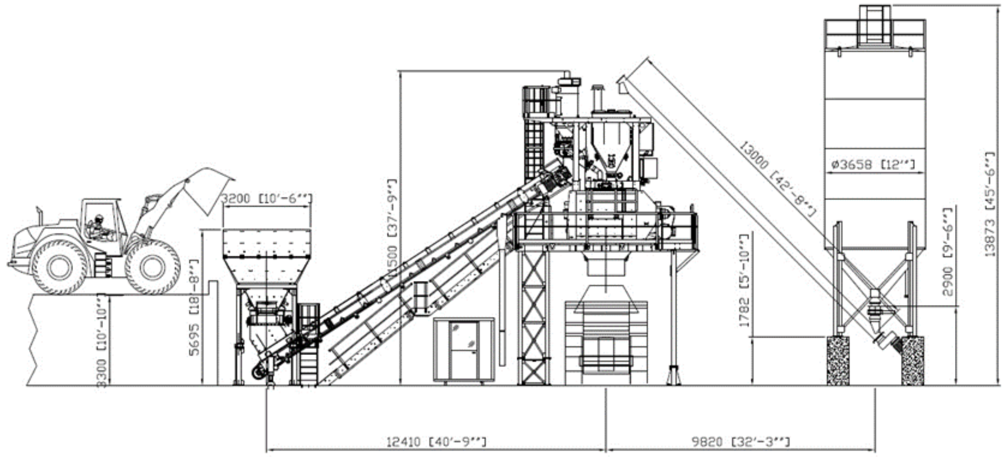

Figure A-38 CRF Backfill Plant Cross-Section
Source: SIMEM, 2017

The cement will be provided by a local manufacturer that will truck the cement in 25-t tanker transports to the site at the rate of approximately two trucks per week.

7.3.1. Waste Rock

Waste rock from the underground will be used as non-cemented fill in secondary stopes when possible. If a secondary stope is not available at the time the waste is mined, it will be hauled to the surface and placed in the UG stockpiling area where it will subsequently be either hauled via open pit trucks to the appropriate waste rock stockpile or used to make CRF. The UG stockpile is located internally to Snake Pit. The waste rock is hauled to the surface prior to stopes being developed.

7.3.2. Grade Control

The characterization of ore versus waste and further geochemical waste classification will be completed through diamond core drilling of the stope accesses prior to mining. Once the footwall level access is established, horizontal drill holes will be drilled 10 ft. beyond the planned length of the stope access. The core will be logged, sampled and analyzed to provide grade control and geochemical waste classification information. Geologic and block models will be updated with this information, and ore/waste grade boundaries will be pre-determined prior to mining the stope accesses. Areas considered to be waste will be characterized geochemically to determine which OSA the material should be sent to. Geochemical sampling techniques for the underground mine will follow existing open pit sampling techniques. Initially, all stope accesses will be drilled and sampled to ensure adequate definition for each stope. As knowledge of the deposit is gained, there may be an opportunity to increase the spacing of the drill holes.

7.4. Ventilation

A ventilation system has been designed to support the development and production activities for the underground mine. The total life-of-mine analysis includes predicted distribution of airflow and pressure. The analysis is broken down into five phases, extending from the initial startup of construction activities to the completion of the decline and all associated levels and raises.

7.4.1. Input Parameters

The location of the mine is in a very temperate area with the average low temperature in January of 29.7°F (average high 53.2°F), and an average high temperature in July of 90.1°F (average low 67.6°F). Combined with the shallow depth and apparent lack of geothermal activity, temperature stress related issues will be minimal.

No harmful strata gases are expected to be encountered at this site. No crushers or fixed ore/waste conveyances (continuous acute dust sources) are currently designed underground. Strategies for controlling dust while loading and hauling ore/waste are an important operational consideration. The configuration of the system as an exhausting ventilation system, which minimizes the blast clearance time/possibility of exposure to blast-generated gases by maintaining the ramp clear of blasting fumes.

Airway dimensions are as per the mine design, with the main ramp being 16.5 ft. x 18 ft. and the raises to surface at 16.5 ft. diameter. Oval equivalent duct of 5.5 ft. equivalent was modeled for the main decline developments. Model friction factors, resistances, shock losses, etc. were used based on available data and standard best practice.

7.4.2. Airflow Requirements

Airflow for individual pieces of equipment in the mine will need to meet (1) the requirements of CFR57.5067, which refers to the nameplate dilution values determined by MSHA/NIOSH testing or (2) the EPA requirements. Overall, the total airflow requirement for the mine is approximately 7,700 ft^3/s. A total volume of 1,836 ft^3/s is required for a one haul truck and one LHD configuration. A volume of 2,966 ft^3/s is required to operate two haul trucks and an HD in the same development heading.

7.4.3. Auxiliary Ventilation Systems

The decline development auxiliary ventilation system is sized for the simultaneous operation of one truck and one LHD. The decline auxiliary ventilation system will consist of:

- One, two, or three fans operating in series that can be added as the length of the development increases. A single fan will be able to be used until the length (resistance) of the duct increases to a point where the airflow delivered to the face is impacted, at which time the second fan should be added and so forth.
- The single 5.4 ft. oval equivalent duct can be used to develop the initial decline. In the immediate development face area, a length of supplemental duct can be attached to the main duct to provide ventilation directly at the face during blasting and during loading. The supplemental duct is advanced with the face and is not left incorporated within the long-term duct installation.

For the stope auxiliary ventilation system, auxiliary fans were selected to provide the air flow required for development or production in a stope. A maximum duct length was assumed for this specification for a forcing auxiliary system. If a haul truck will enter the stope access during the backfill cycle, a second duct system will be installed to be more than sufficient for a single haul truck. Up to four stopes were assumed to be active at once: either in development, production, or backfilling. Each stope will require two auxiliary fan/duct systems, with one fan/duct system moved up from the mucking level to the backfill level after each stope completes production.

7.4.4. Ventilation Model

Model work was completed using 5 stages. Stage 1 is the initial development of the decline and exhaust raise. As the decline continues onto the first level, the duct will extend with the development up to the 2,400 ft. length of ducting required to ventilate the raise boring of the exhaust raise, as shown in Figure A-39.

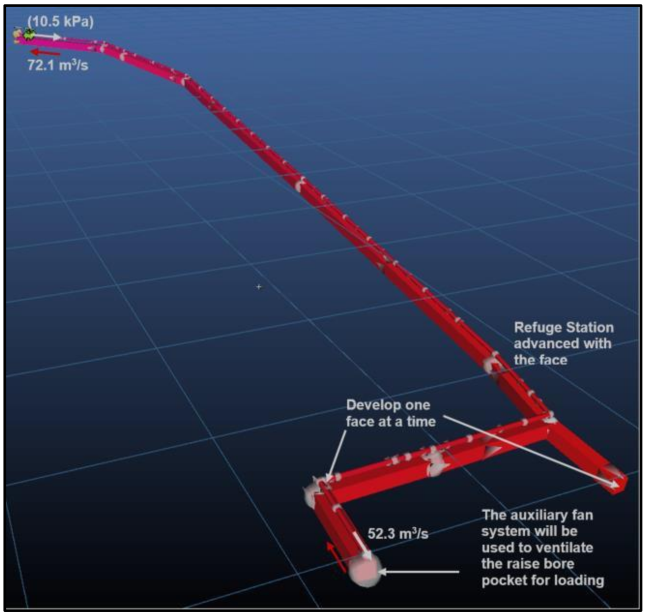

Figure A-39 Stage 1 Airflow Distribution
Source: SRK

The auxiliary fan system operates at 42.2 inches of water and uses two auxiliary fans in series and a third fan in series hung in the decline downstream of the two fans. The two-fan system (See Section 8.6) will be positioned outside of the portal. As development of the decline progresses, the ducting will be extended to the new face as needed, and the third fan will be added as airflow demands increase. An initial quantity of air enters the ducting and is delivered to the raise bore pocket. This quantity should be sufficient to support one truck and one LHD as the decline and initial raise access are developed.

Stage 2 includes further development of the decline, level development along this section of decline, and the eventual addition of the intake raise. The fan to be installed at the top of the exhaust raise should operate at the entirety of Stage 2. This will establish the initial flow-through ventilation in the mine.

The decline development is highly dependent on the continued development of levels. Each level connects into the exhaust raise via slot raises. Once a lower level is properly connected into the exhaust system, a regulator is placed on the exhaust access airway of the level above it. This method will effectively draw more airflow deeper into the mine, through the new level and out to the exhaust slot raise. The availability of flow-through airflow farther down the decline will allow the auxiliary fan system and ducting to advance down ramp, closer to the working face. This “leapfrogging” process shortens the necessary ducting length and utilizes fan power more efficiently.

The development in Stage 2 will progress to develop levels 1, 2, and 3 from their decline accesses to the exhaust airways. Level 5 is developed from its decline access to the bottom of the planned intake raise.

Stage 3 includes finishing construction on the intake raise, further development of levels, and decline advancement. Upon the completion of the intake raise at the end of Stage 2, the overall mine airflow can be increased. This stage also includes the large-scale development and production of the stopes between Levels 4 and 5. Stage 3 airflow distribution is shown in Figure A-40.

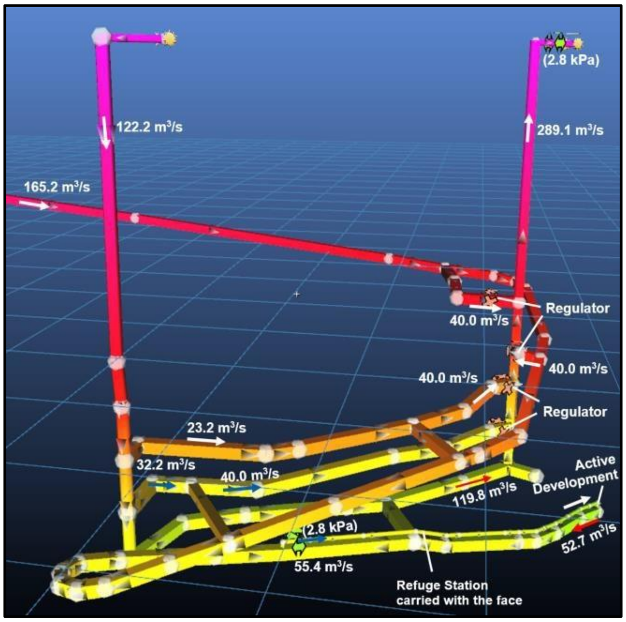

Figure A-40 Stage 3 Airflow Distribution
Source: SRK

Stage 4 is the development of the lower portion of Haile leading up to the boring of the internal raise. This stage includes the construction of the main decline, portions of the lower levels, and the exhaust slot raises. The lower mine levels constructed during this stage will be connected into the exhaust airway via slot raises. Regulators will be used to distribute the airflow between the levels. Stage 4 concludes with the auxiliary system ventilating the starting point of the raise bore for the development of the internal intake raise. Stage 4 air distribution is shown in Figure A-41.

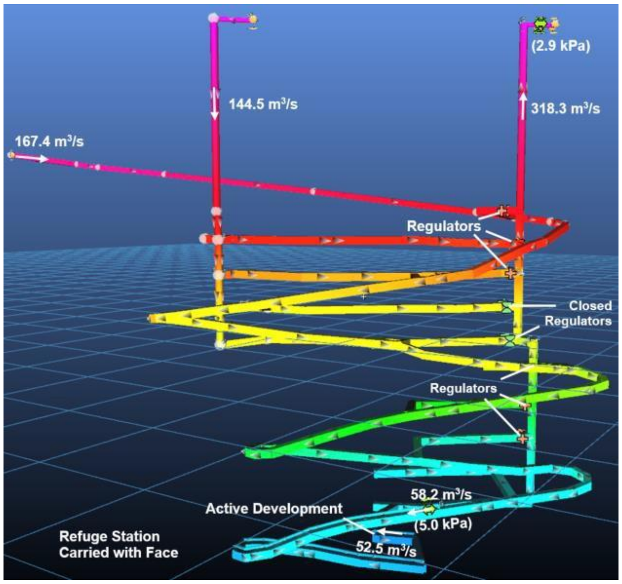

Figure A-41 Stage 4 Airflow Distribution
Source: SRK

Stage 5 will commission internal intake raise, completion of the planned levels, and beginning of full-scale production from the lower block. The internal intake raise will carry air from the intake raise connected to surface. The Stage 5 airflow distribution is shown in Figure A-42.

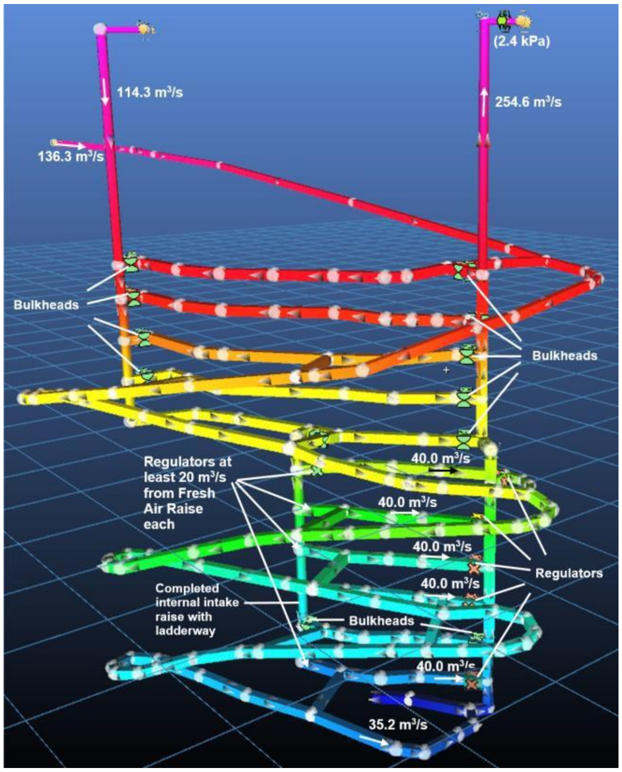

Figure A-42 Stage 5 Airflow Distribution
Source: SRK

In Stage 5, most of the mine's upper levels and stopes have been mined out and the mine airflow is directed to the lower portion of the mine with the use of ventilation controls. Stage 5 overall airflow quantity will enter the mine at the intake raise to surface and a quantity of air will enter the mine through the main portal. The maximum air velocity in the ramp will occur just beyond the portal.

7.5. Mine Services

7.5.1. Dewatering

The Horseshoe Underground will have a dewatering system that has a 1,000 gpm capacity but will typically operate at approximately 600 gpm. The larger peak inflows are expected to be encountered in the decline near surface. The weathered metavolcanics in this area have an enhanced permeability as compared to the other units. Once through the weathered zone, lower amounts of water are anticipated.

The system is built in phases as the mine develops and consists of a portable development system and permanent level pump stations that will be constructed as the mine production levels are constructed. The system will pump from the underground workings through steel and SDR11 8-inch HDPE pipes to 465 Pond where the water will be pumped through an existing system to the Contact Water Treatment Plant (CWTP).

The portable development system will be used from the portal. Once the permanent pump system is completed and piping out through the vent hole is completed, the portable system will be removed from the decline and utilized for the development decline. A second permanent pump station will be established on the -240 m level that will pump to the surface for discharge to Pond 465.

Surface dewatering will be ongoing during the time of underground production and a surface dewatering well is anticipated to be located near the main decline to minimize water encountered during development through the weathered zone.

7.5.2. Electrical

The mine electrical system will be supplied from the existing power line from the main substation at the Mill through the 24.9kV power line that feeds 465 Pond. The line will be further developed to the underground yard and eventually to the ventilation raise to feed the mine.

Initially power will come from the underground yard through a feeder cable to the portable mine substation located at the portal location that will provide power for the portal fans used during development, mine pump system, mine equipment used for driving the access decline, and auxiliary power for miscellaneous equipment required during development of the mine. Power will be carried down the decline in power cables suspended in the back to portable subs that will step the power down to feed the mobile equipment and pumps.

Once the mine ventilation hole is established, a new 13.8 kV overhead line from the underground storage yard will be extended to the vent hole and a main power feed will be run down the vent raise to feed the mine through a distribution system at 13.8kV to portable substations that feed the various mine ventilation, mobile, fixed, and pumping equipment.

The underground mine connected load including all equipment at full capacity is approximately 6 MW. The Life of Mine average usage is 1.2 million kWhr per month with an average operating load of 2.4 MW.

7.5.3. Mobile Equipment

The Mobile Equipment required for underground operation is shown in Table A-12.

Table A-12 Mobile Equipment in Operation, by Year

Type of Equipment	Diesel (kW)	Electric (kW)	2020	2021	2022	2023	2024	2025	2026	Max
DTH	119	119		1	1	1	1	1	1	1
TH Drill	110	119		1	1	1	1	1	1	1
Explosives Charger (large)	158		1	1	1	1	1	1	1	1
LHD's (14T)	256		1	1	2	2	2	2	2	2
Jumbos	119		1	2	2	2	2	2	2	2
Explosive Chargers (small)		200		1	1	1	1	1	1	1
Bolters	70	70	1	2	2	2	2	2	2	2
Scissor Lifts	127		1	1	1	1	1	1	1	1
Trucks (40T)	405		1	2	5	5	5	5	5	5
Cable Bolter	120		-	1	1	1	1	1	1	1
LHD (7T)	150	63	1	2	2	2	2	2	2	2
Boom Truck	127		1	1	1	1	1	1	1	1
Lube Truck	127		1	1	1	1	1	1	1	1
Fuel Truck	127		1	1	1	1	1	1	1	1
Flat Bed (for explosives chargers)	170		1	2	2	2	2	2	2	2
Shotcrete Sprayer Truck	170		1	1	1	1	1	1	1	1
Trans-mixer Truck	170		1	1	1	1	1	1	1	1
Telehandler	106		1	1	1	1	1	1	1	1
Skid Steer	73		1	1	1	1	1	1	1	1
Personnel Carriers (4 person)	19		2	4	4	4	4	4	4	4
Personnel Carrier (16 person)	127			2	2	2	2	2	2	2
Underground Core Drill		55		1	1	1	1	1	1	1
Grader	114			1	1	1	1	1	1	1

Source: SRK

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8. ORE PROCESSING METHODS AND FACILITIES

This section generally describes how the ore is processed to remove the gold. Ore is sent to the Mill, where it goes through a process of physical size reduction and chemical separation to extract the precious metals. The Mill Site is located on a 103-acre portion of the mine (See Figure A-43) that includes the Mill and ancillary support facilities, such as reagent storage and mixing, CWTP, water storage tanks, containment systems, 29 Pond, fuel storage (diesel fuel and gasoline), mine and mill maintenance shops, truck wash, warehouse, administrative offices, and parking. Figure A-44 shows the constructed Process Mill flow sheet and its support facilities. The Mill Site includes stormwater and sediment management features.

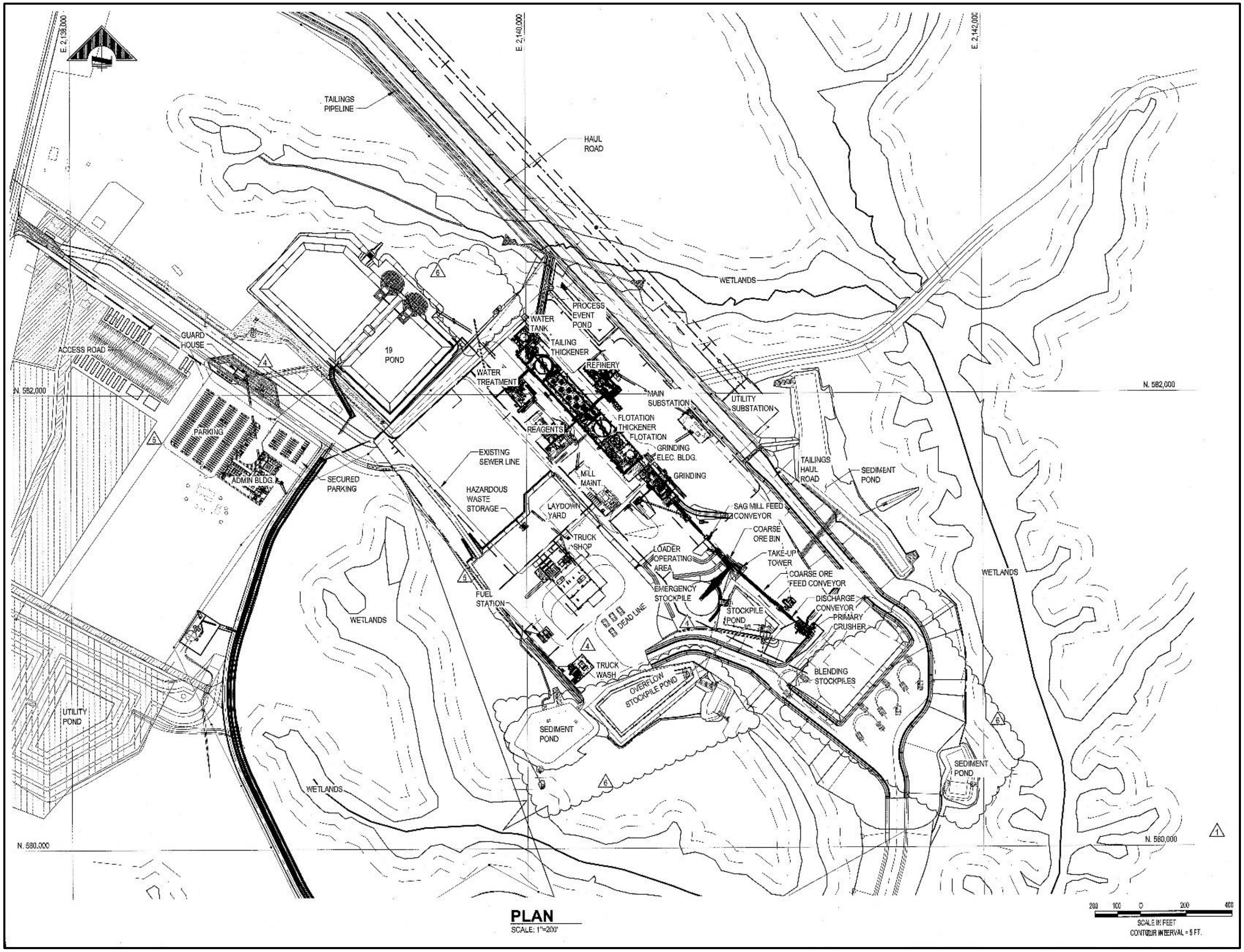


Figure A-43 As-Built Mill Site General Arrangement

Source: Haile 2017.

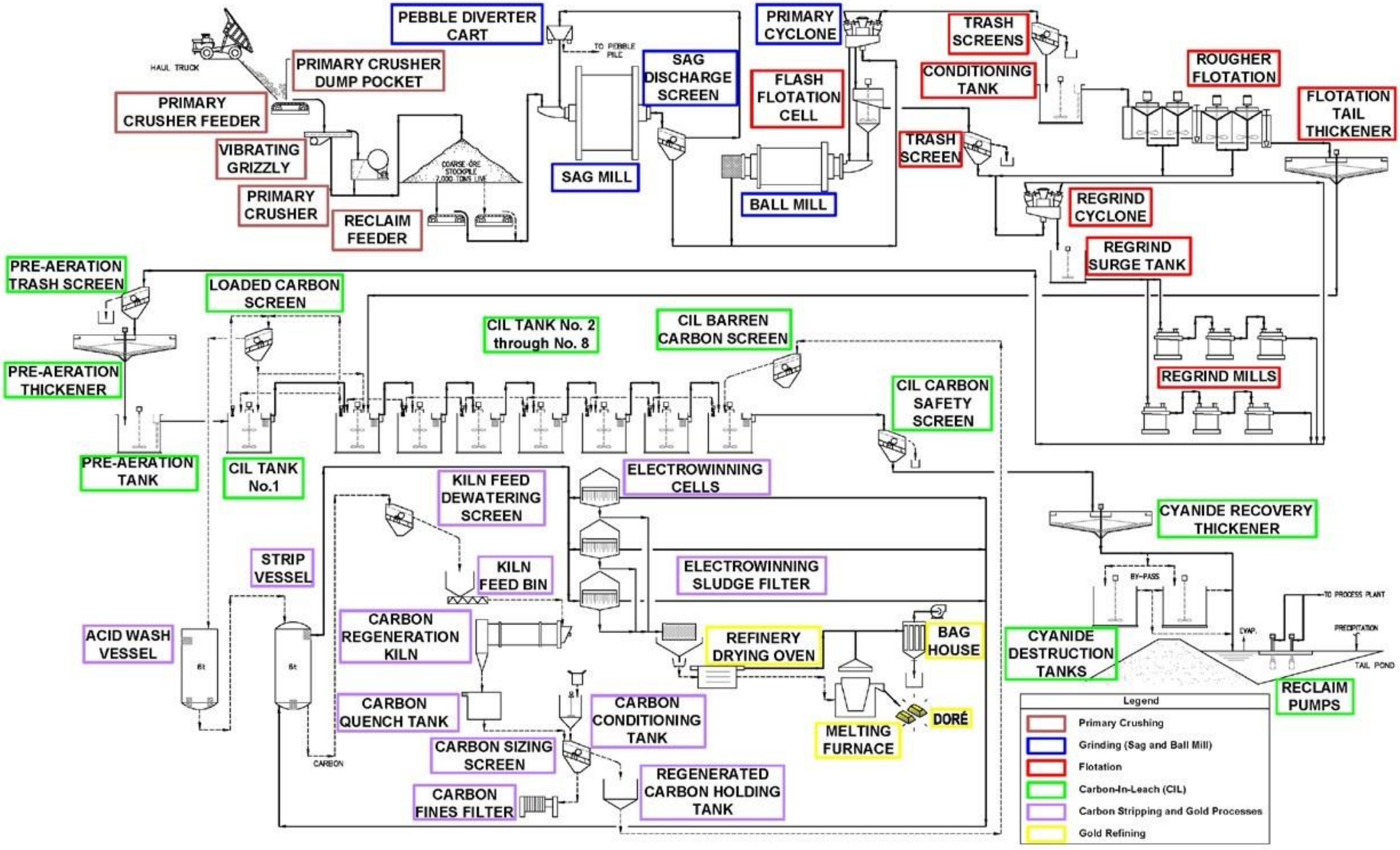


Figure A-44 As-Built Mill Process Flow Sheet

Source: M3 Engineering & Technology 2017.

The following steps summarize the process for extracting the gold from the ore (colors refer to those shown in the figure):

- Primary Crushing (brown) – The ore is crushed to less than 6 inches by the primary crusher (See Figure A-45) and then stacked on the Emergency Stockpile (Figure A-46) or direct fed into the grinding circuit.

- Grinding (SAG and Ball Mill) (blue) – The less than 6-inch rock is ground in water to the size of a fine powder, approximately 74 microns in size, or about the grain size of table salt. The mixture of particles and water is called *slurry*, and the process from this point on is in slurry form. The SAG and Ball Mills are shown in Figure A-47.

- Flotation (red) – The slurry from grinding is treated with chemicals to enable the gold-bearing minerals to float to the top of the flotation machines (flash flotation cell and rougher flotation) and concentrate as a froth. The froth would flow downstream as a slurry concentrate for further processing in the regrind circuit (described next). The ore that does not float in this process is called flotation tailing, and these tailings are pumped to the carbon-in-leach (CIL) circuit described below.

- Regrind (red) – The slurry concentrate of gold-bearing minerals from flotation is ground further to approximately 13 microns in size, about the grain size of talcum powder, in the six regrind mills shown in Figure A-48.

- Carbon in Leach (green) – The CIL process takes place in eight tanks. The reground concentrate slurry is oxidized with air in the pre-aeration tank prior to being treated with sodium cyanide in CIL Tank No. 1. Dissolved gold is adsorbed onto activated carbon. The discharge from CIL Tank No. 1 flows by gravity to CIL Tank No. 2, where it combines with the flotation tailing. The combined streams are treated with sodium cyanide, and the dissolved gold is adsorbed onto activated carbon in CIL Tanks Nos. 2 through 8. The discharge from CIL Tank No. 8 is thickened, and most of the sodium cyanide is returned to the concentrate treatment stage. The remaining flow is pumped to the TSF through the cyanide destruction process, where cyanide is destroyed using a sulfur dioxide and air (INCO) process.

- Carbon Stripping and Gold Processing (purple) – The gold-bearing activated carbon is treated with chemicals to strip the gold from the carbon into solution (called “pregnant solution”). The gold is removed from the pregnant solution in the electro-winning cells. In the cells, a gold-bearing “sludge” forms on the electro-winning cathodes. The sludge is washed off the cathodes and dried in an oven. After the gold is removed from the carbon, the carbon is thermally reactivated by heating in a kiln to remove impurities. After reactivation, the carbon is returned to the CIL circuit for reuse.

- Gold Refining and Processing (yellow) – The gold-bearing sludge is smelted to separate the gold from the waste material, poured into a mold, and cooled to form a doré bar that is a mixture of gold and silver.

Figure A-45 Run-of Mine Pad and Crushing Circuit
Source: Haile 2018.

Figure A-46 Emergency Stockpile
Source: Haile 2018.

Figure A-47 Grinding Circuit – SAG Mill and Ball Mill

Source: Haile 2018.

Figure A-48 Flotation and Ultrafine Grinding Circuit
Source: Haile 2018.

The key additions to optimize the Mill process, shown in Figure A-49, include the following:

- Pebble crushing installation on existing SAG mill scats recycle (See Figure A-50)
- Additional scavenger Flotation cells to maximize reaction times (See Figure A-51),
- Tertiary (whole ore) grinding using a vertical ball ISA mill (See Figure A-52, left and A-53),
- Primary regrinding stage using a vertical ball Tower mill (See Figure A-52, right),
- Additional acid wash and strip vessels in the Elution circuit (See Figure A-54), and
- Additional reaction tank in Cyanide Destruct circuit (See Section 8.1).

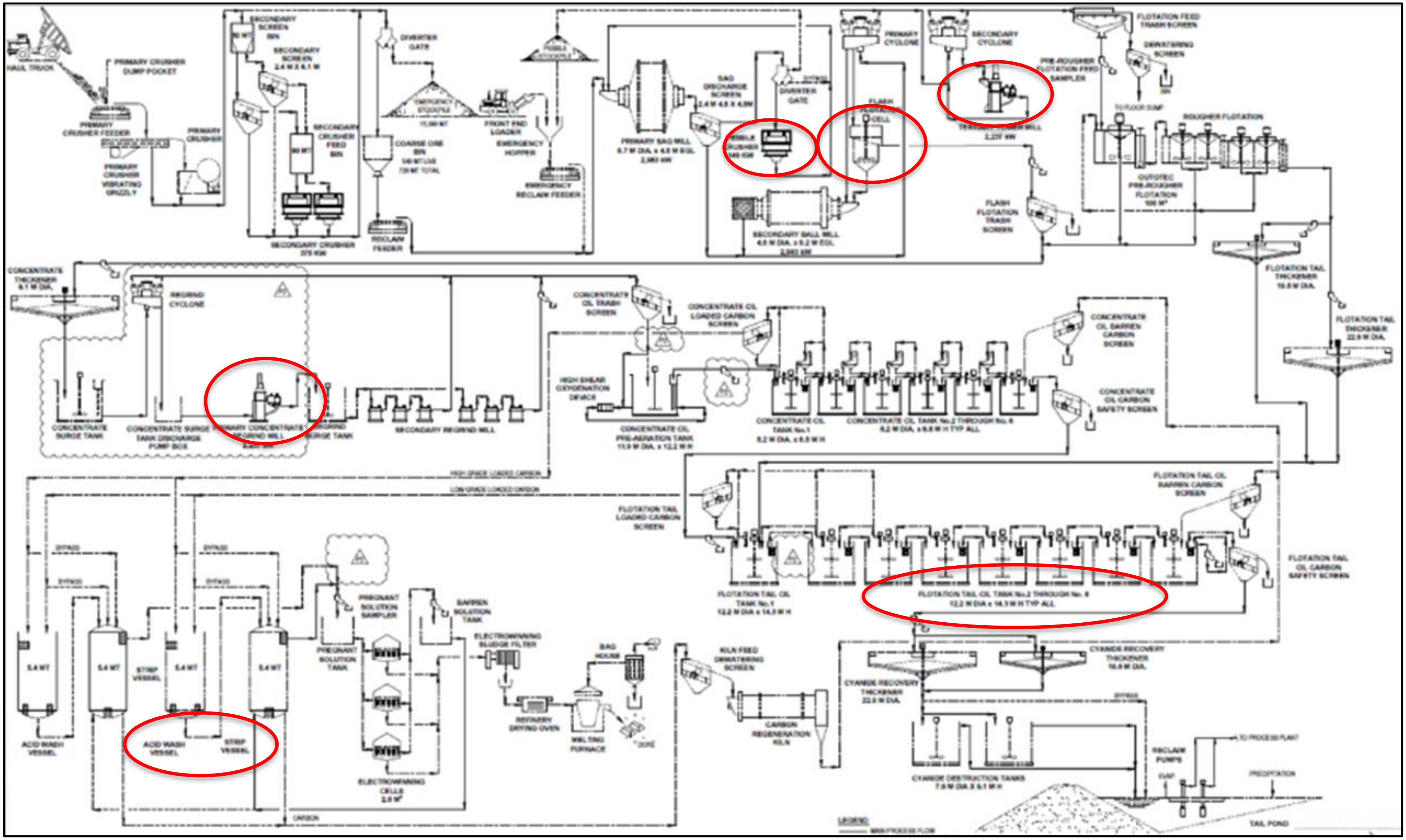


Figure A-49 Optimized Mill Process Flow Sheet (selected additions are circled)
Source: M3 Engineering 2017.

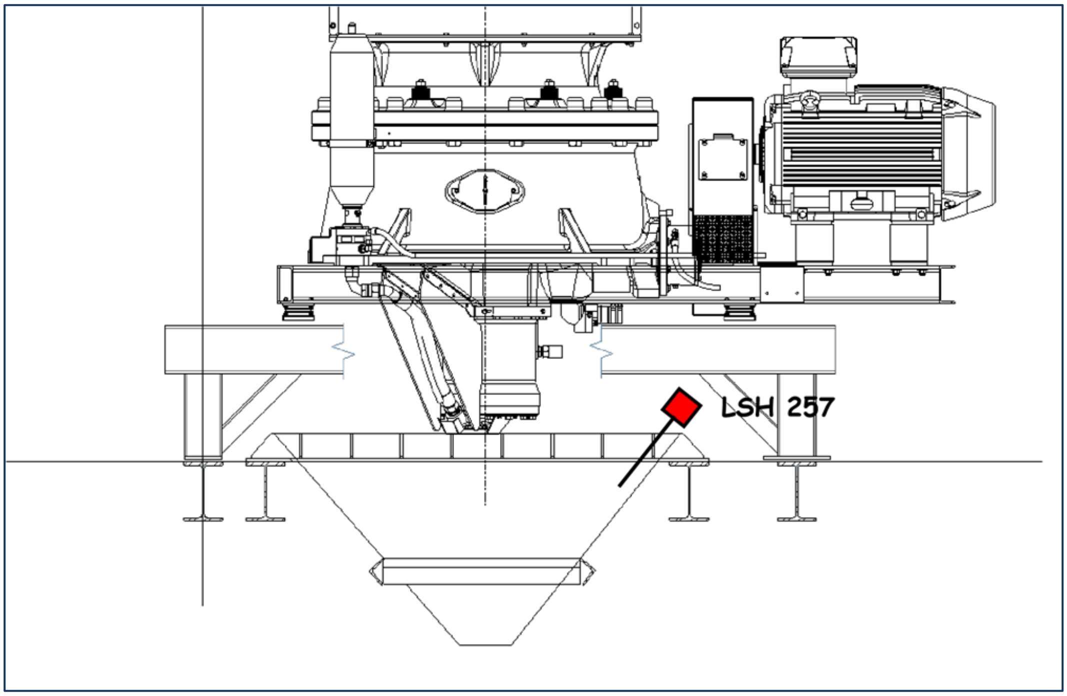


Figure A-50 Pebble Crusher
Source: East Group 2018.

Figure A-51 Flotation Cell
Source: Outotec 2018.

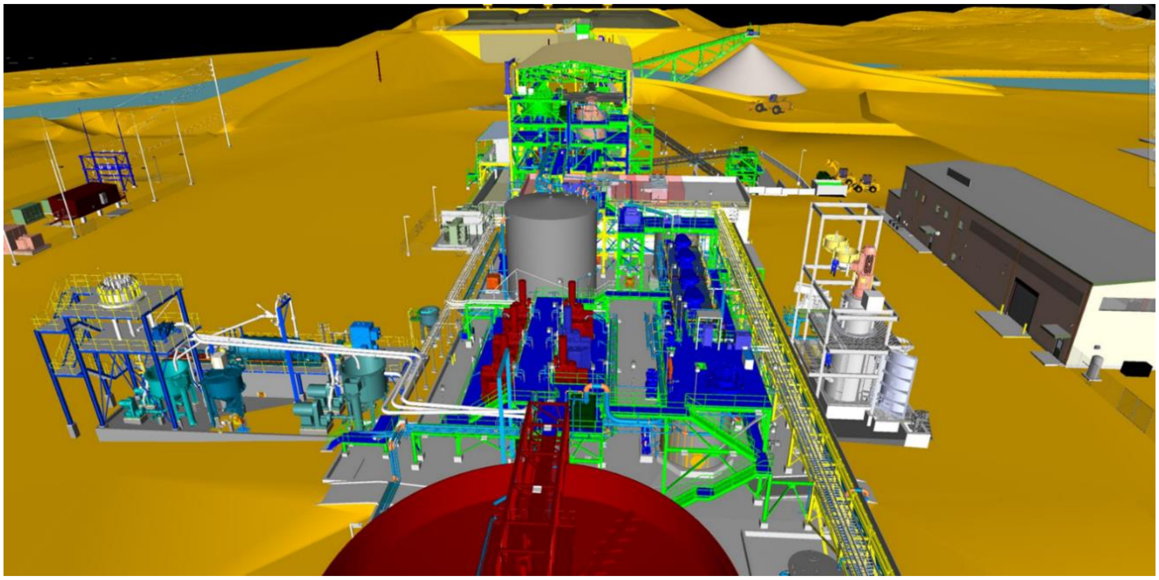


Figure A-52 Location of ISA Mill (left) and Tower Mill (right)
Source: Ausenco 2018.

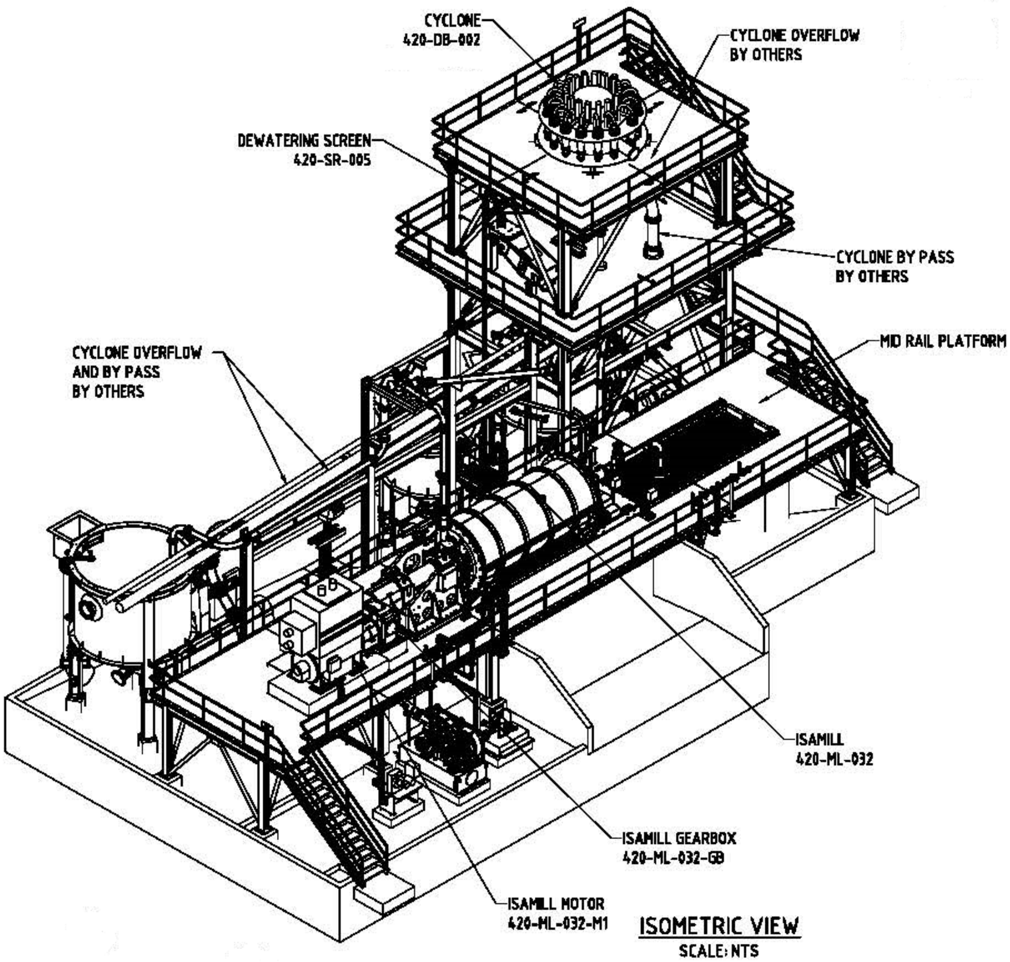


Figure A-53 Isometric View of the ISA Mill
Source: IsaMill 2018.

Figure A-54 Elution Circuit – Acid Wash, Barren Tank, and Carbon Regeneration Rotary Kiln
Source: Haile 2018.

The particle size distribution through each reduction operation is shown in Table A-13.

Table A-13 Approximate Particle Size Distribution by Operation

Operation	Particle Size (P_{80})
Run of Mine Ore	24 inches
Through Crusher	6 inches
Through SAG Mill	2.25 inches
Through Ball Mill	85 microns
Through Tower Mill	47 microns
Through ISA Mill	13 microns

8.1. Sodium Cyanide Use and Recovery

Sodium cyanide is used only in tanks and in the following manner within the closed-loop system for the Mill process water. Sodium cyanide is transported to site in an ISO Container (See Figure A-55), liquefied in the container, and then transferred to the storage tanks. It is pumped to the CIL tanks and mixed with the activated carbon in the concentrate and flotation tailing treatment stages. (Prior to those stages, the slurry is aerated to oxidize the ore, which reduces the amount of sodium cyanide required to extract the gold.) In addition to sodium cyanide and activated carbon, lead nitrate and lime are added in the concentrate and flotation tailing treatment stages in various amounts to enhance gold recovery and maintain the pH to ensure protective alkalinity. The Carbon-In-Leach (CIL) process takes place in eight tanks. Slurry advances from tank to tank by gravity, and all discharge from the last tank reports to the carbon screen. Because the particles of activated carbon with the adsorbed gold are larger than the slurry mixture, they are retained in the tanks by screens while the waste slurry passes through from tank to tank and finally out of the circuit.

Figure A-55 Sodium Cyanide Transfer Station
Source: Haile 2018.

The slurry is pumped to the TSF through the cyanide destruction circuit (if needed to keep WAD cyanide levels in the slurry below 50 ppm), where cyanide is destroyed using a sulfur dioxide and air (INCO) process.

In the cyanide destruction tanks, WAD cyanide is oxidized to form cyanate (OCN-). The process uses sulfur dioxide and air at a slightly alkaline pH in the presence of soluble copper to oxidize the cyanide. Through this process, the cyanate quickly decomposes in water to ammonium (NH4) and bicarbonate (HCO3) ions that are stable. This process was developed in the 1980s and is currently in use at over 30 mine sites worldwide. Ammonium bisulfite is the source of sulfur dioxide, and air is the source of oxygen. Copper sulfate is added as a catalyst and lime is added to control pH.

Discharge from the cyanide destruction tanks is pumped to the TSF with the tailing slurry. In the TSF, UV sunlight and air naturally decompose cyanide and cyanide complexes to further decrease cyanide levels. Figure A-56 shows the Tails Thickener and Cyanide Destruct Circuit.

Figure A-56 Tails Thickener and Cyanide Destruct Circuit
Source: Haile 2018.

8.2. Process Water Supply

Water for the Mill process is obtained from the sources shown in Figure A-57. These sources include:

- Water reclaimed from the TSF tailing slurry;
- Groundwater pumped to depressurize the areas adjacent to the mining pits (see Section A.10.2.3, "Depressurization Water Management" for details) or other non-contact water sources stored in the FWSA;
- Contact water pumped from the pit sumps, underground mine, and PAG Cells; and
- Moisture retained within the ore.

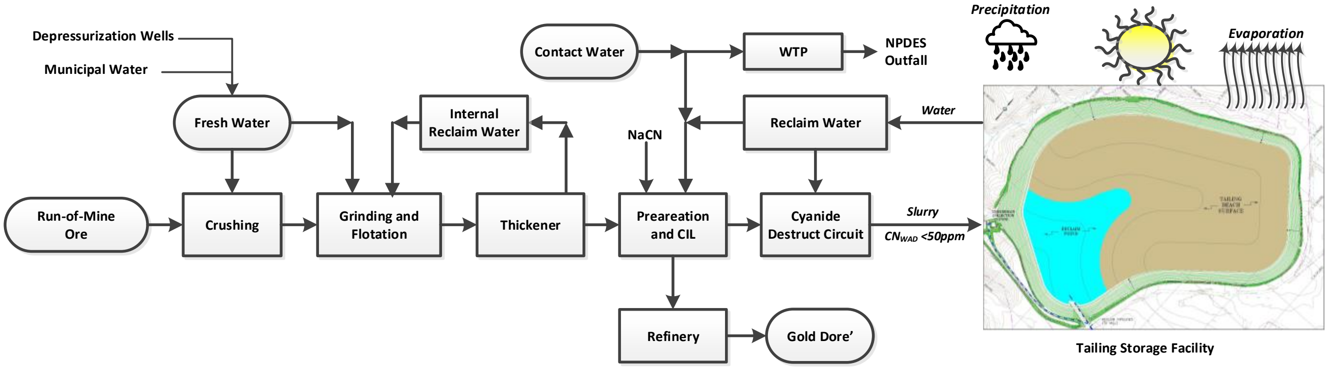


Figure A-57 Process Water Supply
Source: Haile 2013 (updated 2018).

If necessary, Haile can use municipal water as makeup for the Mill, though water balance model results suggest that Haile can meet process water needs through a mix of reclaim water from the TSF; internal reclaim water extracted from the thickeners; contact water; and direct use of non-contact water. Town of Kershaw can also supply water from a new 250,000-gallon tank on Highway 601, at the edge of city limits. The Town of Kershaw has committed a water volume of 640 gallons per minute, as needed, if it poses no encumbrance to the community. This new tank was funded by Haile and state commerce for this specific purpose.

The TSF Reclaim water (reclaimed in the closed-loop process) is the primary source of water for the Mill. The water level in the TSF changes seasonally and in dry or wet periods. The use of non-contact at the Mill increases only when the volume of TSF reclaim water decreases. The amount of water supplied from TSF reclaim is expected to range from approximately 800 to 1,575 gallons per minute (gpm). The range of values is a product of the amount of free water that may be stored in the TSF prior to a drought. The ratio of TSF reclaim water to non-contact water varies based on the available TSF reclaim water. During typical conditions, reclaim is expected to range from approximately 1,200 gpm to 1,575 gpm. Only during severe drought conditions is reclaim expected to drop to the 800 gpm range.

Contact water is derived from runoff and seepage from PAG material, precipitation falling into the pits, and water from underground mine operations. During an extreme dry condition with no precipitation, when the underground mine is not yet operational, little to no contact water is generated; therefore, it cannot be counted on to meet Mill demands. During average and wet conditions, sufficient water is available in the TSF to meet the full reclaim demand of 1,575 gpm, and contact water is not brought to the Mill in these situations. Contact water is brought to the Mill only when minimal amounts of free water exist in the TSF and precipitation occurs (but in limited amounts). Given this atypical condition, the volume of water in the TSF would not be sufficient to meet the full 1,575 gpm reclaim. Contact water or additional non-contact water would then be brought into the Mill to supplement TSF reclaim.

8.3. TSF Reclaim Water

TSF reclaim water is reused in the Mill process. The reclaim water cycles between the Mill and the HDPE-lined TSF in a closed loop, which prevents the Mill process water from being discharged into the environment. As described above, the concentration of WAD cyanide is reduced below 50 ppm prior to being pumped to the TSF, in accordance with the International Cyanide Management Code. Once the slurry reaches the TSF, ultraviolet (UV) sunlight and air naturally further decompose carbon and nitrogen bonds which complexes to further decrease total cyanide levels in the TSF Reclaim Pond.

Given average precipitation conditions, a maximum of approximately 350 acre-feet of reclaimed water is stored in the TSF. If a prolonged period of extreme precipitation were to occur (a 95th-percentile wet cycle), water storage in the TSF is expected to approach approximately 700 acre-feet. In all cases, the TSF is designed to store rainfall associated with the probable maximum precipitation (PMP) event while maintaining an additional 4 feet of freeboard. The American Meteorological Society defines a PMP event as “the theoretically greatest depth of precipitation for a given duration that is physically possible over a particular drainage basin at a particular time of year” (AMS 1959). The PMP storm for the Haile Gold Mine site is calculated as 48 inches for a 72-hour event. Freeboard is a function of the facility design and is calculated to provide a factor of safety greater than that for which the facility is designed.

At the end of the production phase of the mine, Haile's NPDES permit will be modified to include a treatment system for this process water. This new process water treatment system will treat underdrainage from the TSF until it is capped and sufficiently drained down such that the flows have diminished to a level where the outflow can be treated in a passive treatment system.

8.4. Reagents

Reagents are chemicals or solutions used in gold ore processing to produce a desired reaction. Reagents that would require handling, mixing, and distribution systems are listed in Table A-14.

Table A-14 Reagents Used in Ore Processing

Reagent	Use	Maximum On-Site Storage Capacity[a]
Aero 404 (l)	AERO 404 (or an equivalent flotation promoter) is added to the SAG mill and flotation stage to enhance flotation recovery of gold and gold-bearing sulfide minerals.	26 tons 6,070 gallons (total) One tank @ 6,070 gallons
Ammonium bisulfite (ABS) (l)	Ammonium bisulfite is used in the sodium cyanide destruction circuit. Ammonium bisulfite is added to the sodium cyanide destruction tanks as the primary source of sulfur dioxide (SO2), which is used to oxidize free sodium cyanide and weak acid dissociable (WAD) metal sodium cyanide complexes (SO_2/air process).	30 tons 6,365 gallons (total) One tank @ 6,365 gallons
Antiscalant (l)	Antiscalant is added to the barren strip solution, reclaim water, and internal reclaim water tanks to prevent scaling in pipelines and tanks.	25 tons 7,950 gallons (total) Three tanks @ 2,650 gallons (each)
Caustic soda (sodium hydroxide) (NaOH) (l)	Caustic soda solution is used to neutralize acidic solutions after acid washing in the carbon strip stage. Caustic soda can be added to the sodium cyanide mix tank for pH control, if needed.	31 tons 5,265 gallons (total) One tank @ 5,265 gallons
Copper sulfate ($CuSO_4$) (s)	Copper sulfate is delivered dry and stored in bags until mixed with water in a distribution tank. Copper sulfate is added to the sodium cyanide destruction tanks to provide copper ions as a catalyst for the sodium cyanide destruction process.	6 tons dry on pallets plus One mix tank @ 6,390 gallons and one distribution tank @ 6,360 gallons
Flocculant (s)	Flocculant is delivered dry and stored in bags until mixed with water in three separate distribution tanks. Flocculant is added during the slurry thickening process to promote solids settling.	26 tons dry on pallets plus 13,800 gallons mixed – two tanks @ 5,750 gallons and one tank @ 2,300 gallons
Flux (s)	Flux is added in the gold refining stage to remove contaminants from the precious metals. Flux is added in solid form.	3 tons
Frother (MIBC) (l)	Frother is added at the flotation stage to enable flotation of gold-bearing sulfide minerals.	25 tons - 7,500 gallons (total) One tank @ 7,500 gallons
Hydrochloric acid (HCl) (l)	Hydrochloric acid is used in the carbon strip stage to acid wash carbon.	25 tons 5,100 gallons (total) One tank @ 5,100 gallons
Lead nitrate (PbNO3) (s)	Lead nitrate is delivered dry and stored in bags until mixed with water in a distribution tank. Lead nitrate is added in the pre-aeration stage to enhance leaching.	6 tons dry on pallets One mix and distribution tank @ 1,550 gallons

Reagent	Use	Maximum On-Site Storage Capacity[a]
Potassium amyl xanthate (PAX) (s)	PAX (flotation collector) is delivered dry and stored in bags until mixed with water in a distribution tank. PAX is added to the grinding and flotation stages to facilitate flotation of gold-bearing sulfide minerals.	30 tons on pallets plus One 5,140-gallon mixing tank and one distribution tank at 5,485 gallons
Quicklime (pebble lime) (CaO) (l) and (s)	Milk-of-lime slurry (MOL) is produced by hydrating pebble quicklime. MOL is used to control pH in various parts of the process. MOL is distributed to the concentrate treatment stage (pre-aeration), CIL tank Nos. 1 and 2, thickeners, and the sodium cyanide destruction circuit.	One silo at 100 tons dry One mixing and distribution tank @ 24,000 gallons
Sodium cyanide (NaCN) (l)	Sodium cyanide solution is added to the ore in the leach circuit to recover gold and silver. Sodium cyanide solution also is used to promote removal of gold and silver from the carbon in the carbon strip stage.	46 tons 51,000 gallons (total) Two tanks @ 25,500 gallons (each)
Metalsorb (l)	Metalsorb (or an equivalent chelating agent) is used to abate mercury production by complexing mercury to form a stable organic sulfide precipitate.	2.6 tons 560 gallons (total) Two tote bins @ 280 gallons (each)

Notes:

(l) = liquid (s) = solid

[a] Actual volumes stored on site may be less than full storage capacities based on factors such as replenishment order points, market conditions, vendor logistics, Mill throughput, reagent availability, delivery options, and process optimization. Metric conversions are available upon request.

[b] Antiscalant is a vendor-supplied package.

Source: Haile 2018.

The dry reagents are stored under cover and then mixed in reagent mixing tanks and transferred to distribution tanks for process use. Figure A-58 shows the Reagents Storage Facility.

The reagent building is a steel-framed structure with metal roofing. In general, the building is open, but metal siding is installed where necessary to keep reagents dry. The floor is slab on-grade concrete, with concrete containment walls to capture spills and any precipitation that enters the sides of the structure. Reagents that are not compatible to be stored together are kept in separate containment areas within the reagent storage area.

Figure A-58 Reagents Building
Source: Haile 2018.

8.5. Spill Containment

The ore processing facilities, chemical storage areas, and fuel storage areas are designed with the capacity to contain spills or leaks, with the volume to hold a 100-year, 24-hour storm event, assuming it would occur in conjunction with a spill or leak. Each area is built on a concrete floor with cast-in-place concrete walls. The floor area and wall heights are designed to capture any spills, and the floors slope toward a collection sump for cleanup and return of the spill to the process stream for which it is best suited. The floor area and walls are designed to capture 110 percent of the largest vessel (or container) in that process area plus stormwater (for the 100-year, 24-hour storm event) if it is open to the sky. If a spill is greater than the facility's containment capacity, it is captured and flows into the Process Event Pond (explained below). Table A-15 summarizes the proposed containment systems and volumes for components of the Mill and Mill Site.

Three of the containment areas are interconnected – Flotation to Pre-Aeration Thickener; Tail Thickener to CIL; and Cyanide Recovery Thickener to Cyanide Destruct. These areas are separated by a stem wall with a slot, so water can pass in either direction. This feature is based on efficiency in design and allows for the low probability that there will not be multiple tanks fail at the same time.

Table A-15 As-Built Containment Systems

Containment Area	Indoor / Outdoor	Containment System	Containment Volume	Sump Pumps to
Primary crusher	Outdoor	Concrete pad with stem walls	100-year, 24-hour storm event	Stockpile Collection Pond
Grinding (SAG and Ball mill) building	Covered	Concrete pad with stem walls	110% of largest vessel	Grinding circuit

Containment Area	Indoor / Outdoor	Containment System	Containment Volume	Sump Pumps to
Flotation and regrind	Outdoor	Concrete pad with stem walls	110% of largest vessel + 100-year, 24-hour storm event.	Flotation circuit
Pre-aeration thickener	Outdoor	Concrete pad with stem walls	110% of largest vessel + 100-year, 24-hour storm event.	Pre-aeration thickener
Flotation tail thickener	Outdoor	Concrete pad with stem walls	110% of largest vessel + 100-year, 24-hour storm event.	Flotation tail thickener
Carbon-in-leach (CIL) area	Outdoor	Concrete pad with stem walls	110% of largest vessel + 100-year, 24-hour storm event.	CIL circuit
Cyanide recovery thickener/cyanide destruction	Outdoor	Concrete pad with stem walls	110% of largest vessel + 100-year, 24-hour storm event.	Cyanide destruction
Reagent mixing area	Covered	Concrete pad with stem walls	110% of largest vessel in each containment area + 100-year, 24-hour storm event	Cyanide destruction
Reagent storage area	Outdoor	Concrete pad with stem walls	110% of largest vessel in each containment area + 100-year, 24-hour storm event	CIL circuit
Reclaim water pad	Outdoor	Concrete pad with stem walls	110% of largest vessel + 100-year, 24-hour storm event	Reclaim water tank
Tailings line	Outdoor	Lined trench and pond	110% of the entire pipeline volume + 100-year, 24-hour storm event	Process Event Pond
Truck shop tank farm	Outdoor	Double-walled tanks	Tanks are double-walled on concrete foundations	No sump in this area; any spills is remediated at the point of spill.
Carbon acid wash	Outdoor	Concrete pad with stem walls	110% of largest vessel + 100-year, 24-hour storm event	Carbon acid wash
Carbon strip	Outdoor	Concrete pad with stem walls	110% of largest vessel + 100-year, 24-hour storm event	Carbon strip
Carbon regeneration	Outdoor	Concrete pad with stem walls	110% of largest vessel + 100 Year/ 24-hour storm event	Carbon regeneration

Containment Area	Indoor / Outdoor	Containment System	Containment Volume	Sump Pumps to
Refinery	Indoor	Concrete pad with stem walls	110% of largest vessel	Refinery
Fuel storage	Outdoor	Double-walled tanks	Tanks are double-walled on concrete foundations	No sump in this area; any spills are remediated at the point of spill.

Source: M3 Engineering & Technology 2017.

In the event of a spill that exceeds a facility's containment capacity, the overflow drains to the adjacent Process Event Pond (See Figure A-59), which is designed to act as a failsafe in case individual containment systems have insufficient capacity. The Process Event Pond is designed to capture quantities of spilled solution or slurry that may exceed the main process containment facilities, tailing slurry pipeline contents, or reclaim water line contents. It is constructed on the north end of the processing facilities, adjacent to the refinery.

Figure A-59 Process Events Pond
Source: Haile 2018.

The Process Event Pond is an approximately 1.5-million-gallon-capacity HDPE-lined pond to handle overflow events. Should multiple spill events occur in the processing area, any material that would not fit within the containment area would flow to the HDPE-lined Process Event Pond via a pipeline that would flow by gravity to the Process Event Pond. The tailings slurry and process water pipelines (described below) are designed to have double containment, involving either a pipeline within a pipeline or a pipeline within a lined containment structure or trench. Should a failure of the tailings or process water pipelines occur, or a prolonged unplanned power outage occur, the material from the pipelines would drain to the Process Event Pond.

Once the failures have been repaired, or power restored, material in the Process Event Pond is returned to the cyanide recovery thickener or applicable area for processing. Water from a spill or incident that contacts processing reagents is suitable for use in the closed-loop system, which includes use of process water from the TSF.

In addition to the containment systems identified for the Mill, the following support facilities also would have spill control measures: the truck shop, fuel storage locations, hazardous waste storage building, and electrical substation. Chemical storage and containment are designed to avoid mixing chemicals that interact negatively.

8.6. Air Point Sources

The summary of air discharge and point sources placed into the Haile operation are shown in Table A-16. These are monitored quarterly for visible emissions and were measured during initial compliance testing. Stack testing and calculations were performed in accordance with initial performance test requirements of the New Source Performance Standards (NSPS) 40 CFR Part 60 Subpart LL and the National Emissions Standards for Hazardous Air Pollutants (NESHAP) 40 CFR Part 63 Subpart EEEEEEE. The NSPS standards apply to ore processing equipment and impose limits on particulate matter (PM) and visible emissions.

Table A-16 Air Point Sources

Source Identification	Engineering ID	Description	
PT-1	100-CR-001	Primary Crusher including Load-In/Load-Out	
PT-2	150-BN-001	Crusher Conveyor Transfer to Stockpile Feed Conveyor	
PT-3	150-CV-003	Stockpile Feed Conveyor Transfer to Coarse Ore Stockpile	
PT-2A	150-CV-002	Crusher Conveyor Transfer to Coarse Ore Bin	
PT-3A	200-HP-001	Emergency Hopper Load-In	
PT-4	300-CV-002	Conveyor Transfer to SAG Mill	
PT-5a	500-KN-001	Carbon Regeneration Kiln	Kiln Exhaust (Wet Scrubber)
			Natural Gas Combustion
PT-5b	500-WS-002	EW Cells, Pregnant and Barren Tanks (Wet Scrubber)	
PT-6	500-DC-001	Electric Melting Furnace - Refinery (Baghouse)	
PT-7	800-FL-001	Reagent Area Lime Silo Bin Vent Filter (75 ton capacity silo)	
PT-7a	800-PK-010	Reagent Area Lime Slaker	
PT-8	700-GE-001	1,500 kW Diesel Emergency Generator	
PT-9	NA	Trailer Mounted Lighting Systems (10 kW each)	
PT-15	NA	335 hp Diesel Fired Sump Pump Engine	
PT-16	500-HT-001	Natural Gas Fired Thermal Fluid Heater	
PT-17	650-PP-022	Fire Water Pump Engine (149 hp)	

Source Identification	Engineering ID	Description
PT-18	050-CR-002	Portable Crushing Operation
T-1	450-TK-001 through 008	Carbon-in-Leach Tanks (8 total) and Cyanide Recovery Thickener
T-2	800-TK-015	Hydrochloric Acid (30%) Storage Tank
T-3	800-TK-007	Sulfuric Acid (93%) Storage Tank
T-5	800-TK-010	Potassium Amyl Xanthate Storage Tank
TK-001	960-TK-001	Diesel Off-Road Fuel Storage Tank
TK-002	960-TK-002	Diesel Off-Road Fuel Storage Tank
TK-003	960-TK-003	Diesel Off-Road Fuel Storage Tank
TK-004	960-TK-004	Diesel Off-Road Fuel Storage Tank

Additional point sources that have been modelled and permitted as part of 2014 Air Permit 1460-0070-CA include the following equipment. Note that this equipment has not been installed.

Source Identification	Engineering ID	Description
PT-10	950-TK-001	150-ton Overburden Lime Silo
PT-11	950-TK-002	58.5 tpd Lime Drop to Truck Bed

There are two ventilation fans planned for the underground portals as shown in Figure A-60.

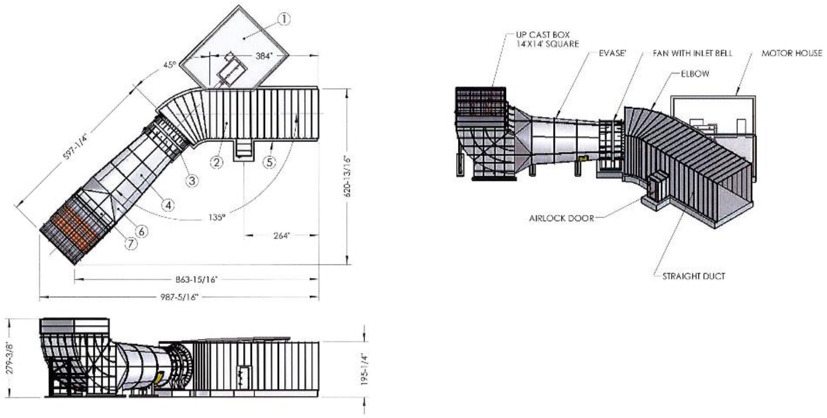


Figure A-60 Portal Ventilation Fans

Source: SRK 2017.

8.7. Electrical Power

The Haile Gold Mine straddles the boundary between the Duke Energy-franchised electric service territory and that of Lynches River Rural Electric Cooperative. Haile has entered into an agreement with Duke Energy to supply Haile's power, and Lynches River (and its engineering and construction partner, Central

Electric Power Cooperative) have constructed a new 69 kilovolt (kV) overhead power line and a 69 kV/24.9 kV substation to serve the mine.

Central Electric has an existing 69 kV power line, known as the Heath Springs to Flat Bush transmission line that runs in an east-west direction north of Project site. The new connecting 69 kV line of approximately 4.5 miles is constructed to run from near the intersection of this line and Duckwood Road north of US Highway 903 to a substation on the Haile Gold Mine property (see Figure A-61). Most of the new line at the Mill Site is within or alongside of the existing Duckwood Road and US 601 utility right-of-way.

Figure A-61 Lynches River 69 kV Power Station
Source: Haile 2018.

After the mine is permanently closed, the line and substation may be available to serve other customers. If other potential customers ask for service from the line and substation while the mine is operating, Haile would consider such requests, provided there is no degradation to the quality of power delivered to the mine (specifically the CWTP).

The peak electrical load for the Haile Gold Mine is approximately 14 megawatts (MW), and the typical operating load is from 11 to 12 MW. Power is distributed throughout the site via underground duct banks as well as by a series of 24.9 kV overhead lines.

8.8. Natural Gas

Natural gas is brought to the Project via a buried pipeline connecting to the Lancaster County Natural Gas Authority near US 601 to supply process requirements such as heating the carbon stripping solution, reactivating carbon, and comfort heating requirements. Figure A-62 shows the natural gas pipeline connection for the Project.

Figure A-62 Natural Gas Line at Highway 601
Source: Haile 2018.

8.9. Potable Water

The Haile Gold Mine currently obtains potable water from the Lancaster County Water and Sewer District. The Project is connected to the Town of Kershaw municipal water system.

8.10. Fire Protection Water

The Haile Gold Mine uses water from the mine depressurization wells for fire protection water. If fire trucks are called to the site, they can connect to one of the fire hydrants located around the Guard House, Administration Building, Warehouse, Mill Maintenance, Mine Maintenance, or from the Mill itself. The Town of Kershaw can also supply fire protection water from an existing 250,000-gallon storage tank near the Kershaw Correctional Institution or the new 250,000-gallon tank on Highway 601 at the edge of city limits.

8.11. Sewage

The Haile Gold Mine is connected to the Town of Kershaw municipal waste water treatment facility. There is a network of lift stations near the Mine Maintenance Building and the Administration Building that remain intact through the life of mine.

9. DUCKWOOD TAILINGS STORAGE FACILITY (TSF)

Once the ore is processed to remove the gold, the resulting slurry of pulverized rock and process water, known as tailings (approximately 55 percent solids and 45 percent liquids by weight), is piped to the TSF located across US 601 at the north end of the Project area. The TSF is designed for permanent storage of all tailings produced during operations of the Mill.

9.1. General Layout

The TSF is currently permitted to cover an area of approximately 524 acres (including the TSF, the TSF Underdrain Collection Pond that holds the seepage captured beneath the tailings but above the liner, the perimeter service road, diversion channels, and sediment control basins) located in the upper portion of Camp Branch Creek. Under the proposed mine expansion plan, the area covered by the TSF (and ancillary facilities) would increase to 632 acres. The TSF is constructed in stages with storage to contain the current life-of- mine total tons of tailings. Each stage allows for storage of an operating reclaim water pond plus a PMP event with 4 feet of freeboard above the maximum water elevation. The much smaller volume TSF Underdrain Collection Pond would have a freeboard of 2 feet. Benches along the interior embankment are constructed for placement of the tailings distribution pipelines.

The TSF is currently bounded by the Project Boundary on the northeast and northwest, Duckwood Road on the east, US 601 on the southeast, and the existing surface drainages on the south and west. To construct the TSF, Haile will need to move Duckwood Road and US 601. Existing topography in the area slopes toward the southwest at an average gradient of approximately 1 percent, with an overall maximum elevation change across the site of approximately 100 ft.

9.2. Stages of Construction

The TSF was previously permitted as a four-stage facility to an elevation of 630' AMSL to safely contain up to 40 million tons of tailings. The revised design is a five-stage construction to an elevation of 670' AMSL as described below:

Stage A: The constructed and operational starter embankment as presented in the original permitted design and is now renamed Stage A.

Stage B: Combines the original Stages II and III for a 25 foot raise up to elevation 600.

Stage C: Raises the embankment by 30 feet to elevation 630. Per the FEIS, this was ultimate facility. Up to this point, the original runoff collection channels, underdrain collection pond and highway overpass can be used.

Stage D: Raises the facility 20 feet to elevation 650. As the TSF footprint will exceed the original area for this raise, the following will be required to be in place by the time of the embankment raise:

- Realign portions of the following local roads and highways:
  - ✓ US Highway 601
  - ✓ Duckwood Road
  - ✓ Old Jefferson Highway
  - ✓ Estridge Avenue
  - ✓ Install "T" intersections at Earnest Scott Road / Highway 265.
  - ✓ Crossbow Lane
- New haul truck overpass over the realigned US601.
- Reconstruct all perimeter runoff collection channels.
- Relocate and construct a new channel for upper Camp Branch Creek.
- Remove existing stormwater sediment collection basin and the current TSF underdrain collection pond.
- Reconstruct perimeter stormwater sediment collection basins.

- Repurposing the existing stormwater sediment collection basin into the new TSF underdrain collection pond.
- Reshape the Existing TSF Growth Media Stockpile.
- Relocate the TSF Perimeter Fence
- Relocate the Hilton Archaeological Site

Stage E: Final raise to elevation 670.

A tailings density of 80 pounds per cubic foot was used to estimate the storage capacities for the facility.

The TSF embankment is constructed to higher elevations by increasing the height and width of the embankment. Figure A-63 shows the Layout of the TSF, and Figure A-64 illustrates a section of the TSF embankment at each stage of construction. The final embankment configuration would allow for a total storage capacity of approximately 72 million tons to account for variables in the production tailings densities. An aerial view of the current TSF is shown in Figure A-65.

The construction materials for each stage of the TSF will come from green material internal to the mine pits. Stages and surface area acreage is shown in Table A-17.

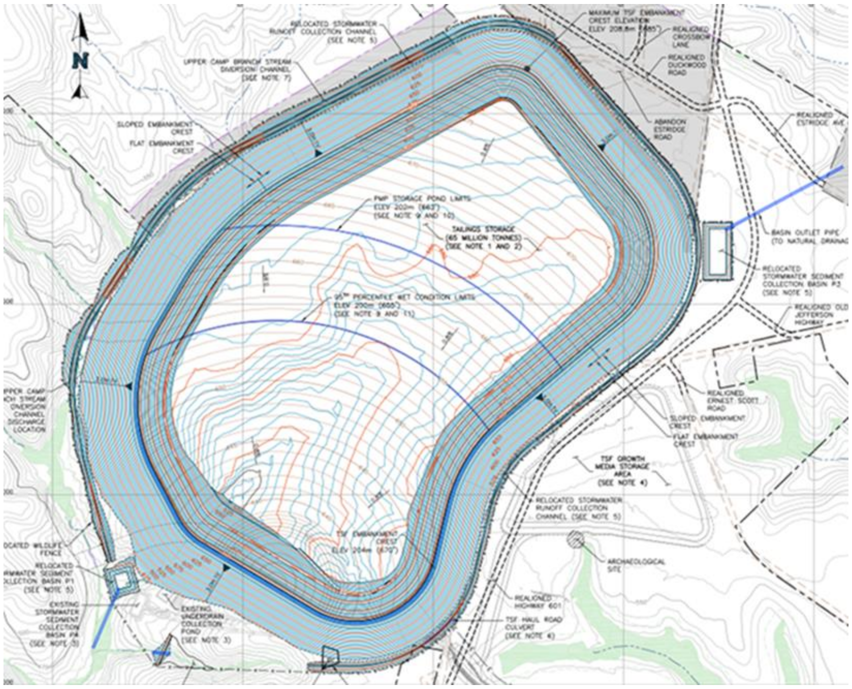


Figure A-63 Layout of the Tailings Storage Facility
Source: NewFields 2018.

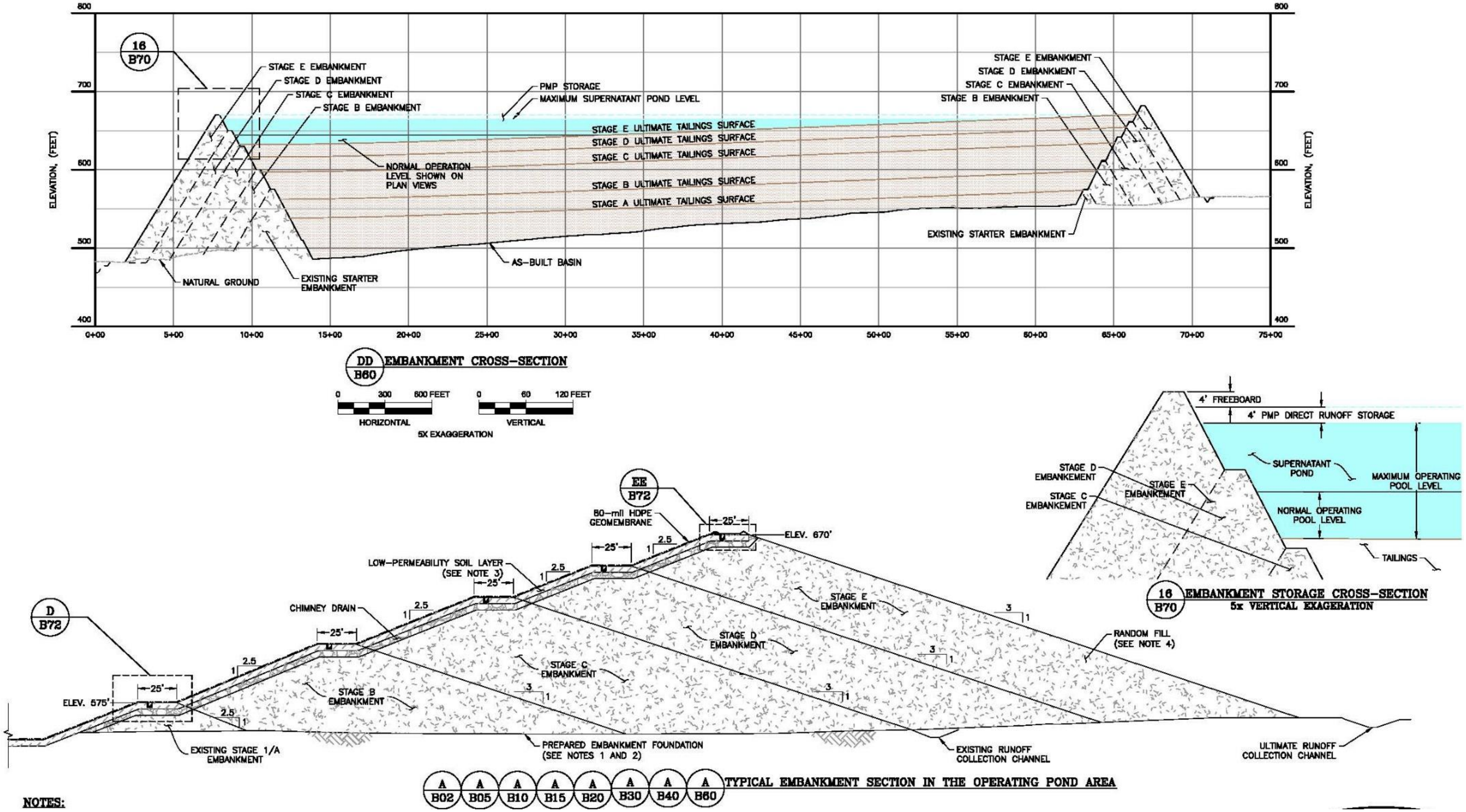


Figure A-64 Cross Section of the Tailings Storage Facility Embankment Showing the Stages of Construction

Source: NewFields 2018.

Figure A-65 Aerial View of TSF
Source: Haile 2018.

Table A-17 Stages and Acreages of the Tailings Storage Facility

Phase	Planned Construction (complete by date)	Maximum Tailings Surface Area (acres)	Lined Surface Area (acres)	Basin and Embankment Footprint (acres)	Volume of Material for Each Lift (M yd^3)
Stage A	Completed	198	320	353	In-place
Stage B	2020	219	326	377	3.478
Stage C	2023	303	337	417	7.526
Stage D	2028	338	356	498	8.225
Stage E	2031	350	356	537	10.748

Source: NewFields 2018.

9.3. Design Components

The Duckwood TSF includes the following primary design components:

- **Zero Discharge** – the TSF is designed as a zero-discharge facility. In addition to the anticipated tailings storage requirements, the facility is designed to contain the PMP storm event and an additional 4 feet of freeboard during operation. Water drained from the tailings slurry at the TSF is the primary source of water used for the Mill, in a closed-loop process. If TSF water volumes are high (e.g., after a storm event), all stormwater is used at the Mill, reducing the need for using fresh make-up water at the Mill. All water is used in the closed-loop cycle and is not released into the environment.

- **Zoned Earth Fill Embankment** – The TSF is designed as a zoned, well-compacted earth fill material embankment. The TSF is constructed in stages during the life of the mine. The zoned features of the TSF embankment consist of distinct parts or zones of dissimilar soil or rock materials. Majority of the TSF is built using a shell zone of random fill material on the exterior, downstream side of the embankment using Coastal Plains Sand (CPS), saprolite or bedrock. Interior, upstream to the random fill is the chimney drain zone. The chimney drain is constructed of CPS and is designed to control any unlikely seepage from the Tailings Reclaim Pond and preserve the integrity of the downstream random fill zone. Upstream of the chimney drain is the compacted low-permeability soil layer zone.

  This low-permeability soil layer is constructed of saprolite from the mine overburden. The purpose of the low-permeability soil layer is:

  1. To act as a suitable layer for placement of the 60-mil HDPE geomembrane under-liner; and
  2. To act as a secondary liner to control any seepage through defects in the HDPE geomembrane liner and prevent the tailings from migration into the chimney drain.

  Chimney drains and low-permeability soil layer zones consist of selected, fine-grained materials designed to meet the geotechnical specifications for particle size and other engineering parameters, such as the gradation of particle size and plasticity to ensure against segregation and clogging, and basic filter and permeability criteria for each of the two zone materials.

- **Toe Drain –** As part of the ultimate TSF embankment construction, a toe drain is constructed along the perimeter of the toe of the TSF footprint. The toe drain construction would consist of a ditch-type flow conduit of perforated pipe wrapped in a non-woven geotextile, backfilled with drainage aggregate, and covered with fill. The purpose of the toe drain is to ensure that (1) any seepage from precipitation within the exterior embankment slope is controlled; and (2) erosion of the embankment toe is reduced and routed safely into the sediment control channels and basins at locations around the TSF perimeter.

- **Basin –** The TSF basin is fully lined with a 60-mil HDPE geomembrane underlain by 12 inches of a compacted low-permeability soil liner. Above the geomembrane liner, a network of perforated pipe and 18 inches of a drainage layer material is built to collect and route underdrainage from the tailings to a central collection point. The basin is graded to promote gravity flow to the downstream TSF Underdrain Collection Pond.

- **TSF Underdrain Collection Pond –** An HDPE geomembrane double-lined pond with a leak collection and recovery system (LCRS) is constructed downstream of the embankment toe, at the southwest corner of the facility, for collection of underdrainage flows from the basin through a concrete-encased series of outlet pipes. See Figure A-66 for a cross-section view of the TSF ground water and seepage collection system, which feeds the TSF Underdrain Collection Pond. The TSF Underdrain Collection Pond is pumped back into the TSF Reclaim Pond for return to the Mill for reuse as process water.

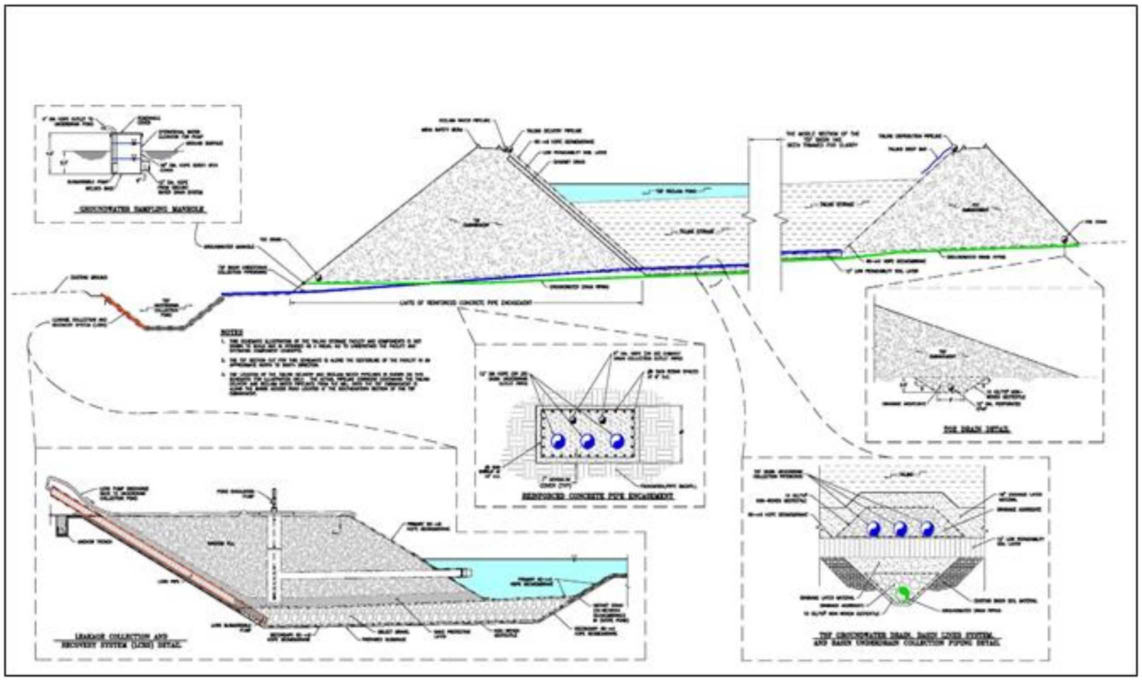


Figure A-66 Cross Section of TSF Groundwater Drain and Seepage Collection System
Source: Haile 2013a.

- **Leakage Collection and Recovery Systems –** A LCRS is constructed as part of the TSF Underdrain Collection Pond. The purpose of the LCRS is to provide a method to collect seepage in the unlikely event that leakage should develop within the pond through the primary HDPE liner. Seepage is collected and removed from a low point located above the secondary HDPE liner. The LCRS design is shown in Figure A-67.

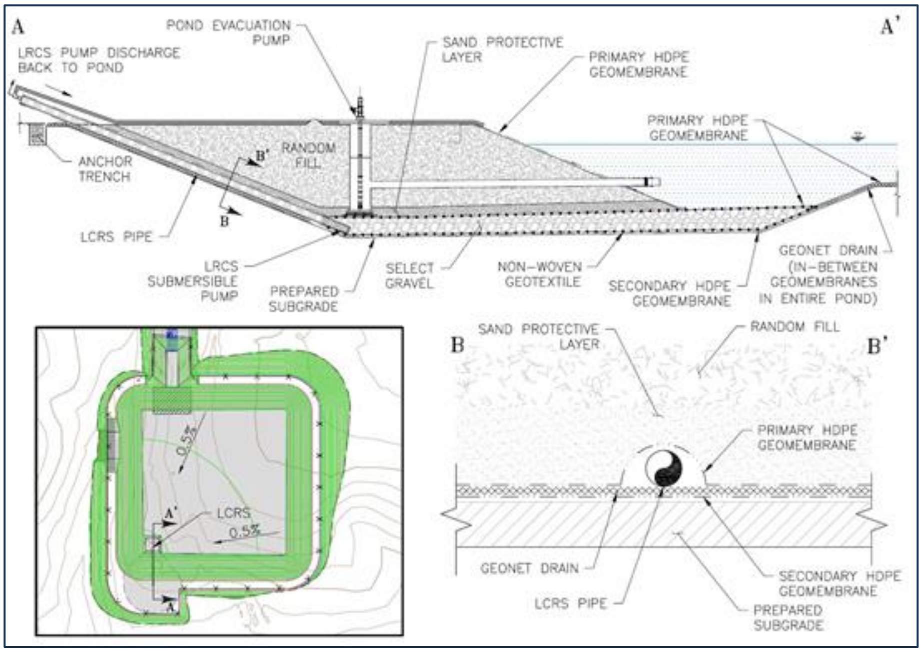


Figure A-67 Typical Leak Collection and Recovery System Design
Source: Haile 2013

- **Pipeline Corridor and Tailing Distribution System –** Benches along the interior embankment are constructed for placement of the tailings slurry distribution pipeline. Rotational distribution of tailings slurry is from the perimeter of the upper northwest, west, and upper northeast reaches of the facility through a series of drop bars. The reclaim and tailings slurry delivery pipe is included in the haul road corridor.

Tailings from the Mill is pumped in a pipeline system that minimizes the potential of an accidental spill to the distribution system along the interior crest perimeter of the TSF embankment. The tailings distribution system is operated as a rotational tailings distribution system to control the reclaim water pond position and to promote tailings beach development within the TSF.

Banks of tailings drop bars (distribution pipes or spigots) are operated rotationally using mainline valves to control a specific group of drop bars (8 to 10) spaced around the TSF perimeter. The individual drop bars are connected to the main distribution pipeline with holes drilled in the top of each drop bar. When a bank of drop bars is actuated to direct flow to a specific location within the TSF, flow exits the drop bars—reducing flow energy and creating laminar flow along the perimeter of the TSF. Deposition in this manner results in a “beach” development by deposition of the coarser fraction of the tailings sand adjacent to the TSF embankment. The finer fraction of tailings moves away from the embankment along with the process water slurry.

The tailings beach development serves as a topographic feature within the TSF that would confine the TSF Reclaim Pond within the TSF to the southern end of facility. Process water from the TSF Reclaim Pond is reclaimed and pumped back to the Mill for reuse in the mill process. (See Figure A-68 TSF Reclaim Pond and Pumping Facility.) Process water that drains through the tailings is collected by the TSF underdrain collection system, which feeds the TSF Underdrain Collection Pond, and is pumped back into the TSF Reclaim Pond and eventually back to the Mill for reuse as process water. The reclaim pipeline is in a lined HDPE trench that drains toward the Process Events Pond (from the 601 Overpass toward the Process Mill Plant) or toward the TSF (from 601 Overpass to the TSF).

Figure A-68 TSF Reclaim Pond and Pumping Facility
Source: Haile 2018

The process water reclaim system within the TSF can reclaim water for reuse at the Mill. As a closed-loop system, process water would circulate only between the TSF and the Mill (zero discharge) and is separate from other water management systems.

The TSF is open to the air and, except for water that evaporates, any precipitation that falls on the facility is part of the closed-loop process water system. The TSF Underdrain Collection Pond is sized to contain the calculated underdrain flow for a 24-hour period in the event of a pump or power outage, plus precipitation from a 100-year, 24-hour storm event falling directly on the pond surface, and an additional 2 ft. of freeboard. Given the size of the TSF Underdrain Collection Pond, 2 ft. of freeboard provides an additional factor of safety. The TSF Underdrain Collection Pond is further protected against overflow because the valve can be closed, or it can be pumped directly into the TSF Reclaim Pond, which can contain the PMP event in addition to 4 ft. of freeboard at minimum.

An Emergency Action Plan (EAP) has been developed to reduce the potential for loss of life and injury and to minimize property damage during an unusual or emergency event at the TSF. Locations and contact information for any residents or structures that may be flooded if the TSF should breach are noted. Names and numbers for federal, state, and local emergency contacts are provided in the notification list. The EAP provides an overview for roles and responsibilities, including methods to detect and evaluate the emergency condition, methods to assess the situation and determine the emergency level for notification, and procedures for communication and expected actions.

An Operations, Maintenance, and Inspection Manual has been prepared for the TSF. This manual is intended to serve as an operating guide for initial, normal, and emergency operating procedures for the TSF. The main components of the manual cover the following topics:

- Fluid management for the TSF Reclaim and TSF Underdrain Collection Pond;
- Facility instrumentation and monitoring for geotechnical and groundwater concerns;
- Operation of the tailings management system;
- Emergency operating procedures (power outage, extreme rainfall, excessive pond volumes);
- Component failure (leakage through liners, blockage of pipe works, pump and pipeline failures); and
- Inspection and maintenance (daily, weekly, quarterly, and annually).

10. SURFACE AND GROUNDWATER WATER MANAGEMENT

Water is managed in the Project area based on its classification into one of three designations: non-contact water, contact water, and process water. Non-contact water is groundwater captured via depressurization well pumping, any flow withheld from Haile Gold Mine Creek by the FWSD, stormwater runoff that does not come in contact with mined PAG material, and effluent from the CWTP. Contact water is water that has come in contact with PAG material in the mine pits, underground mine, ore stockpiles, or PAG Cells. Process water is water used in the Mill, which circulates in a closed-loop system within the Mill and the TSF and has come in contact with sodium cyanide. These three classifications of water are each described in the sections below. Figure A-69 illustrates the management and use of non-contact (green), contact (purple), and process water (orange).

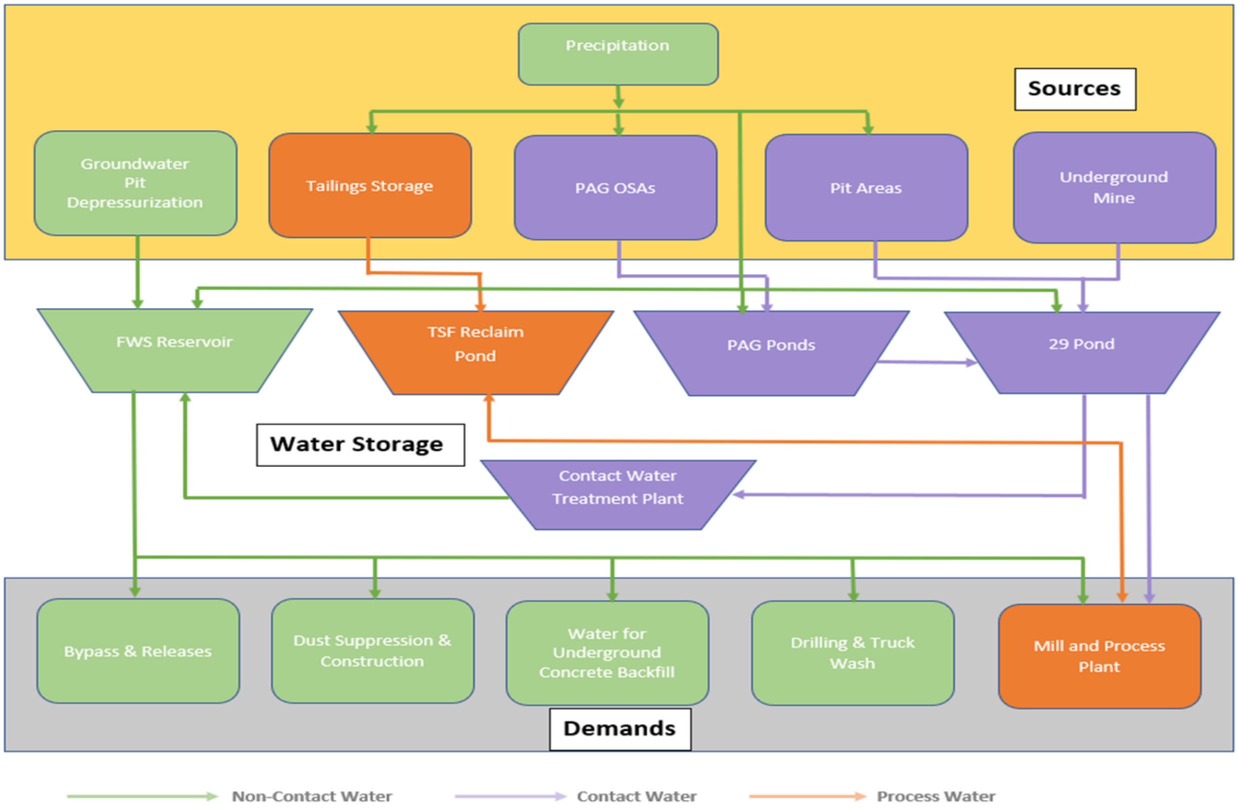


Figure A-69 Management of Non-Contact, Contact, and Process Water
Source: ERC 2018.

10.1. Non-Contact Water

Non-contact water does not require treatment at the CWTP; it includes (1) precipitation and runoff from the property and Project facilities that do not contain PAG materials; (2), groundwater depressurization well water; (3) retained stream flow from Haile Gold Mine Creek; and (4) effluent from the CWTP.

Non-contact stormwater is subject to the SCDHEC, Bureau of Water, Stormwater Permitting Section's stormwater management practices and the permit conditions in Haile's Industrial General Permit.

Non-contact water may be used to meet non-contact water demands in the Mill, dust suppression and construction water demands, with any excess discharged to Haile Gold Mine Creek.

10.1.1. Stormwater Management

Management of non-contact stormwater involves routing runoff from undisturbed areas around mine facilities, collection of stormwater runoff from non-PAG mine facilities, sediment control, and release of non-contact waters to the stream system. Figure A-70 shows a typical Sediment Pond with a Faircloth Skimmer.

Figure A-70 Sediment Pond with Faircloth Skimmer
Source: Haile 2018

The first role of the non-contract stormwater system is to keep runoff from undisturbed areas from coming into contact with mine facilities and operations. Diversion facilities are designed to capture runoff from undisturbed areas before it reaches disturbed ground. For major drainages, such as Haile Gold Mine Creek and the North Fork of Haile Gold Mine Creek, stormwater management includes collecting flows and routing them past active mining areas in diversion pipes and releasing them into Lower Haile Gold Mine Creek.

Runoff from undisturbed areas that would otherwise come into contact with mine-related facilities (including such areas as PAG Cells, the TSF, OSAs, and roads) is captured in diversion channels and routed past the disturbed area without commingling runoff from undisturbed and disturbed areas. This water is released into natural drainages.

Runoff originating from non-PAG mine facilities is also classified as non-contact stormwater but is managed in a different manner than runoff from undisturbed areas. Given that ground disturbance occurs at all non-PAG facilities, it is possible that sediment loading in runoff from these areas could be elevated. Thus, Haile implements measures to minimize the amount of erosion from all disturbed areas, which reduces the sediment loading carried in runoff from non-PAG mine facilities. Temporary erosion control measures are implemented to minimize erosion and soil loss associated with initial ground disturbance. Methods of managing sediment and erosion control during construction follow guidelines presented in the Stormwater Management Handbook (SCDHEC 2005) and comply with Haile’s Industrial General Permit.

General runoff collection practices include minimization of soil loss through direct stabilization of disturbed areas, including surface roughening, seeding, mulching, and erosion control blankets. Runoff collection measures are implemented to limit erosion and movement of soils that are not contained in place. Concurrent reclamation practices are implemented to minimize the duration of impacts and stabilize disturbed areas as quickly as possible.

Runoff and sediment that originates from non-PAG facilities is captured in collection channels, including the outer perimeter of the TSF, the non-PAG OSAs, growth media storage areas, roads, and non-process areas of the Mill Site. Collection channels route runoff from these areas to individual sediment collection basins. Each sediment basin is sized for particle removal efficiencies based on the SCDHEC, Bureau of

Water standards and Haile's Industrial General Permit. Sediment ponds effectively limit peak runoff rates and provide sediment removal, positively affecting both water quantity and quality from the non-PAG facilities. All sediment control systems, including collection channels and spillways, have the capacity to convey the 10-year, 24-hour storm event.

10.1.2. Depressurization Water Management

The proposed mine pits would extend below the water table, requiring extraction of groundwater in and around the open pit to remove the hydraulic pressure on the pit walls, stabilize the pit walls, and promote safe and efficient mining practices during mining operations. This process is referred to as "depressurization" and involves drawing down the localized groundwater table by pumping from wells located near each pit before and during mining operations.

The depressurization systems have been planned to intercept groundwater from the upper weathered and fractured bedrock units where the majority of groundwater occurs and is transmitted. Figure A-71 is a generalized cross section of a mine pit with depressurization and water management features such as depressurization wells, horizontal drains, and dewatering pumps. The objective is to draw down the water table to below the operating depth of the pit, as illustrated by the dashed blue line in the figure.

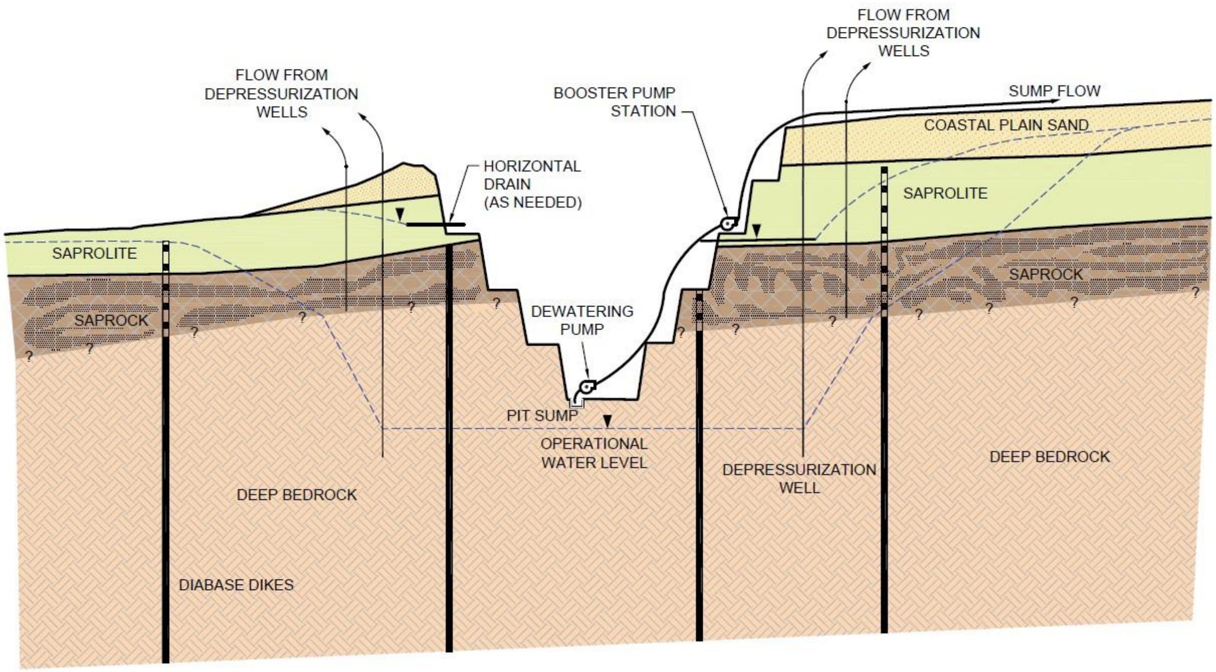


Figure A-71 Mining Pit Cross Section Showing Groundwater Depressurization
Source: Haile 2018

Depressurization of the pits is a significant, consistent source of non-contact water throughout the Project. The range of potential pumping rates from depressurization wells has been predicted using a numerical groundwater model (NewFields 2018). This water will be used for process water at the Mill, supply water for the fire hydrant network, and for dust suppression.

The number of depressurization wells may vary depending on the hydrogeology of each pit's area. Depressurization wells installed adjacent to mine pits will also aid in the depressurization of underground workings. The wells will discharge into Fresh Water Storage Tank. The 250,000-gallon tank has the capability to pump water to the Mill, to the fire-water pump, or may be used for dust control in mine water truck(s). Any depressurization water not used on site would remain in the tank until the tank is full. When the depressurization tank is full, overflow is discharged into the upper north fork of Haile Gold Mine Creek via a pipe to a designed outfall.

Depressurization pumping from wells would continue through mining operations. In some cases, depressurization would continue after mining has ended to support backfilling operations, mining in nearby pits, or support for concurrent reclamation activities.

10.1.3. Surface Water Diversion

For temporary surface water control, diversion ditches are installed to enable flow around active open pit mining activities. In 2016, a HDPE-lined diversion channel was constructed to divert the Haile Gold Mine Creek flow below the historic Ledbetter Reservoir around the Mill Zone Pit (See Figure A-72).

Figure A-72 Mill Zone Diversion Ditch
Source: Haile 2018.

For permanent water control, the FWSD is a retention structure is expected to be constructed in 2019 within the footprints designated for the previously permitted detention structure and the previously permitted "Pit-Related Activities" area south of there. Initially, this will be retention structure placed in the upper reaches of Haile Gold Mine Creek that can capture of some stream flow (to a 470' amsl operating level and then divert the remaining Haile Gold Mine Creek streamflow) once related permitting is completed. There will be a haul road over the top of the FWSD that will be a crossing between West PAG and East PAG. The FWSD will have the capacity to detain up to 100-year precipitation event and will allow for controlled flow into the diversion pipes. Stormwater exceeding the design event would flow through the emergency spillway into Ledbetter Pit. Figure A-73 shows the plan view of the Haile Gold Mine Creek FWSA.

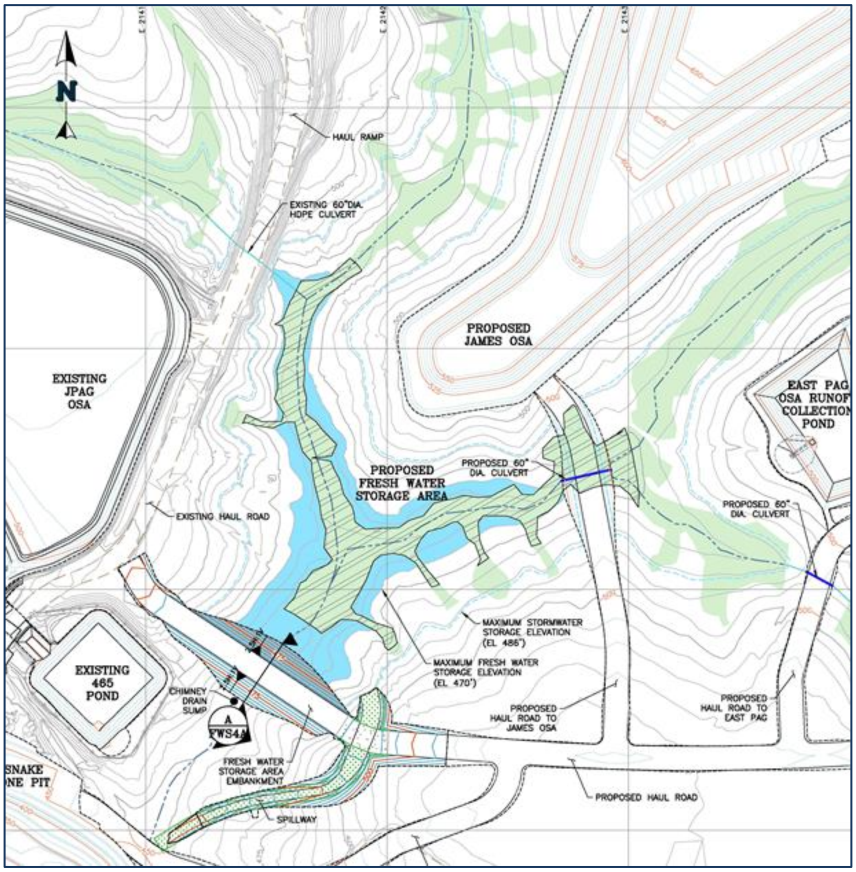


Figure A-73 Haile Gold Mine Creek Fresh Water Storage Area
Source: Haile 2018.

During filling of the new Ledbetter Reservoir post-mining, the FWSD will be modified to function as a low-head dam that would continue to divert flow into the diversion pipes consistent with the SCDHEC, Bureau of Water, Surface Water Withdrawal Permitting Section standards for safe yield. The intent of the low-head dam is to maintain, at a minimum, regulated minimum instream flows while allowing the remaining stream flows to flow into the Ledbetter Pit to expedite pit filling.

Upon filling of new Ledbetter Reservoir to equilibrium (approximately 95 percent), the low-head dam would be removed, and all stream flows would flow into the new pit lake. Flows would exit the pit lake through an engineered outlet structure into reestablished stream channels constructed over the backfilled pits, into the Lower Haile Gold Mine Creek, and into the Little Lynches River.

10.2. Contact Water

10.2.1. Sources of Contact Water

Contact water is water that comes into contact with PAG material that originates from the following sources:

- Dewatering of the surface water within pits mined into PAG material, including seepage, stormwater runoff, and pit wall runoff;
- Depressurization water pumped from the Horseshoe underground mine;
- Runoff and seepage from PAG Cells; and

- Runoff and seepage from ore stockpiles, including Low-grade stockpiles and Run-of Mine ore stockpile at the Mill crusher.

Depressurization of the Horseshoe Underground Mine to facilitate safe and efficient mining will be performed by pumping from within the underground mine and will be aided by pumping from adjacent depressurization wells (Section 10.1.2). Water that flows into the underground workings through PAG materials will be contact water, which will be used for make-up water in the Mill or treated as described in Section 10.2.2. The pumping rates of contact water from the underground mine has been predicted using a numerical groundwater model (NewFields 2018).

Contact water is collected, stored in HDPE-lined ponds, and either used in the Mill or treated at the on-site CWTP and then either stored in the FWSA or discharged as a point source under an NPDES permit. Figure A-74 shows the 003 Outfall that is located downstream of the contact water treatment plant. This outfall type is appropriate for use where flow rates and pressures are low, dispersion of flow is not required, and riprap can be extended to the receiving water without additional stream or wetland impacts. This outfall will have to be relocated prior to construction of the West PAG facility and will need to be redesigned to accommodate potentially higher flow rates and pressures.

Figure A-74 NPDES 003 Outfall for Water Treatment Discharge
Source: Haile 2018.

10.2.2. Treatment and Management of Contact Water

The existing CWTP will be expanded to treat up to 2,000 gpm from the current capacity of 1,200 gpm. The new facility will be a mirror image of the current facility and will be modified to handle variable low flows efficiently. The contact water treatment process is a two-stage clarification system to address the estimated influent metals loading. Redundancy has been provided for critical process areas and unit process equipment to ensure compliance with the NPDES permit and to better handle the variable water quality and loading, as water would have varying levels of contaminants depending on the source.

The CWTP is currently a 7,800-square-foot self-contained facility within the Mill Site (See Figure A-75). This will be expanded to a 15,000-square-foot self-contained facility in approximately 2024. Contact water is collected in the 29 Pond (See Figure A-76), the primary contact water storage pond servicing the CWTP, which is a make-up source for the Mill or can be sent to the CWTP plant. The current treatment process consists of two reaction tanks, two clarifiers, and a multi-media filtration process that is designed to precipitate the metal hydroxides into flocculated solids. These solids settle in containment compartments, are pumped to the cyanide recovery thickener, and ultimately are disposed of in the TSF. The clarified water is reused in the Mill process or discharged from the CWTP.

Figure A-75 Water Treatment Plant with 19 Pond (Background)
Source: Haile 2018.

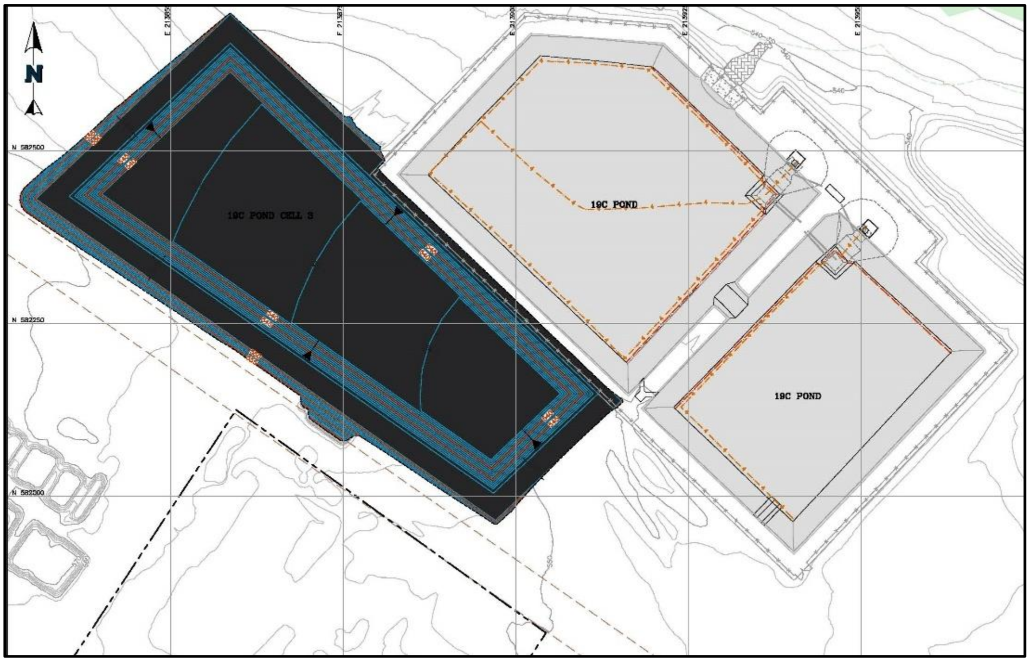


Figure A-76 29 Pond – Converted from 19 Pond
Source: Haile 2018.

The CWTP and associated 29 Pond were sized based on two requirements. First, the facilities were sized to ensure that the combined capacity of the contact water treatment plant and the 29 Pond were sufficient to meet the design criteria that the 465 Pond, 470 Pond, and the 500 Pond, which accept runoff and seepage from PAG Cells, can be emptied within a period of 72 hours after a 100-year storm event. Second, the adequacy of the CWTP capacity and 29 Pond storage volume was evaluated based on the site-wide water balance. Detailed water balance modeling indicates that 29 million gallons of storage capacity is adequate for managing contact water in predicted consecutive wet months.

- **465 Pond (east side of the West PAG Cell) –** The 465 Collection Pond (See Figure A-77) is double lined with an LCRS and currently collects internal seepage from within the JPAG PAG Cell and any runoff from the PAG Cell slopes. Ultimately, JPAG will be integrated into West PAG and 465 Pond will collect seepage from the east side of the West PAG Cell. The pond has a capacity of 2.61 million cubic feet (19.5 million gallons), with an additional 3 feet of freeboard and hold runoff from a 100-year, 24-hour storm volume plus 10 percent excess storage capacity. The pond is designed so that the 100-year runoff volume can be emptied in 72 hours, with water pumped to the 29 Pond for treatment and discharge or use as make-up water at the Mill.

Figure A-77 465 Pond

Source: Haile 2018.

- **470 Pond** (southwest side of West PAG Cell)– The 470 Pond is double lined with an LCRS and will collect seepage and runoff from the southwest side of West PAG Cell. The pond has a capacity of 6.7 million cubic feet (50.0 million gallons), with an additional 3 feet of freeboard and hold runoff from the entire 100-year, 24-hour storm volume plus 10 percent excess storage capacity. The pond is designed so that the 100-year runoff volume can be emptied in 72 hours and is pumped to 29 Pond for treatment and discharge or use as make-up water at the Mill.

- **500 Pond** (East PAG) – The 500 Collection Pond is double lined with an LCRS and will collect seepage and runoff from the East PAG Cell. The pond has a capacity of 6.7 million cubic feet (50 million gallons), with an additional 3 feet of freeboard and hold runoff from the entire 100-year, 24-hour storm volume plus 10 percent excess storage capacity. The pond is designed so that the 100-year runoff volume can be emptied in 72 hours and is pumped to 29 Pond for treatment and discharge or use as make-up water at the Mill.

- **29 Pond** – The 29 Pond has expanded from the original 19 Pond to accommodate the additional water that requires treatment. It is double lined with an LCRS; it is designed to store approximately 3.88 million cubic feet (29 million gallons) of water, with an additional 2 feet of freeboard. The 29 Pond is designed to be used as a buffer between the various sources of contact water and the CWTP. The 29 Pond is sized to ensure that the combined volume of 465, 470, and 500 Ponds can be evacuated of runoff from the 100-year event within 72 hours, in coordination with running the CWTP. The water reporting to the 29 Pond can be treated in the CWTP or can be sent to the Mill for use as make-up water.

11. SITE RECLAMATION

Site reclamation would occur both during mining ("concurrent reclamation") and after mining ceases ("post-mining reclamation"). A revised site reclamation plan will be submitted for approval by the SCDHEC, Bureau of Land and Waste Management, Division of Mining and Solid Waste Management, Mining and Reclamation Program as part of the mining permit application. In concert with the Mining and Reclamation Plan, Haile will develop a Monitoring and Management Plan to continually assess the effectiveness of the reclamation and closure actions in order to detect any failures of closure structures and to initiate any required response actions to maintain environmental standards.

During operations, certain reclamation activities are conducted concurrent with operations. Concurrent reclamation is performed when a portion of mining activity is complete and final reclamation can be safely performed. Final site-wide reclamation would commence upon final cessation of mining and processing operations. Final reclamation is completed as soon as practicable after mining activities cease at a given mine facility.

The objective of the site reclamation plan is to provide stable slopes, manage discharge water quality, and establish vegetation over all portions of the mine site except those areas designated as (1) post-mining pit lakes; (2) pit high walls adjacent to the post-mining pit lakes; and (3) any roads and access areas necessary for post-mining activities and land uses. Visual observations of concurrent reclamation are conducted at various times throughout the mine life to establish and refine appropriate vegetation species and seeding rates, soil and amendment requirements, and overall vegetation procedures to ensure sustainable post-mining vegetation for each facility type.

Reclamation falls into seven types:

1. Backfilled pits;
2. Pit lakes;
3. Red/Yellow Class OSAs (PAG Cells);
4. Green Class OSAs;
5. Stream restoration (portions of North Fork and Haile Gold Mine Creek that were diverted prior to and during mining);
6. TSF; and
7. Mill Site, roads, pipelines, and other ancillary facilities (including underground utilities) not needed to support post-closure activities and land uses.

11.1. Backfilled Pits

Mill Zone, Snake, Haile, and Red Hill are backfilled with overburden (See Figure A-78) to an elevation below original contour. After these pits reach planned depths, mining in them will cease and the pits will be backfilled as part of overburden placement taken from mining of other pits during operations. Overburden classified as Yellow and Green Class will be placed as pit backfill. Special precautions are taken when placing Yellow Class overburden in the pits. Yellow Class overburden is placed in the pits up to a level to ensure that this material is permanently inundated with water following the cessation of depressurization pumping.

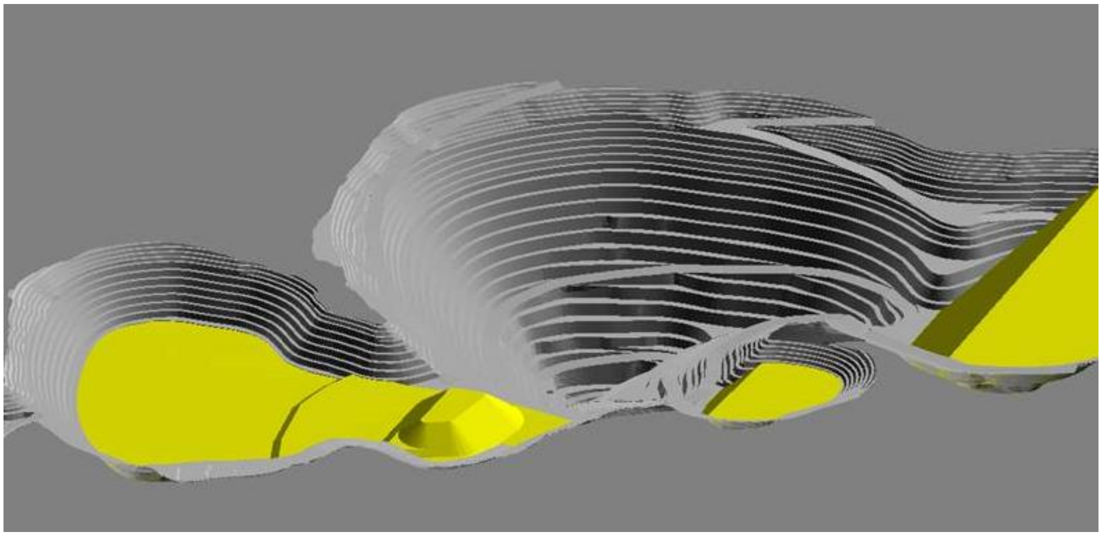


Figure A-78 Backfilled areas in Mill Zone, Haile, Red Hill and Snake Pits
Source: Haile 2018

Inundation with water would limit the ability of the overburden material to generate acid rock drainage. Lime, or other suitable pH buffering material (referred to as lime or lime amendment), will be placed concurrently with the Yellow Class backfill. The mixed Yellow Class material is backfilled in compacted layers to limit oxygen transport into the backfilled pit. The addition of lime is performed as part of this concurrent reclamation during normal mining operations. Green Class overburden may be placed in the pits along with or in lieu of Yellow Class overburden but is the only class of overburden that may be placed above the long-term inundation elevation.

11.2. Pit Lakes

Groundwater and surface water will accumulate in the co-mingled mine pits to re-create Ledbetter Reservoir. Champion 1 and 2 Pits are also comingled to create Champion and Champion Southwest Reservoirs. Figure A-79 is a cross-sectional view of Ledbetter Reservoir above the amended Yellow backfill in Mill Zone Pit.

Groundwater modeling results predict that Ledbetter Reservoir reaches a stable stage of 403 ft after approximately 57 years. The larger Champion Reservoir stabilizes at 442 ft after about 54 years, and the smaller Champion Southwest Reservoir reaches a stable level of 424.5 ft after about 68 years. Model predictions indicate that Ledbetter Reservoir and the large Champion Lake will discharge to surface water at that time – Ledbetter discharges a substantial flow into Lower Haile Gold Mine Creek and Champion discharges a nominal amount to surface runoff to an un-named tributary – but that Champion Southwest Reservoir will stabilize below the spill point and is not expected to discharge (NewFields, 2018).

In addition, prior to the end of active mining, another pit lake study will be performed to precisely predict final water levels and water quality of the pit lakes to further instruct their design plans and management. During reclamation, a security fence and/or safety berm will be established around the remaining pit high walls. All surface water inlets or outlets to the pit lakes will be improved to limit erosion and control flow into and out of the pit lakes.

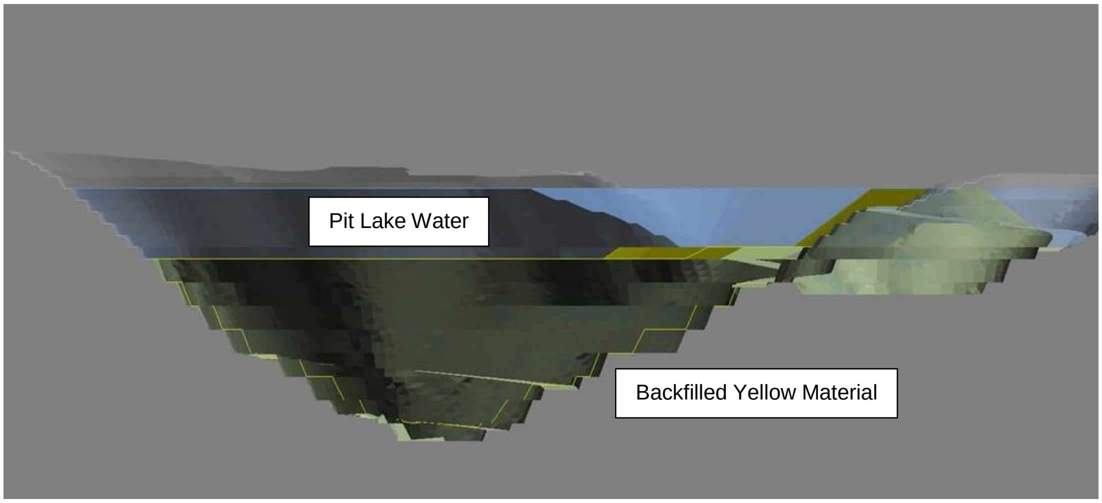


Figure A-79 Cross-section of Ledbetter Reservoir covering Mill Zone Pit
Source: Haile 2018

The FWSD and pipes would remain in place above the reconstructed Lower Haile Gold Mine Creek channel. However, the Haile Gold Mine Creek flow from upstream of Ledbetter Pit is split between a diversion to allow some flow into Ledbetter Pit Lake and some flow through diversion pipes to the reconstructed stream channel. Haile would divert flow into the Ledbetter Reservoir consistent with standards for safe yield from Haile Gold Mine Creek. During Ledbetter Reservoir filling, the FWSD is modified to a low head dam that continues to divert flow into the diversion pipes consistent with the SCDHEC, Bureau of Water, Surface Water Withdrawal Permitting Section standards for safe yield but also allows any flows exceeding State standards for minimum instream flow to be directed over the low head dam to fill Ledbetter Pit Lake. This would reduce the time needed to achieve stable pit lake levels and inundation of the exposed pit wall.

11.3. PAG Cells - Red and Yellow Class Overburden Storage Areas

During reclamation, a minimum 20 ft. thick layer of saprolite is placed on the entire outer slope of the PAG cells; the saprolite layer is covered by a 60-mil HDPE liner and 2 feet of growth media. See Figure A-80 for a cross section of PAG Cells after reclamation. The final lift is covered with a 5-foot-thick layer of saprolite. The final slopes are constructed with alternating benches and slopes with an overall slope of 3:1 to provide surface water controls to limit erosion and manage stormwater. By designing benches on the outside of the slopes, the length of stormwater flows down the side of the facility is shortened and erosion is minimized. The benches also provide stormwater channels for managing the flows and directing the water off the facility. Finally, the benches are spaced so that equipment can reach areas from the bench above and the bench below, should repairs be needed on the slopes. The side slopes that have been graded are then seeded for stabilization in accordance with the Reclamation Plan approved by the SCDHEC, Division of Mining.

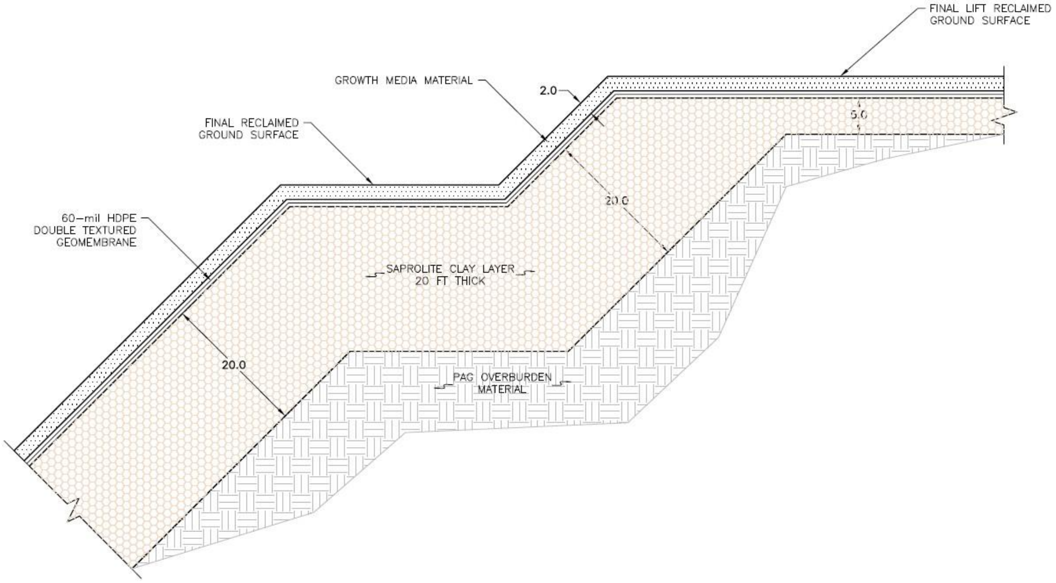


Figure A-80 Cross Section of Reclaimed PAG Cell
Source: Haile 2013a.

As noted, final reclamation of PAG Cells includes a 60-mil HDPE geosynthetic liner cover and a minimum of 2 feet of growth media. The growth media is vegetated. Seepage resulting from years of the PAG being exposed to precipitation and the precipitation infiltrating the PAG material would continue to drain and collect in the underdrain collection system that sits on the HDPE liner under each PAG facility. This PAG seepage would continue to be collected in the PAG Collection Ponds, sent to the 29 Pond, and treated in the same manner as during the operating period. Because precipitation is prevented from infiltrating the overburden once the cap (both the saprolite layer and the HDPE liner) is in place, the seepage from the PAG overburden would decrease significantly in a short time.

Over time, seepage would be reduced where passive treatment systems can effectively treat lower flows. These passive treatment systems would treat the seepage using an anaerobic (no-oxygen) treatment cell filled with organic media containing beneficial bacteria, followed by an aerobic (with oxygen) polishing treatment cell and discharge to Haile Gold Mine Creek. Design, operations, and discharge of the passive systems are permitted through the SCDHEC, Bureau of Water, NPDES Permitting Division. The system is planned to be constructed in the lined PAG Collection Ponds. Due to the passive (no pumping) nature of the system, maintenance is expected to be minimal. The media in the cells may require replacement approximately every 25 years. Passive cell designs are approved by the SCDHEC's NPDES Permitting Division and Mining Division. Maintenance and monitoring of the passive systems is included in Haile's post-mining monitoring plan

11.4. Green Class Overburden Storage Areas

The four OSA's at the Haile Gold Mine designated to receive only Green Class overburden (601, Ramona, Hayworth / South, and James OSAs) will be reclaimed concurrently during mining as each reaches its designed capacity. Final grading of the OSAs will be alternating benches and slopes for an overall slope of 3:1. Surface water controls will be constructed to limit erosion. During reclamation, the Green Class overburden will be vegetated according to the vegetation plan contained in the Reclamation Plan.

11.5. Haile Gold Mine Creek

Flow from Haile Gold Mine Creek upstream of Ledbetter Pit is split to allow some flow into Ledbetter Reservoir and some flow through existing diversion pipes to the reconstructed stream channel. Flow from Haile Gold Mine Creek is diverted into the Ledbetter Reservoir only as authorized by the SCDHEC, Bureau of Water consistent with standards for safe yield. The Haile Gold Mine Creek Retention structure is modified or replaced with a low head dam that continues to divert flow into the diversion pipes but also allows any flows exceeding State standards for minimum instream flow to be directed over the low head dam to fill Ledbetter Reservoir. This would reduce the time needed to achieve stable pit lake levels and inundation of the exposed pit wall.

Once full, the entire flow of Haile Gold Mine Creek is redirected to run through Ledbetter Reservoir. The low head dam is removed, the area reclaimed, and that portion of Haile Gold Mine Creek restored shortly after the new Ledbetter Reservoir is filled.

11.6. Tailings Storage Facility

As the exterior slopes of the TSF achieve final configuration, they are vegetated. At the completion of mining and ore processing, the TSF would consist of an above-grade, lined impoundment, filled with tailings material and unused process water.

The TSF is reclaimed using a dry closure approach that focuses on isolating the tailings material and limiting the infiltration of water into the tailings. TSF process water would continue to drain down within the tailings fill material and any remaining water absorbed, evaporated, or removed via the underdrain collection system to the TSF Underdrain Collection Pond. From there, this TSF water is pumped to the modified CWTP to treat this type of water. Treatment and discharge of this new water source (other than contact water) would require a modified NPDES permit. Prior to cessation of ore processing, Haile would initiate permitting for this water source through the SCDHEC, Bureau of Water, NPDES Permitting Division. This active drain down and water treatment system would continue until the flows have reduced to a level where a passive system can be utilized for long-term water management.

In the final months of ore processing, the tailings are deposited in the TSF in a manner that promotes positive draining of the tailings pond. Specialized equipment designed for working in soft soils is used to achieve final grading contours. As the surface of the tailings is stabilized and shaped for stormwater management, a 60-mil HDPE geosynthetic liner is placed over the tailings in stages. A minimum of 2 feet of growth media is placed over the geosynthetic liner, and the entire area is vegetated using established procedures. This complete closure process may be achieved in sections beginning at the higher elevation (Duckwood Road side) and progressing downward to the TSF Reclaim Pond side (lower elevation) as the tailings material stabilizes sufficiently for safe equipment usage. Stabilization of the entire TSF and complete placement of cover will likely take approximately 5 to 10 years after final tailings deposition. During this time, stormwater runoff from the partially covered TSF basin is managed within the basin of the TSF and treated along with the drain-down water from the TSF Underdrain Collection Pond. Stormwater would not be allowed outside the TSF basin until the stormwater was completely isolated from the tailings surface.

Once the surface of the TSF has been successfully reclaimed, water could freely drain off the covered and reclaimed tailings surface without contacting the tailings. Surface water controls will be established at the spillway outlet location to prevent erosion of the embankment during periods of high flow. Drain down will continue to be collected in the TSF Underdrain Collection Pond and treated as specified in the new or modified NPDES permit. Once the cover is in place, drain down from the TSF would decrease significantly over time as the tailings approach ultimate consolidation within approximately 20 years. Once drain down has been reduced sufficiently, a passive treatment cell, using an anaerobic treatment, is constructed in the lined TSF Underdrain Collection Pond. This passive treatment cell would provide long-term management from the TSF with minimal maintenance requirements.

11.7. Mill Site, Roads, Power Lines, Pipelines, and Other Facilities

Other facilities at the mine—including the Mill Site, GMSAs, sediment and settling ponds, roads, power lines, pipelines, and surface water controls—that are not required for post-mining monitoring or maintenance and not needed for post-mining land use are demolished and salvaged, or removed, and the sites are regraded to promote drainage with growth media placed, if needed, to support vegetation. All disturbed areas are vegetated in accordance with the Reclamation Plan.

11.8. Maintenance and Monitoring

The Haile Gold Mine will require maintenance and monitoring after active reclamation work is completed. Haile will follow a Monitoring and Management Plan that describes the requirements for monitoring and management of various environmental resources. This includes monitoring surface water and groundwater, as well as stormwater runoff, from the reclaimed areas. The TSF will require monitoring during drain down in addition to monitoring for a period of at least 10 years following completion of drain down. Periodic maintenance of drainage and treatment systems also may be required during post-mining monitoring. Haile will monitor the site for decades after active mining ceases.

In addition to general site monitoring and maintenance, passive treatment cells will require replacement approximately every 25 years, or as necessary. Groundwater and surface water samples will be collected and analyzed. The passive treatment cells will require periodic maintenance until untreated drainage comes within permit standards. Monitoring and replacement of water treatment systems will be carried out in accordance with SCDHEC regulations.

12. FUTURE USES OF THE SITE

After reclamation, the site is suitable for various uses. Because of the HDPE liner in the reclamation design, woody growth is managed on the TSF and PAG Cells. The remaining property could be used for recreation, agriculture, or more intense land development (e.g., industrial, office or residential development) because utility infrastructure is available.

Appendix A Conversion Factors and Constants

Mass / Density
1 ton = 1.10231 tonnes
1 tonnes = 0.907185 tons
1 lb. = 0.453600 kg
1 kg = 2.204600 lb.
1 g = 0.035274 oz. (avoirdupois)
1 g = 0.032151 oz. (troy)
1 lb. = 1 4.58 oz. (troy)
1 kg/m^3 = 0.062428 $lb./ft^3$
1 $lb./ft^3$ = 16.018000 kg/m^3
1 g / tonnes = 0.0291667 oz. (troy) / ton

Length
1 cm = 0.3937 in.
1 in. = 2.5400 cm
1 m = 3.2808 ft.
1 ft. = 0.3048 m

Area
1 ha = 2.471050 acre
1 acre = 0.404686 ha

Velocity
1 km/h = 0.62137 mile/h
1 mile/h = 1.60930 km/h
1 m3 / sec = 35.3147 ft3 / sec (air)

Volume / Flow
1 cm3 = 0.061024 in.3
1 in.3 = 16.387000 cm3
1 m3 = 35.314700 ft3
1 ft3 = 0.028317 m3
1 L = 0.035300 ft3
1 gal = 0.003785 m3 (water)
1 gal = 0.133680 ft3 (water)
1 gal = 0.832680 IMPgal
1 gal / min = 0.227125 m3/hr

Power
1 W = 3.4130 Btu/h
1 Btu/h = 2.9300 W
1 kW = 1.3410 hp
1 hp = 2545.0000 Btu/h
1 hp = 550.0000 ft·lbf/s
1 hp = 0.7457 kW

Pressure
1 Pa = 0.000145 lbf/in.2
1 lbf/in.2 = 6,894.757000 Pa
1 bar = 100,000 Pa
1 lbf/in.2 = 144 lbf/ft2
1 atm = 1.013250 bar
1 atm = 14.696000 lbf/in.2

Energy
1 J = 0.737560 ft·lbf
1 ft·lbf = 1.355820 J
1 kJ = 0.947800 Btu
1 Btu = 1.055100 kJ
1 kJ/kg = 0.429920 Btu/lb
1 Btu/lb = 2.326000 kJ/kg
1 J = 0.238846 cal
1 kcal = 4.186800 kJ

Force
1 N = 0.22481 lbf
1 lbf = 4.44820 N
1 lbf = 32.17400 lb·ft/s2

Specific Heat
1 kJ/kg·K = 0.238846 Btu/lb·°R
1 Btu/lb°R = 0.293 kJ/kg·K

Appendix B Haile Gold Mine Timeline (*Recent)*

December 3, 2010	Environmental Assessment Initiated for Haile Gold Mine Project
February 10, 2011	Haile Gold Mine NI 43-101 Technical Feasibility Study
October 27, 2014	ACOE Issues 404 Permit
November 6, 2014	DHEC Issues Modified Mine Permit I-000601
March 30, 2015	HGM Groundbreaking with first shovel in the dirt
October 3, 2015	Romarco Minerals and OceanaGold Joint Venture Announced
November 2, 2015	Construction of Process Plant, JPAG and 465 Pond Initiated
January 19, 2017	First Gold Pour – Commissioning Activities Initiated
June 23, 2017	HGM Open House and Ribbon Cutting
August 10, 2017	Updated NI 43-101 Technical Study for Optimized Operations
October 4, 2017	HGM declares Commercial Operation

Appendix C Glossary

A

Abutment	The weight of the rocks above a narrow roadway is transferred to the sides, which act as abutments of the arch of strata spanning the roadway; and the weight of the rocks over a longwall face is transferred to the front abutment.
Acid mine water	Mine water that contains free sulfuric acid, mainly due to the weathering of iron pyrites.
Active workings	Any place in a mine where miners are normally required to work or travel and which are ventilated and inspected regularly.
Aquifer	A water-bearing bed of porous rock.
Auxiliary operations	All activities supportive of but not contributing directly to mining.
Auxiliary ventilation	Portion of main ventilating current directed to face of dead end entry by means of an auxiliary fan and tubing.

B

Backfill	Mine waste or rock used to support the roof after removal.
Berm	A pile or mound of material capable of restraining a vehicle.
Borehole	Any deep or long drill-hole, usually associated with a diamond drill.
Bottom	Floor or underlying surface of an underground excavation.
Breakthrough	A passage for ventilation that is cut through the pillars between rooms.

C

Comminution	The breaking, crushing, or grinding of ore or rock.
Competent Rock	Rock which, because of its physical and geological characteristics, is capable of sustaining openings without any structural support except pillars and walls left during mining (stalls, light props, and roof bolts are not considered structural support).
Core sample	A cylinder sample generally 1-5" in diameter drilled out of an area to determine the geologic and chemical analysis of the overburden.
Cover	The overburden of any deposit.

D

Deposit	Mineral deposit or ore deposit is used to designate a natural occurrence of a useful mineral, or an ore, in sufficient extent and degree of concentration to invite exploitation.
Dip	The inclination of a geologic structure (bed, vein, fault, etc.) from the horizontal; dip is always measured downwards at right angles to the strike.
Drift	A horizontal passage underground. A drift follows the vein, as distinguished from a crosscut that intersects it, or a level or gallery, which may do either.
Dump	To unload; specifically, a load of ore or waste; the mechanism for unloading, e.g. a car dump (sometimes called tipple); or, the pile created by such unloading, e.g. a waste dump (also called heap, pile, tip, spoil pike, etc.).

E

Explosive	Any rapidly combustive or expanding substance. The energy released during this rapid combustion or expansion can be used to break rock.
Extraction	The process of mining and removal of ore from a mine.

F

Face	The exposed area of material being extracted.
Fault	A slip-surface between two portions of the earth's surface that have moved relative to each other. A fault is a failure surface and is evidence of severe earth stresses.
Fill	Any material that is put back in place of the extracted ore to provide ground support.
Fracture	A general term to include any kind of discontinuity in a body of rock if produced by mechanical failure, whether by shear stress or tensile stress. Fractures include faults, shears, joints, and planes of fracture cleavage.

G

Ground control	The regulation and final arresting of the closure of the walls of a mined area. The term generally refers to measures taken to prevent roof falls or bursts.
Gunite	A cement applied by spraying to the roof and sides of a mine passage.

H

Haulage	The horizontal transport of ore, supplies, and waste. The vertical transport of the same is called hoisting.
Highwall	Face or bank on the uphill side of a contour mine excavation.

I

Incline	Any entry to a mine that is not vertical (shaft) or horizontal (adit). Often incline is reserved for those entries that are too steep for a belt conveyor (+17 degrees -18 degrees), in which case a hoist and guide rails are employed. A belt conveyor incline is termed a slope. Alt: Secondary inclined opening, driven upward to connect levels, sometimes on the dip of a deposit; also called "inclined shaft".
Indicated resources	Estimates of the rank, quality, and quantity have been computed partly from sample analyses and measurements and partly from reasonable geologic projections.
Inferred resources	Unexplored extensions of the demonstrated resources for which estimates of the quality and size are based on geologic evidence and projection. Quantitative estimates are based largely on broad knowledge of the geologic character of the deposit and for which there are few, if any, samples or measurements. The estimates are based on an assumed continuity or repletion of which there is geologic evidence; this evidence may include comparison with deposits of similar type.

J

Job Safety Analysis	A job breakdown that gives a safe, efficient job procedure.

K

Kerf	The undercut of a mined face.

L

Lithology	The character of a rock described in terms of its structure, color, mineral composition, grain size, and arrangement of its component parts; all those visible features that in the aggregate impart individuality of the rock.
Low voltage	Up to and including 660 volts by federal standards.

M

Measured resources	Estimates of the rank, quality, and quantity have been computed from sample analyses and measurements from closely spaced and geologically well-known sample sites, such as outcrops, trenches, mine workings, and drill holes. The points of observation and measurement are so closely spaced, and the thickness and extent of ores are so well defined that the tonnage is judged to be accurate within 20 percent of true tonnage.

N

Nitrogen oxides (NOx)	Formed when nitrogen (N2) combines with oxygen (O2) in the burning of fossil fuels, from the natural degradation of vegetation, and from the use of chemical fertilizers. A significant component of acid deposition and photochemical smog. The primary source of nitrogen oxide emissions is mobile equipment exhaust.

O

Outcrop	Ore that appears at or near the surface.
Overburden	Layers of soil and rock covering an ore body. In surface mining operations, overburden is removed prior to mining using large equipment. When mining has been completed, it is either used to backfill the mined areas or is hauled to an external dumping and/or storage site.

P

Permissible	That which is allowable or permitted. It is most widely applied to mine equipment and explosives of all kinds which are similar in all respects to samples that have passed certain tests of the MSHA and can be used with safety in accordance with specified conditions where hazards from explosive gas or ore dust exist.
Permit	A document issued by a regulatory agency that gives approval for operations to take place.
Pinning	Roof bolting.
Plan	A map showing features such as mine workings or geological structures on a horizontal plane.
Portal	The structure surrounding the immediate entrance to a mine; the mouth of a tunnel or decline.

R

Raise	A secondary or tertiary inclined opening, vertical or near-vertical opening driven upward form a level to connect with the level above, or to explore the ground for a limited distance above one level.
Ramp	A secondary or tertiary inclined opening, driven to connect levels, usually driven in a downward direction, and used for haulage.
Reclamation	The restoration of land and environmental values to a surface mine site after the ore is extracted. Reclamation operations are usually underway as soon as the ore has been removed from a mine site. The process includes restoring the land to its approximate original appearance by restoring topsoil and planting native grasses and ground covers.
Recovery	The proportion or percentage of ore mined from the original seam or deposit.
Reserve	That portion of the identified mineral deposit resource that can be economically mined at the time of determination. The reserve is derived by applying a recovery factor to that component of the identified resource designated as the reserve base or proven reserves.
Resources	Concentrations of ore in such forms that economic extraction is currently or may become feasible. Resources broken down by identified and undiscovered resources. Identified resources are classified as demonstrated and inferred. Demonstrated resources are further broken down as measured and indicated. Undiscovered resources are referred to as hypothetical and speculative.
Respirable dust	Air-borne dust particles 5 microns or less in size.
Run-of-mine (ROM)	Raw material as it exists in the mine.

S

Section	A portion of the working area of a mine.
Slip	A fault. A smooth joint or crack where the strata have moved on each other.
Slope	Primary inclined opening, connection the surface with the underground workings.
Steeply inclined	Deposits with a dip from 40 degrees to 60 degrees.
Stemming	The noncombustible material used on top or in front of a charge or explosive.
Stope	Any excavation made in a mine to remove ore that has been made accessible by shafts and drifts.

T

Ton	A short or net ton is equal to 2,000 pounds;
Tonnes	A metric ton is approximately 2,205 pounds.
Transfer	A vertical or inclined connection between two or more levels and used as an ore pass. Location in the materials handling system, either haulage or hoisting, where bulk material is transferred between conveyances.
Tunnel	A horizontal, or near-horizontal, underground passage, entry, or haulage-way, that is open to the surface at both ends. A tunnel passes completely through a hill or mountain.

U

Undercut	To cut below or undermine the ore face.

V

Valuation	The act or process of valuing or of estimating the value or worth; appraisal.
Velocity	Rate of airflow in lineal feet per minute.
Ventilation	The provision of a directed flow of fresh and return air along all underground roadways, traveling roads, workings, and service parts.

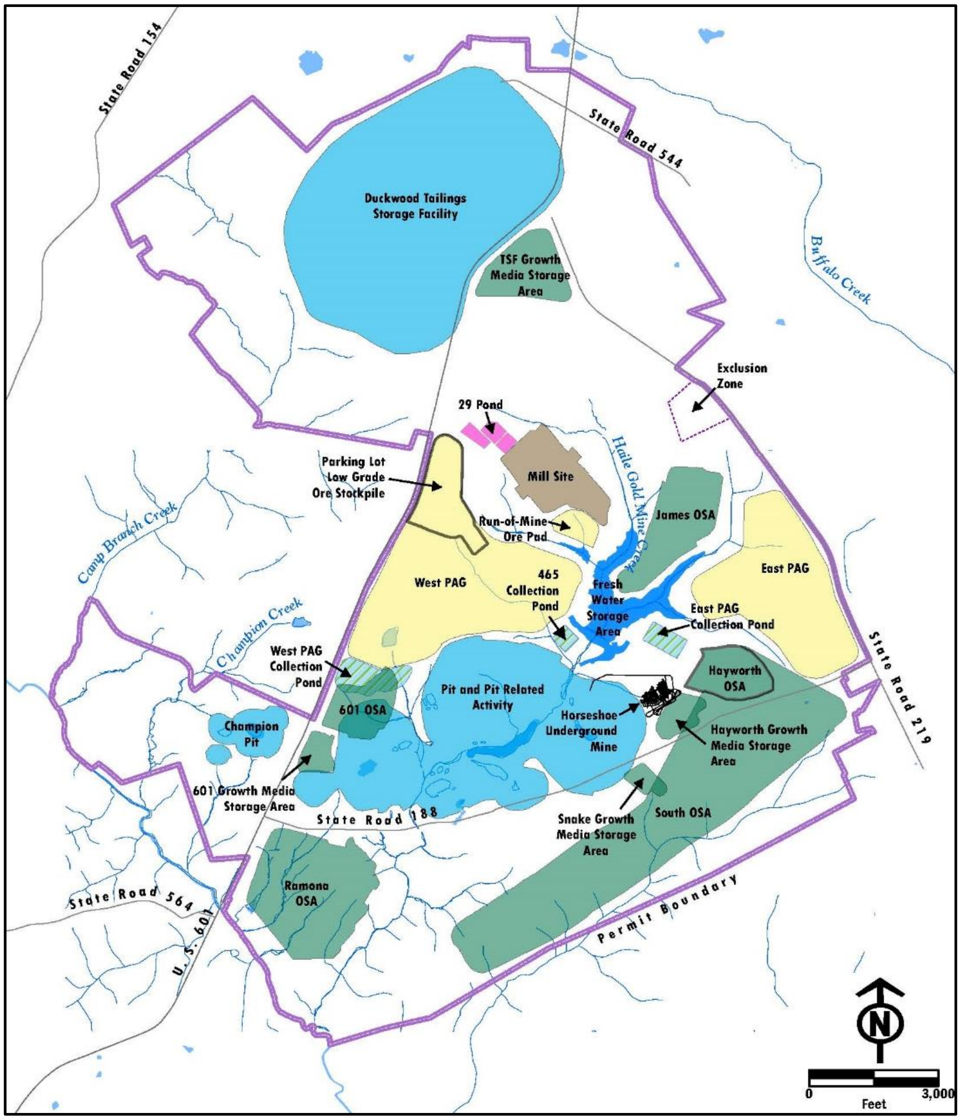
W

Waste	That rock or mineral which must be removed from a mine to keep the mining schedule practical, but which has no value.

Haile Gold Mine
Site Wide Water Balance Report

Prepared for

Haile Gold Mine, Inc.



November 21, 2018
Revised January 29, 2019

Table of Contents

List of Tables

List of Figures

1.0 Introduction

Ecological Resource Consultants, Inc. (ERC) has been retained by Haile Gold Mine, Inc., a wholly-owned subsidiary of OceanaGold Corporation, (Haile) to conduct a site wide water balance analysis for mine operations corresponding to Haile's 2018 Revised Mine Plan at the Haile Gold Mine near Kershaw, South Carolina. The primary objectives of the site wide water balance are to estimate:

- Process water and precipitation storage at the Tailings Storage Facility (TSF)
- Available water supply versus demands for mine operations
- Amount of TSF reclaim water, contact water, and non-contact water used in Mill operations
- Amount of contact water requiring treatment
- Amount of treated contact water and non-contact water used for mine operations other than the Mill
- Rate at which treated contact water and pit depressurization water not used at the mine will be released

Assumptions used in the model, modeling techniques and results obtained are presented herein.

This water balance is a revision to the water balance work that was done by ERC in support of the original project's Final Environmental Impact Statement (FEIS) issued in 2014. This revised water balance for the 2018 Revised Mine Plan incorporates greater total reserves to be mined, updated mine plan concepts and facilities (including underground mining), and an increased production rate.

Since the original EIS was completed, Haile also has continued to further refine its groundwater characterization based upon several years of depressurization (and monitoring) work done to support the mine construction and operations permitted in 2014. This additional hydrogeologic information has been incorporated into an updated site groundwater model (done by NewFields), the results of which are inputs to this ERC site wide water balance model and analysis.

2.0 Objectives

The mine water balance is an important tool for planning and operational considerations for Haile. At all times, adequate storage must be available in the TSF for both process water and precipitation. Additionally, facilities must be adequately sized to store the volume of contact water that will be generated. Also, treatment facilities must be adequately sized for contact water generated (and not otherwise sent directly to the Mill), and fresh water storage must be adequately sized for purposes of meeting makeup demands at the Mill or other operational demands (e.g., dust suppression) requiring fresh water.

This water balance model was developed as a tool to aid in the planning, design and operation of the TSF and water management facilities, to inform related impact analyses, and to assist with future water management planning.

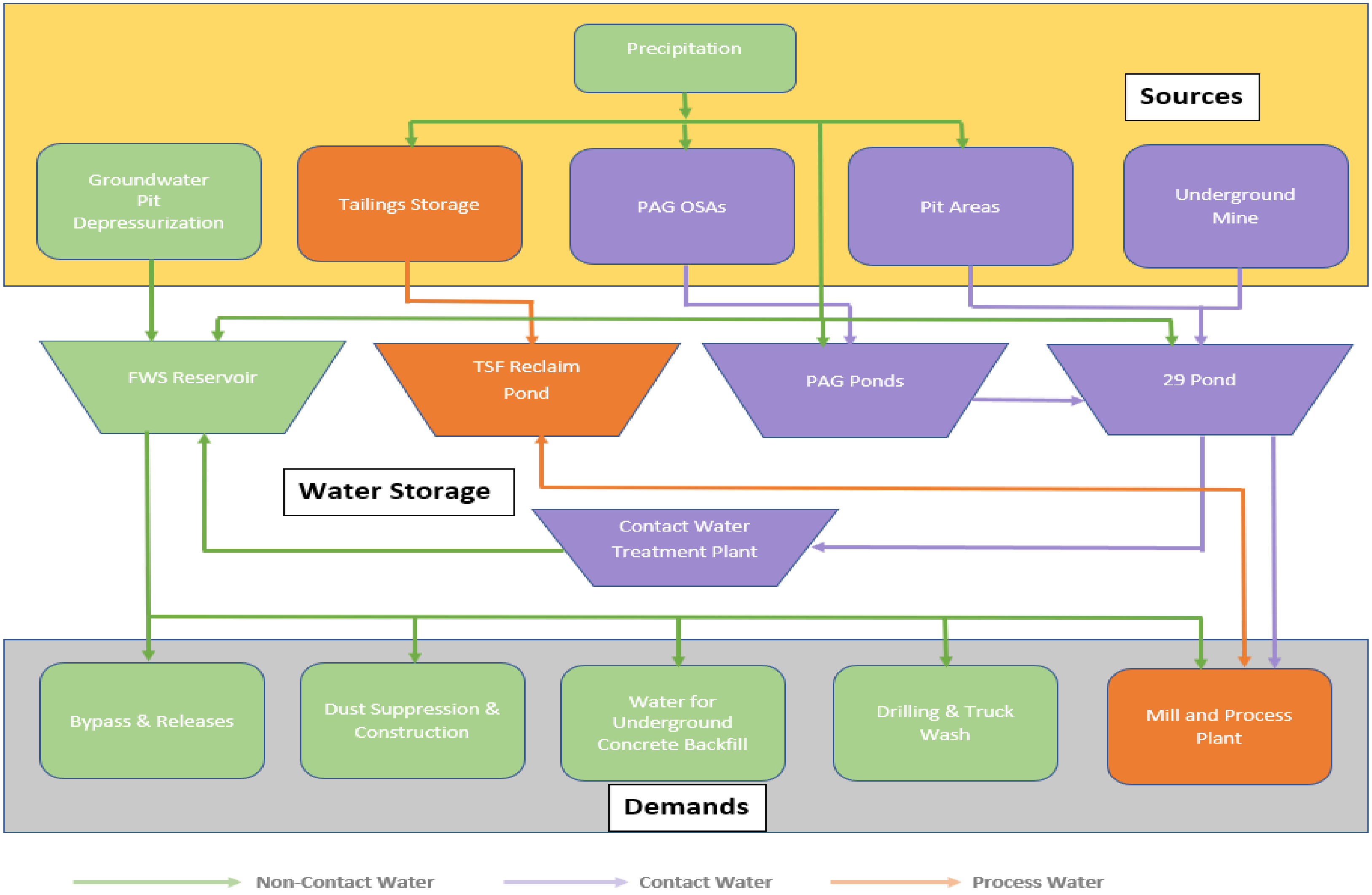
The water balance is heavily influenced by fluctuations in precipitation. Based on the site's climatic setting snowfall and freezing conditions are rate. They do not have a significant impact on the water balance. Given the uncertainty that variable precipitation adds to water management, the water balance was modeled in a probabilistic manner. Modeling included Monte Carlo simulations intended to understand the anticipated variability and required water management resulting from a range of potential precipitation conditions. Monte Carlo simulations include running the water balance multiple times, each time with differing, equally likely meteorological input. Results obtained from the different model runs are intended to provide insight into the probability of different outcomes, thus allowing for risk-based decision making. The computer software GoldSim, version 9.60, was used for these dynamic simulations. The updated model was run using a daily time step.

3.0 Water Balance System Components

3.1. Overall Water Balance

The site wide mine water balance was developed to include all major facilities that are expected to add water to the system, store water, require or consume water, or remove water from the system. A schematic of the overall system is provided as **Figure 3.1**.

Figure 3.1 Site Wide Water Balance Schematic



In simplified form, the water balance can be reduced to facilities that add water to the system, facilities that store water, facilities that use water, and facilities that treat water. Any water that enters the milling process stream and discharges to the TSF has the potential to contact cyanide and is considered process water (illustrated in **orange** on **Figure 3.1**). All process water will be stored in a fully closed-loop system (including only the Mill, the TSF, and pipelines connecting them) that prevents the release of any process water. A majority of process water will be reused in the mining process by reclaiming this water from the TSF Reclaim Pond. Other water that is added to the system is grouped into two categories, contact water (illustrated in **purple** on **Figure 3.1**) and non-contact water (illustrated in **green** on **Figure 3.1**). Contact water is water that may be contaminated as a result of contact with potentially acid generating (PAG) material. Non-contact water is water in the Project area (e.g., direct precipitation and runoff or groundwater from depressurization) that does not come into contact with PAG material and is collected and stored in the Fresh Water Storage Area (FWSA) behind the Fresh Water Storage Dam (FWSD). Both contact and non-contact water will be used at the mine. Any contact water not used in the milling process will require treatment at the Contact Water Treatment Plant (CWTP) before it can be released. Anticipated sources of process, contact, and non-contact water are summarized below.

Process Water

- Free water in the TSF
- Any water in the Mill process stream
- Natural moisture in the processed ore

Contact Water

- Runoff and seepage from PAG storage areas
- Water pumped from the underground mine workings
- Direct precipitation and runoff accumulated in and pumped from the open pits

Non-Contact Water

- Groundwater from pit depressurization
- Runoff that does not come in contact with PAG

Some non-contact storm run-off within the Project area from green overburden storage areas (OSAs), growth media stockpiles, and undisturbed ground is not collected in FWSA but rather flows directly (or sometimes via storm pond) into Haile Gold Mine Creek and its tributaries, other adjacent streams and their tributaries, and/or the Little Lynches River. As a result, this non-contact run-off is not addressed in the site wide water balance. This non-contact storm run-off is addressed in a separate detailed assessment of surface water flows in Haile Gold Mine Creek and its tributaries, other adjacent streams and their tributaries, and the Little Lynches River, which was completed as part of the Haile Surface Water Direct and Indirect Flow Impact Assessment Report (ERC 2018).

There are several water storage facilities included in the water balance model:

- The TSF Reclaim Pond is effectively a water storage pond within the footprint of the TSF where process water is stored.
- Contact water is stored in several PAG ponds (including the 465, 469, West PAG, and East PAG Ponds) and 29 Pond (which serves the Mill and CWTP). PAG ponds are intended to temporarily store runoff and seepage from the PAG facilities. Contact water also is temporarily stored in pit sumps after rainfall events until this water is evacuated shortly after storms. Contact water from the PAG ponds and pit sumps will be sent to the 29 Pond, and from there it will be used in the Mill or treated at the CWTP.
- Non-contact water is stored in the FWSA. Inputs to the FWSA include direct rainfall and non-contact runoff, groundwater depressurization water, a portion of flow retained from Haile Gold Mine Creek, and effluent from the CWTP.

3.2. Major System Components

Each of the major elements of the water balance is described below.

3.2.1 Mill

The supply of operational water to the Mill is generally the largest water demand at the mine. The Mill uses water to process ore to remove the gold from it. The remaining waste from the milling process (i.e., tailings) is then sent to the TSF in the form of tailings slurry.

The model was run for the period of January 1, 2020 through December 31, 2032 for an overall period of 13 years. Planned production is assumed to be a constant of 12,080 tons per day over this period. It is assumed that approximately 12,555,000 tons will have been processed prior to January of 2020, so the total processed volume at the end of 2032 is expected to be approximately 65,465,000 tons.

Tailings produced at the Mill and sent to the TSF were modeled as having a solids content of 51.4% by weight. The tailings production rate and slurry content result in a total estimated 1,900 gpm of water sent to the TSF as part of the slurry based on the 12,080 tons/day production rate at the Mill[1].

3.2.1.1 Mill Non-Contact Water Requirements

Non-contact (fresh) water is required for parts of the Mill process. Mill requires a total of 245 gpm of fresh water that must come from non-contact sources for gland seals (177 gpm) and water for reagents (68 gpm).

3.2.1.2 Natural Ore Moisture

Ore processed at the Mill also contributes moisture to the system. An average natural ore moisture content of 4% was used in the water balance model. At a production rate of 12,080 tons of ore per day, natural ore moisture accounts for a constant input of 80 gpm to the system.

3.2.1.3 Consumed Water

Approximately 20 gpm of water is consumed at the Mill via evaporation. This water input was included in the model, as well.

3.2.2 Tailing Storage Facility

Process water is stored in the Reclaim Pond within the TSF. Reclaimed process water is the primary water source used to meet Mill water demands. Free water in the TSF Reclaim Pond is comprised of process water that drains from the tailings slurry and from direct precipitation. Water from the TSF Reclaim Pond can be used to meet much of the 1,900 gpm that the Mill sends to the TSF in the tailings slurry while operating at 12,080 tons/day. Because the Mill requires 245 gpm of non-contact water and receives 80 gpm from ore moisture, a maximum of 1,575 gpm of water can be reused from the TSF Reclaim Pond. Actual reclaim rates are calculated by the model based on water available in the TSF Reclaim Pond and are discussed in **Section 6.5.**

Because the TSF will be built in five different stages (with an ultimate crest elevation of 670 feet), ERC needed to evaluate the relationship between stored volume and water depth at each stage to accurately model this relationship. NewFields provided filling

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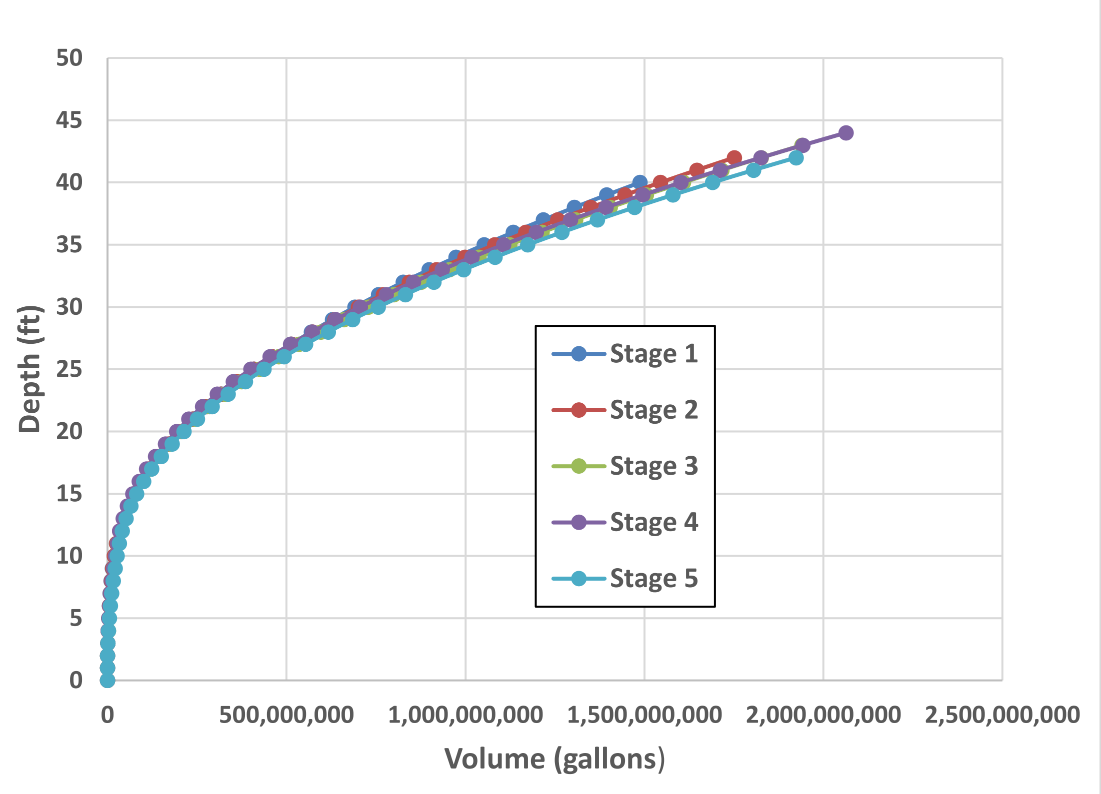
[1] The Haile Project Description (Revision 1) states that the maximum operational rate for the Mill under the Haile 2018 Mine Expansion Plan is 14,400 tons/day. However, based on the assumption that the Mill would operate at an annual average rate that is approximately 85% of the maximum capacity of the Mill, ERC is using 12,080 tons/day.

curves for the TSF Reclaim Pond at each of the five embankment stages, and ERC plotted depth versus capacity for each stage. The results are presented in **Figure 3.2**.

Figure 3.2 TSF Reclaim Pond Filling Curves



Given the similarities of the curves for the various embankment stages, a single depth-area-volume relationship was used for all stages. **Table 3.1** includes the modeled Reclaim Pond geometry.

Table 3.1 Reclaim Pond Geometry

DEPTH (ft)	AREA (ft^2)	CUMULATIVE VOLUME (ft^3)	CUMULATIVE VOLUME (gal)
0	0	0	0
1	419	140	1,045
2	31,545	12,007	89,816
3	95,892	72,819	544,722
4	192,974	214,451	1,604,207
5	322,609	469,482	3,511,970
6	385,146	822,898	6,155,706
7	452,983	1,241,504	9,287,098

8	526,029	1,730,555	12,945,453
9	604,194	2,295,216	17,169,405
10	687,390	2,940,561	21,996,921
11	775,531	3,671,579	27,465,315
12	1,072,559	4,591,619	34,347,698
13	1,410,752	5,829,419	43,607,081
14	1,784,110	7,423,202	55,529,404
15	2,184,680	9,404,219	70,348,441
16	2,606,811	11,796,859	88,246,632
17	3,047,015	14,620,911	109,372,012
18	3,494,085	17,888,912	133,818,354
19	3,941,080	21,604,253	161,611,035
20	4,391,568	25,768,546	192,762,108
21	4,847,932	30,386,416	227,306,174
22	5,310,906	35,464,075	265,289,705
23	5,781,617	41,008,671	306,766,165
24	6,260,499	47,028,142	351,794,933
25	6,893,903	53,602,800	400,976,791
26	7,394,177	60,745,380	454,406,997
27	7,899,310	68,390,733	511,598,207
28	8,407,337	76,542,737	572,579,433
29	8,915,919	85,203,120	637,363,598
30	9,425,128	94,372,465	705,955,061
31	9,937,136	104,052,468	778,366,517
32	10,451,296	114,245,604	854,616,468
33	10,966,597	124,953,518	934,717,222
34	11,481,692	136,176,677	1,018,672,283
35	11,995,149	147,914,161	1,106,474,763
36	12,506,424	160,164,058	1,198,110,359
37	13,012,761	172,922,814	1,293,552,478
38	13,512,334	186,184,577	1,392,757,358
39	14,003,141	199,941,586	1,495,666,926
40	14,483,312	214,184,137	1,602,208,613
41	14,954,205	228,902,268	1,712,307,873
42	15,415,962	244,086,766	1,825,895,807
43	15,868,203	259,728,303	1,942,902,633
44	16,309,455	275,816,628	2,063,251,660

Geometric data for the different stages of the TSF that impact direct runoff into the TSF and therefore the water balance were provided by NewFields. Pertinent information is summarized in **Table 3.2**. Areas and elevations in the table below represent properties at the beginning end of each corresponding phase. The beginning of Stage 1 listed below is January 2020, which is the start of the water balance model.

Table 3.2 TSF Geometry

Stage	Time	Geomembrane Area (ft2)	Exposed Liner Area (ft2)	Tailings Area (ft2)
1 - Beginning	January 2020	14,034,182	1,454,132	12,580,050
1 – End	October 2020	14,034,182	550,228	13,483,954
2 – Beginning	November 2020	15,497,832	1,856,151	13,641,680
2 – End	October 2023	15,497,832	410,801	15,087,031
3 – Beginning	November 2023	17,081,560	1,867,244	15,214,316
3 – End	May 2028	17,081,560	203,617	16,877,943
4 – Beginning	June 2028	18,311,495	1,326,591	16,984,903
4 – End	June 2031	18,311,495	401,552	17,909,943
5 – Beginning	July 2031	19,573,155	1,563,386	18,009,769
5 - End	June 2035	19,573,155	679,053	18,894,102

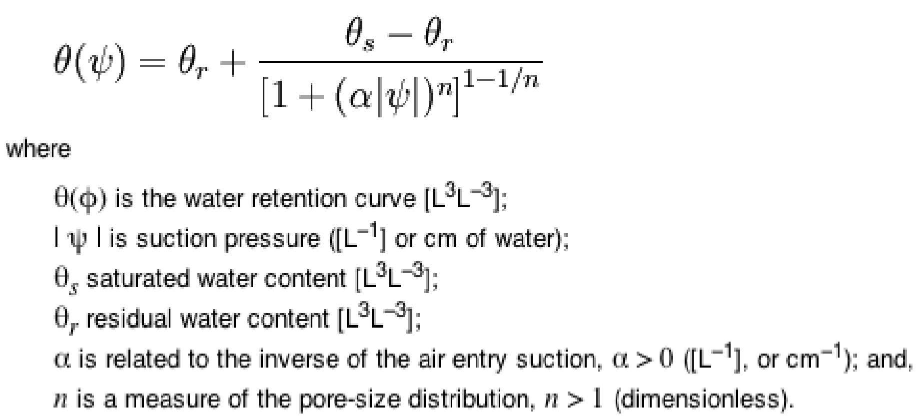
Tailings are assumed to have a specific gravity of 2.85 and to be deposited in the TSF at a dry density of 80 pounds per cubic foot (pcf). Deposited tailings were assumed to be 100% saturated.

3.2.3 PAG Overburden Storage Areas

There will be two PAG Overburden Storage Areas (OSAs) on the mine site, West PAG (which incorporates the original Johnny's PAG) and East PAG. The facilities will contain potentially acid generating (PAG) material, will be lined with an 80-mil, high-density polyethylene (HDPE), and will be equipped with an underdrain to collect any water that infiltrates through the PAG material. Runoff and seepage flow from the PAG facilities is considered contact water and will either be used at the Mill or be treated at the CWTP before storage in the FWSA. Runoff and seepage from the West PAG gravity will drain to the 465 and 469 collection ponds. Runoff and seepage from the East PAG will drain to the East PAG collection pond. Contact water in these collection ponds will be pumped to the 29 Pond from where it can be used at the Mill.

A curve number (CN) of 75 was used to calculate direct PAG runoff. Water that does not directly run off the PAG facilities will either be lost to the system through evaporation or infiltrate through the PAG. The top surface of the PAG facilities was assumed to retain up to two inches of moisture that was available for evaporation. Any water in excess of two inches was assumed to infiltrate.

Infiltration rates through the pile were calculated based on unsaturated flow regimes using the Van Genuchten equation, presented below.



$$\theta(\psi) = \theta_r + \frac{\theta_s - \theta_r}{\left[1 + (\alpha|\psi|)^n\right]^{1-1/n}}$$

where

$\theta(\phi)$ is the water retention curve [L^3L^{-3}];
$|\psi|$ is suction pressure ([L^{-1}] or cm of water);
θ_s saturated water content [L^3L^{-3}];
θ_r residual water content [L^3L^{-3}];
α is related to the inverse of the air entry suction, $\alpha > 0$ ([L^{-1}], or cm^{-1}); and,
n is a measure of the pore-size distribution, $n > 1$ (dimensionless).

Modeled parameters for flow through the PAG are given on **Table 3.3**.

Table 3.3 Material Properties

Parameter	Modeled Value
Alpha (cm-^{1})	0.1
N	1.35
M	0.23
theta r	0.03
theta s	0.35
Ko (cm/sec)	10

All PAG facilities will be operational throughout the duration of the model. Areas of the PAG facilities are summarized on **Table 3.4**.

Table 3.4 PAG Geometry

PAG Facility	PAG Area (ft^2)	Pond Area (ft^2)
JPAG[2]	3,886,700	189,200
West	9,809,000	437,000
East	9,050,000	290,000

3.2.4 Pits

Six open pits (Mill Zone, Red Hill, Snake, Haile, Ledbetter and Champion) will be in operation at various times. Precipitation in the pits will be considered contact water and therefore will be pumped to the 29 Pond from where it will be either used at the Mill or sent to the CWTP. Pit areas were split into pit highwall/floor area or backfill for calculations with the two area types having different runoff characteristics. Areas used in the model are presented in **Table 3.5**. Since Champion Pit is a stand-alone pit and the other five pits are generally connected, the table lists values for the "Main" Pit and Champion Pit only. Areas at intermediate times from those presented in the table are interpolated by the model. Total areas of each system are equal to the sum of the highwall/floor area and the backfill area.

Table 3.5 Modeled Pit Areas

PAG Facility	Main Pit Highwall/Floor (ft^2)	Main Pit Backfill (ft^2)	Champion Pit Highwall/Floor (ft^2)	Champion Pit Backfill (ft^2)
Jan 2020	7,610,000	0	0	0
Jan 2021	9,720,000	0	0	0
Jan 2024	12,800,000	0	0	0
Jan 2029	14,599,675	3,511,325	0	0
Dec 2032	11,101,542	7,900,483	320,975	0

Pumping from the pits is limited to pump capacities within each pit, and at times excess storm water will be temporarily stored in the pits. Predicted daily pumping from each pit and accumulated volumes of stored water are calculated by the model.

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[2] The current JPAG will get integrated into the ultimate West PAG.

3.2.5 Contact Water Pumping for Underground Mine Operations

The mine will be pumping to dewater the underground mine and dewater areas near pit sumps. NewFields calculated the amount and timing of this pumping as part of their groundwater modeling (NewFields 2018). Water pumped as part of this process has the potential to come into contact with mine workings and is therefore considered contact water. This water will be sent to the 29 Pond where it will comingle with other contact water. Some amount of contact water may be used as makeup at the Mill when reclaim from the TSF isn't fully available. At all other times, this water will be sent to the CWTP, where it will be treated and released to the FWSA. The timing and amount of water predicted by NewFields to be generated from dewatering of the underground mine and used in the water balance model is given in **Table 3.6**.

Table 3.6 Contact Water Pumping for Underground Mining

Time	Contact Water Pumping for Underground Mining (gpm)
2020	617
2021	628
2022	707
2023	749
2024	746
2025	739
2026	759
2027	520
2028	547
2029	543
2030	738
2031	693

3.2.6 Contact Water Treatment and Pretreatment Storage

All contact water not used in the Mill process will require treatment before it can be released from the system. The model assumes that the CWTP will be expanded from its current 1,200 gpm capacity to 2,000 gpm.

Monthly contact water runoff rates may peak at rates higher than 2,000 gpm. The 29 Pond temporarily stores contact water and regulates flows to the CWTP. The total capacity of the storage pond was assumed to be 29 million gallons in the model. (The

19 Pond currently holds up to 19 million gallons, but pond cells will be expanded to hold approximately 29 million gallons.)

3.2.7 Pit Depressurization Water

A system of production pumping wells will be used to depressurize groundwater around the pits and underground mine operations to facilitate mining. Depressurization of the pits is expected to be a significant source of fresh water throughout the project. It will be sent to the FWSA from where it can be used to meet any non-contact water need.

Depressurization rates used in the water balance were calculated by NewFields as a result of their detailed depressurization groundwater modeling (NewFields 2018). NewFields' modeling produced various depressurization rates for different times during planned mining operations. **Table 3.7** presents estimated pit depressurization rates used in this water balance model. Modeled monthly pit depressurization pumping rates listed below are estimated values at the beginning of the year. Daily values used in the water balance model were linearly interpolated from these listed values.

Table 3.7 Pit Depressurization Rates

Time	Modeled Pit Depressurization Rates (gpm)
Start of 2020	741
Start of 2021	686
Start of 2022	658
Start of 2023	414
Start of 2024	389
Start of 2025	483
Start of 2026	464
Start of 2027	446
Start of 2028	572
Start of 2029	640
Start of 2030	636
Start of 2031	334
Start of 2032	270

3.2.8 Fresh Water Storage Dam

A Fresh Water Storage Dam (FWSD) will be constructed on Haile Gold Mine Creek upstream of the pits to collect water in the FWSA. The FWSA will serve multiple purposes including:

- the main component of site water management that captures and diverts non-contact runoff around the open pits and protects the open pits from flooding in severe weather
- a storage area for managing non-contact and treated contact water generated and required by the mine and Mill operations
- a source of water to ensure that the mine can maintain the necessary minimum releases downstream of the mine

The various inputs to and outflows from the FWSA are shown below.

Inputs

- Rainfall/Runoff from the tributary basin
- Effluent from the CWTP
- Groundwater depressurization pumping

Outflows

- Evaporation
- Infiltration losses (assumed an average of 5% of water per annum)
- Bypass flows for minimum releases to Lower Haile Gold Mine Creek (set at 100 gpm)
- Dust suppression
- Mill fresh water requirements
- Construction water
- Water required for the underground concrete backfill
- Excess water discharge (maximum rate set at 34 cfs or approximately 15,200 gpm)

The facility has a dam crest at elevation 491 feet, an emergency spillway at 485 feet and is planned to be operated at a maximum normal water level of 470 feet. At a water surface elevation of 470 feet it has a storage capacity of approximately 3.72 million cubic feet (85 acre-feet). Water in excess of this level will be released to lower Haile Gold Mine Creek. The filling curve for the FWSA is presented in **Table 3.8**.

Table 3.8 Fresh Water Storage Area Geometry

Elevation (ft)	Area (ft^2)	Cumulative Volume (ft^3)	Cumulative Volume (gal)
454	0	0	0
455	7,550	2,517	18,827
456	15,751	13,919	104,122
457	29,611	36,239	271,084
458	49,129	75,199	562,528
459	74,318	136,489	1,021,012
460	139,839	241,856	1,809,210
461	163,352	393,299	2,942,084
462	190,832	570,213	4,265,493
463	223,411	777,121	5,813,272
464	261,092	1,019,129	7,623,611
465	364,182	1,330,339	9,951,630
466	405,496	1,714,994	12,829,044
467	448,905	2,142,010	16,023,350
468	494,407	2,613,483	19,550,212
469	542,013	3,131,511	23,425,330
470	639,041	3,721,373	27,837,802
471	712,958	4,397,035	32,892,107
472	788,681	5,147,537	38,506,247
473	874,220	5,978,621	44,723,187
474	969,574	6,900,107	51,616,383
475	1,079,278	7,924,043	59,275,958
476	1,170,231	9,048,491	67,687,412
477	1,266,597	10,266,587	76,799,408
478	1,369,747	11,584,423	86,657,503
479	1,480,055	13,008,968	97,313,838
480	1,649,406	14,572,934	109,013,117
481	1,766,226	16,280,417	121,785,977
482	1,886,849	18,106,623	135,446,944
483	2,012,223	20,055,823	150,027,973
484	2,142,882	22,133,033	165,566,582
485	2,281,556	24,344,889	182,112,417
486	2,427,999	26,699,287	199,724,536
487	2,569,618	29,197,761	218,414,421
488	2,716,913	31,840,685	238,184,862
489	2,870,059	34,633,821	259,078,971
490	3,029,540	37,583,261	281,142,315

491	3,169,092	40,682,315	304,324,852

3.2.9 Mine Dust Suppression and Minor Uses

The mine has indicated that it requires an average of 933 gpm for dust suppression. The model includes this demand. Non-contact water is required for dust suppression.

3.2.10 Construction Water

Water will be required for major construction activities at the mine including TSF expansions and OSA construction. These water demands will impact the overall site water balance; therefore, they were calculated and incorporated into the model. The exact timing of specific construction activities and their water demands will be determined as part of detailed scheduling. Best estimates of the major construction activities were generated by NewFields based on planned expansions and the nearly constant use of overburden as random fill in the TSF. Modeled construction water demands in the water balance model are summarized in **Table 3.9**. All major construction-related water is assumed to come from non-contact sources.

Table 3.9 Construction Water Estimates

Year	Estimated Construction Water Requirement (gpm)			
	Q1 (gpm)	Q2 (gpm)	Q3 (gpm)	Q4 (gpm)
2020	142	177	285	495
2021	33	33	33	33
2022	33	33	33	44
2023	33	33	186	186
2024	164	140	140	148
2025	140	140	140	140
2026	140	140	140	149
2027	140	140	276	276
2028	236	236	236	236
2029	236	236	236	236
2030	236	236	33	33
2031	0	0	0	0
2032	0	0	0	0

3.2.11 Water for Underground Concrete Backfill

The mine will be backfilling portions of the underground workings with concrete. This operation will require water. The model assumes that non-contact water from the FWSA will be used to meet backfill water demands.

The mine indicated that the concrete backfill will be 4% concrete by weight and have a 2:1 water to cement ratio. A total of 3,700,000 tons of ore will be removed from the underground leaving an approximately 1,827,000 cubic yard void to be filled. Based on the underground development schedule, the water balance model assumed that this void would be filled over a 42-month period from July 2023 to December 2026. A constant non-contact water demand of 38.5 gpm was assumed in the water balance model for this 42-month period to meet this demand.

4.0 Operational Assumptions

How the mine manages water systems on site will impact the overall water balance. This section describes two significant operating assumptions; (1) the priority of water used in the process at the Mill and (2) how the CWTP will reduce contact water volumes in the system.

4.1. Water Use Priorities

Based on fresh water Mill demands described in **Section 3.2**, a minimum of 245 gpm of fresh water is required and 80 gpm comes from natural ore moisture. A maximum of 1,575 gpm of the Mill water demand can be met using reclaim from the TSF or other contact water in the system. The model assumes a combination of reclaim and contact water will be used to meet this 1,575 gpm demand, when available.

The water balance prioritized the type of water used in the Mill. When available, water from the TSF Reclaim Pond was assumed to be the first water sent to the Mill. (However, reclaim water from the TSF Reclaim Pond was assumed to be limited to free water stored above a dead pool depth of 10 feet; if the TSF Reclaim Pond depth is less than 10 feet, the model assumes water will not be taken from the reclaim pond. The 10-foot dead pool criterion is based on the need to have a minimum depth of water so that the reclaim pumps do not draw tailing solids into the reclaim line.)

In the event that water from the TSF Reclaim Pond is not available in sufficient quantity to meet the 1,575 gpm demand, runoff and seepage from contact water sources was then assumed to be used for Mill process water, where available. In the event that reclaim water and contact water are not available in sufficient quantity to meet the

1,575 gpm demand, all deficits were assumed to be met using non-contact water from the FWSA. In addition to providing fresh makeup water to the Mill as needed, non-contact water from the FWSA also is used for dust suppression, construction water, and miscellaneous water.

4.2. Pretreatment Storage and Water Treatment

Contact water from PAG ponds, the pits, and underground mine operations will be captured and sent to the 29 Pond. Contact water not used to meet Mill water demands will be treated at the CWTP with effluent released to the FWSA. The 29 Pond will be used to reduce peak treatment rates by temporarily storing runoff during peak wet periods. The peak contact water held in the 29 Pond will be stored so that it may be treated during drier periods when the CTWP has treatment capacity, and will be managed to minimize water stored in the 29 Pond. In the event of major storms, water from PAG ponds will be pumped to the 29 Pond prior to dewatering the pit sumps to ensure sufficient capacity is retained in the PAG ponds.

The CWTP is assumed to operate at the maximum capacity of 2,000 gpm when required, and the 29 Pond is planned to provide approximately 29 million gallons of storage. The CWTP capacity and size of the 29 Pond are increases over existing conditions, which presently include a treatment capacity of 1,200 gpm and approximately 19 million gallons of storage in the 19 Pond.

5.0 Meteorological and Hydrologic Parameters

5.1. Precipitation

Daily precipitation values were required to run the daily time step model. ERC utilized recorded daily precipitation as the basis for this input. Daily data was obtained from the Kershaw station (USC00384690) and the site’s meteorological station.

Data from the Kershaw station was relatively complete from May 1916 to November 2005. **Table 5.1** lists missing data.

Table 5.1 Missing Kershaw Daily Precipitation

Year	Missing Dates
1919	March 1-4, 7, 9-17, 19-26, 28-30
1923	October 1-2, 4-18, 20-23, 25-30
1925	June 1-9, 11-13, 16, 20-24, 27, 29-30; July 2-4, 6, 8-11, 15-23, 28-31; December 1, 4-14, 18-19, 21, 23-31
1926	January 9-17, 19-24, 26-30; February 1-2, 5-9, 11-14, 16-17, 20-24, 26-28
1928	August 1-4, 7-10, 13-14, 18-19, 21-21, 24-25, 28-30; September 7-11, 14-17, 20, 22-30
1934	July 1-2, 5-6, 8-9, 12-18, 21-24, 28; September 1-4, 8-12, 17-28
1937	Jan 1-31; November 1-30
1938	November 1-30; December 1-31
1939	January 1-31
1942	August: 1-4, 6-8, 14-15, 20, 22-23, 26-30
1944	July 10-11, 13, 17, 19, 23-28, 30; November 1-9, 11-15, 17-19, 22-25, 27
1947	July 1-6, 7-16, 22-31
1950	July 1-31
1953	May 1-31
1955	April 1-30
1959	August 6-11; October 23-31; November 1 – December 21
1960	January 1 – 31; March 3
1961	July 26-August 10
1964	August 1-7
1965	September 4-8
1966	January 25-31
1968	January 10-31
1969	February 16-17; March 1-6
1972	July 3-7
1973	Jan 1 - February 22; October 1 – December 31
1974	April 1 – August 30; October 1 – December 31
1975	January 1 – January 31
1976	July 26-30
1987	December 1-4
1994	January 1 – December 31
1995	January 1 – December 31
1996	January 1 – November 30; December 29-31
1998	August 1-31
1999	June 1-July 14

2000	September 2
2001	June 25; September 8-9
2002	April 13-14; June 22-23; August 24-25; September 1; November 2-3; December 7-9, 21-23
2005	March 1-6, 8-12, 14, 17-21, 23-26, 28-29, 31; April 2-6, 4-11, 13-30; May 1-9, 11-14, 16-19, 21-28; July 29-30; November 21-22, 28-30

Data from the Haile site's station was relatively complete from January 2000 to April 2016. **Table 5.2** lists missing data.

Table 5.2 Missing Site Daily Precipitation

Year	Missing Dates
2000	March 2; April 28-30
2005	June 30
2009	February 20
2014	April 30-May 1
2016	February 20-21

A synthetic site daily precipitation dataset was developed based on data from these two stations. First, site data was used. Missing site data in 2000 and 2005 were filled with precipitation at Kershaw on those days. The five missing dates from 2009 – 2016 were filled with zeros. Next ERC evaluated the Kershaw data to identify years with the most missing values to remove. In general years with data missing for a majority of a month or years, with significant numbers of individual days missing and low annual totals for remaining days, were removed. Missing data on the remaining years were filled as zero rainfall days. Based on this ERC was able to generate 77 years of daily site precipitation for use in the model.

The 77-year data set has an average annual precipitation of 46.14 inches. The peak individual day modeled produces 9.85 inches of rain.

The water balance model was run so that each model realization randomly started at one of the 77 potential January 1st dates in the precipitation dataset and utilized the following 13 years of daily data for the run. One thousand different scenarios were run in the Monte Carlo simulation to achieve probabilistic results.

5.2. Evaporation

Evaporation data used in the water balance model were based on data collected at the Sand Hill Research Station in Elgin, South Carolina, located approximately 29 miles southwest of the mine site. Evaporation measurements at that station are “pan evaporation,” which is the amount of evaporation recorded in a standard pan instrument. The period of record for the Sand Hill Research Station evaporation data is 1963 to 1992 (ERC 2012).

For use in water balance modeling, ERC used the total annual pan evaporation value of 64.10 inches. Actual evaporation from different surfaces was taken by multiplying the monthly pan evaporation values by different evaporation coefficients. The average monthly evaporation rates used in the water balance model are provided in **Table 5.3**. The modeled evaporation coefficients for pond surface areas (TSF Reclaim Pond and 29 Pond) and beach areas are 0.70 and 0.40, respectively. Daily evaporation rates were assumed to be uniform throughout the month.

Table 5.3 Monthly Pan Evaporation

Month	Evaporation (in)	Percent of Annual (%)
Jan	1.80	2.81
Feb	2.72	4.24
Mar	4.76	7.43
Apr	7.34	11.45
May	7.81	12.18
Jun	8.23	12.84
Jul	8.49	13.24
Aug	7.12	11.11
Sep	5.88	9.17
Oct	4.79	7.47
Nov	3.19	4.98
Dec	1.98	3.09
Annual	64.10	100

5.3. Runoff Calculations

Runoff from different land types were calculated by the model. The Natural Resource Conservation Service (NRCS) Curve Number (CN) method was used to calculate daily runoff from daily precipitation values and land types. The following CN values were used:

- Pits: 94
- Undisturbed Ground: 84
- OSAs: 75
- Pit Backfill Areas: 80

6.0 Model Results

The water balance model was run using a daily time step. The model has a start date of January 1, 2020 and ran through December 31, 2032.

The water balance was run using a Monte Carlo simulation. In the Monte Carlo simulations, the model was run 100 different times, each time with a different, equally likely sequence of daily precipitation based on the synthetic daily site precipitation that was generated. Running the model with a range of precipitation produces a range of results (probabilistic results) rather than a specific value (deterministic result). Monte Carlo simulations allow for the model to evaluate uncertainty that is inherent to the water balance.

6.1. Interpreting Statistical Results

Stochastic results are presented on the figures below with a range of statistical values shown in various colors.

- Top of the upper blue shading corresponds to the upper bound result
- Top of the upper yellow shading corresponds to the 95th percentile result
- Top of the green shading corresponds to the 75th percentile result
- Red dots represent the mean results
- Black line presents the median
- Top of the lower yellow shading (bottom of the green) is the 25th percentile result
- Top of the lower blue shading (bottom of the yellow) is the 5th percentile result
- Top of the white shading (bottom of the blue) is the lower bound result

6.2. Probabilities

When considering results, the percentiles discussed above and presented in the results below can be related to probabilities. Upper bound results are based on the greatest result in 100 realizations. They therefore have a 1% probability of occurrence in a given day. The 95th percentile result is a result that is exceeded 5 percent of the time or 5 times during the 100 model runs. The 95th percentile results therefore have a probability of being exceeded of 5%. **Table 6.1** summarizes the relationship between percentiles, number of exceeded and probabilities.

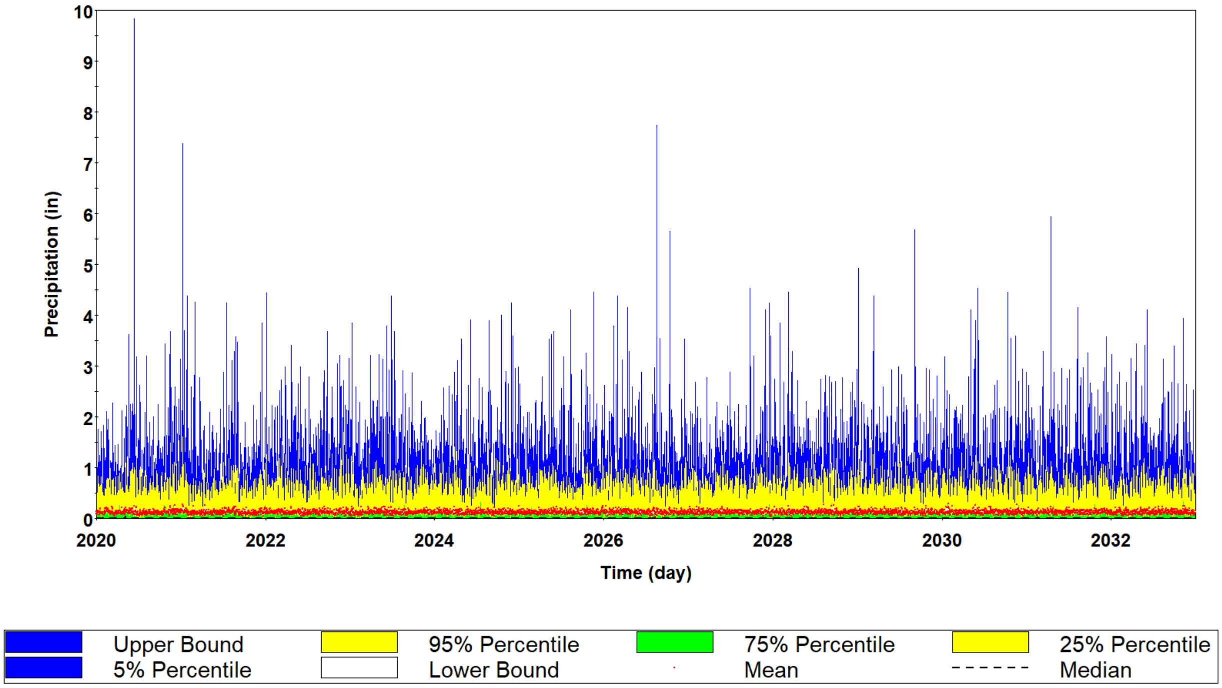
Table 6.1 Summary of Statistical Parameters

Model Result	Number of Times Equaled or Exceeded in 100 Scenarios	Probability of Being Equaled or Exceeded (%)
Upper Bound	Equaled 1 Time, Never Exceeded	Equaled 1% of the Time, Never Exceeded
95th Percentile	Equaled or Exceeded 5 Times	5%
75th Percentile	Equaled or Exceed 25 Times	25%
Mean	Average of All Results	Average of All Results
Median	Equaled or Exceeded 50 Times	50%
25th Percentile	Equaled or Exceeded 75 Times	75%
5th Percentile	Equaled or Exceeded 95 Times	95%
Lower Bound	Equaled or Exceeded All 100 Times	99%

6.3. Precipitation

Daily precipitation values derived from the Monte-Carlo simulations in the GoldSim model are presented in **Figure 6.1**. The single peak daily precipitation is 9.85 inches. The variability shown in this figure is the basis for stochastic nature of other model results.

Figure 6.1 Daily Stochastic Precipitation



6.4. TSF Free Water Storage

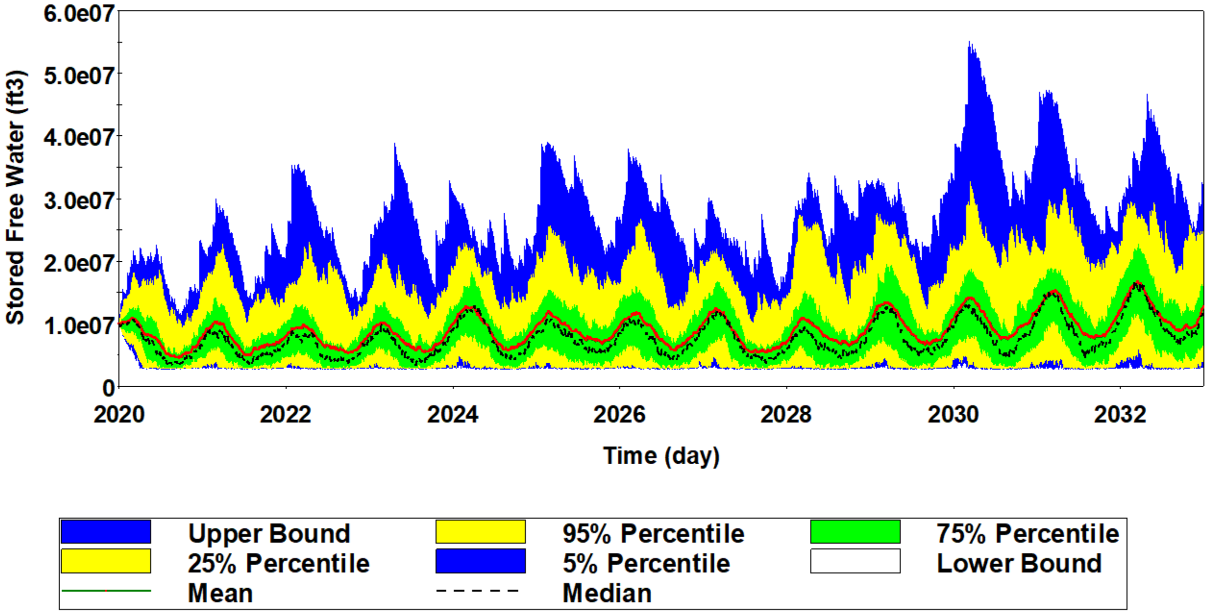
Figure 6.2 shows the amount of free water predicted to be stored in the TSF Reclaim Pond. For modeling purposes, it is assumed that 10 million cubic feet (230 acre-feet) of free water was in the Reclaim Pond when the model starts on January 1, 2020. Results indicate that the volume of stored free water is expected to follow seasonal trends with more water in the pond during winter months when evaporation is lowest and less free water during the summer.

For mean precipitation conditions (red line), results suggest that the volume of free water in the TSF Reclaim Pond will be maintained at less than or equal to roughly 15 million cubic feet. For upper bound wet conditions (top of blue shading), the peak volume of stored water would be approximately 55 million cubic feet (1,263 acre feet). Given drought conditions, the reclaim pond could be drawn down to its minimum 10-foot deep pond depth, which equates to 2.9 million cubic feet (67 acre feet).

Based on the reclaim pond geometry presented in **Table 3.1**, a total of approximately 275 million cubic feet of storage is expected to be available in the pond. Based on the upper bound result of 55 million cubic feet the pond will maintain approximately 220 million cubic feet of storage. A Probable Maximum Precipitation (PMP) event would result in approximately 48 inches of rainfall. Four feet of water over the full TSF basin equals approximately 66 million cubic feet of water. This shows that even for the predicted upper bound storage result the TSF will have sufficient capacity to store the PMP.

It is worth noting that the predicted volume of water in the TSF Reclaim Pond is highly dependent on reclaim rates. The model assumes that, when available, 1,575 gpm is reclaimed from the Pond to the Mill. Taking less than this amount when it is available would result in additional free water in the TSF.

Figure 6.2 Free Water Stored in the TSF Reclaim Pond

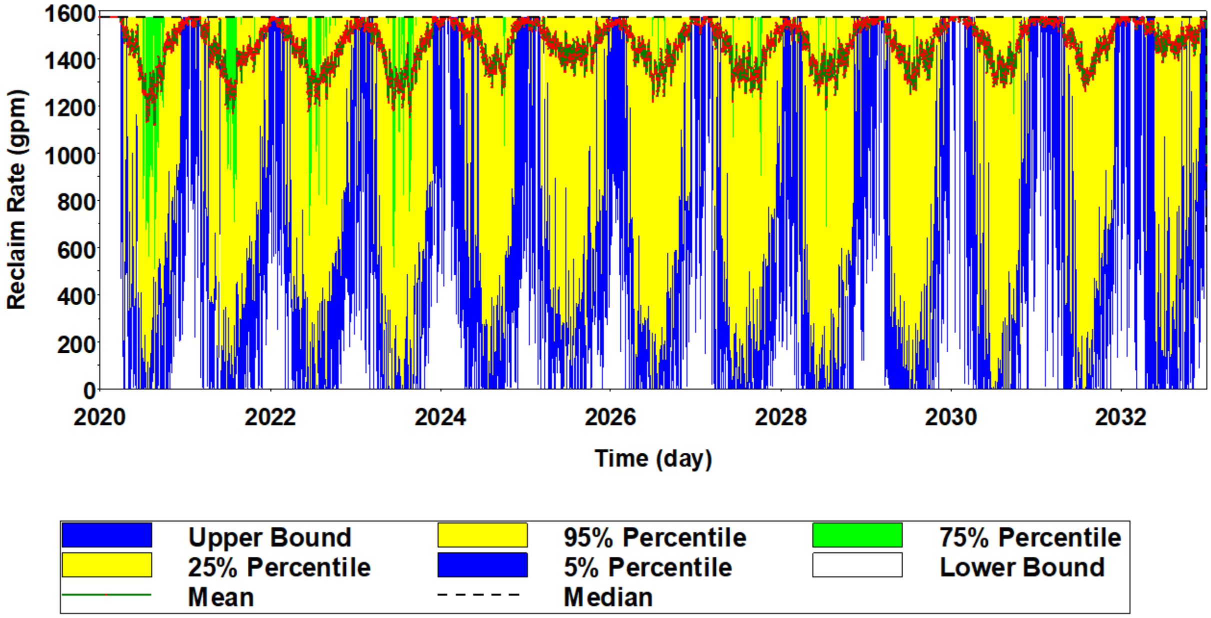


6.5. Reclaim Rate

Figure 6.3 shows the rate at which the model predicts water will be recycled from the TSF Reclaim Pond back to the Mill. The available volume of reclaim water is limited by the dead pool depth in the TSF of 10 feet required for reclaim pumping. The upper bound value of 1,575 gpm shown on the graph occurs when sufficient water is available to meet the maximum reclaim rate needed at the Mill.

Mean results show that reclaim is predicted to reach 1,575 gpm in winters and dip to approximately 1,200 gpm in the middle of summer. In wetter than average conditions, reclaim may stay at or near 1,575 gpm throughout the year. Only in extreme drought conditions is reclaim expected to drop below about 800 gpm.

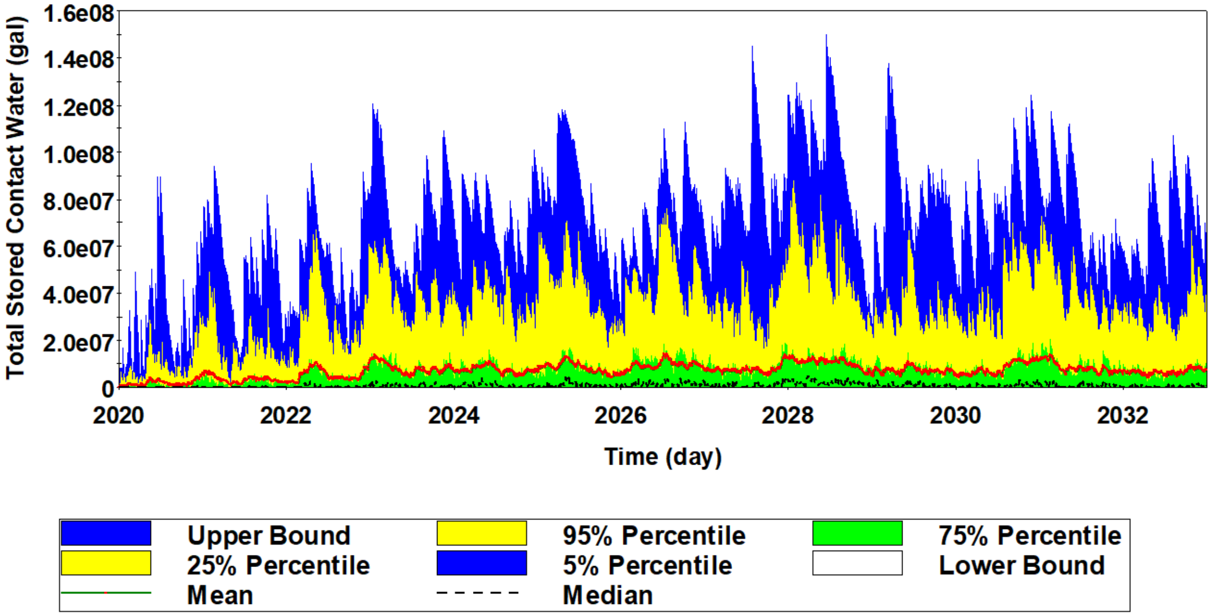
Figure 6.3 Reclaim Rate



6.6. Total Contact Water

The water balance model tracks the amount of contact water that is expected to be generated at the mine. Contact water is classified as runoff and seepage from PAG facilities, water pumped to dewater the underground workings, and all surface water collected in and pumped from the pit sumps. **Figure 6.4** presents the amount of contact water expected to exist at the site throughout the life of mine. The increase in contact water over time is the result of the increased footprint of the pits and the increasing seepage predicted through the PAG facilities. Based on average conditions, about 5-15 million gallons (668,000 – 2,000,000 cubic feet) of contact water will exist. For peak wet conditions the maximum amount of contact water predicted to be stored at any time is approximately 150 million gallons. This water is stored in the 29 Pond, PAG ponds and pit sumps.

Figure 6.4 Total Contact Water

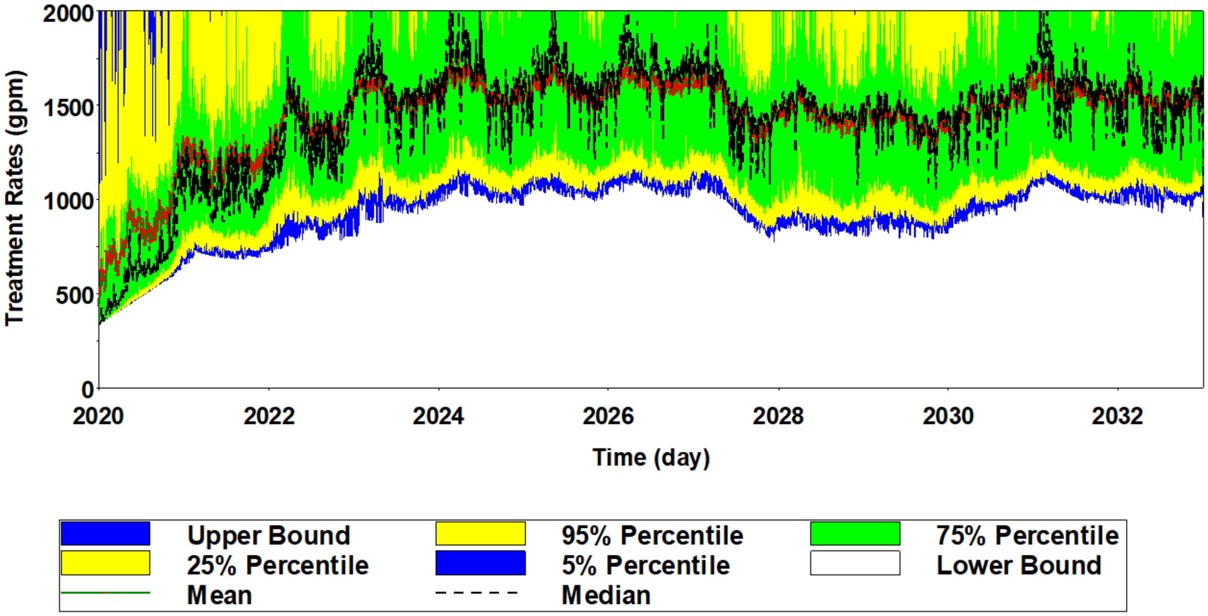


6.7.Contact Water Treatment Rates

Contact water not used at the Mill will require treatment at the CWTP. **Figure 6.5** shows the anticipated rate at which contact water will be treated.

Results suggest that required treatment will grow steadily from 2020 to about 2024 with average rates increasing from about 600 gpm to 1,600 gpm over this time period. This increase is the result of increased seepage collected from the PAG facilities as they develop and contact water inputs from underground mining operations. Treatment requirements are expected to have seasonal variability with more water treatment occurring in the winter and less in the summer. Other than the first months of 2020, the upper bound results suggest treatment will be 2,000 gpm. The figure also shows that at times the 75th percentile result equals the CWTP capacity of 2,000 gpm. These results indicate the expectation that the CWTP will need to operate at full capacity at times during operations more than just following large precipitation events.

Figure 6.5 Contact Water Treatment

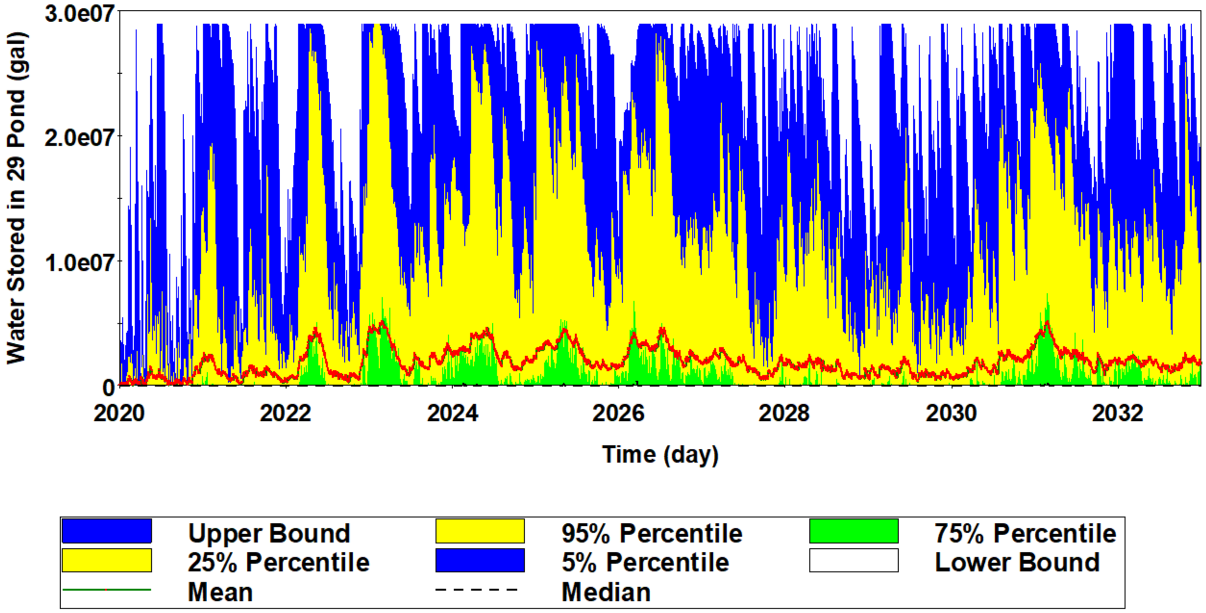


6.8. 29 Pond Water Storage

The model evaluated the amount of water that can be expected in the 29 Pond. This assessment was done assuming the prior of pumping to the 29 Pond was groundwater from the underground operations, pumping from the PAG Ponds and pumping from pit sumps. Results of the evaluation are shown on **Figure 6.6**.

Average results indicate that the 29 Pond volume will typically range between empty and up to about 5 million gallons stored. The pond is predicted to be full over the course of operations for upper bound results and some 95th percentile conditions in 2023.

Figure 6.6 Calculated Storage in the 29 Pond



6.9. Contact Water Stored in Pits

Due to the finite size of the 29 Pond and the CWTP capacity, there will be times when contact water is temporarily stored in the pit sumps until sufficient capacity exists for this water to be evacuated. The water balance model calculated the amount of water estimated to be in the pit sumps throughout operations. **Figure 6.7** shows the results.

Of more importance to the mine is the frequency at which water can be expected in the pit floors. The model tracked the number of days per year when more than a minimal amount of 1,000 gallons of excess water was predicted in any of the pit floors. Results of this analysis are given on **Figure 6.8**. The figure indicates that for average meteorological conditions, water can be anticipated on the pit floor for about 20-30 days per year. In extreme wet conditions there may be 40-50 days per year when water would persist on the pit floor.

Figure 6.7 Contact Water in Pits

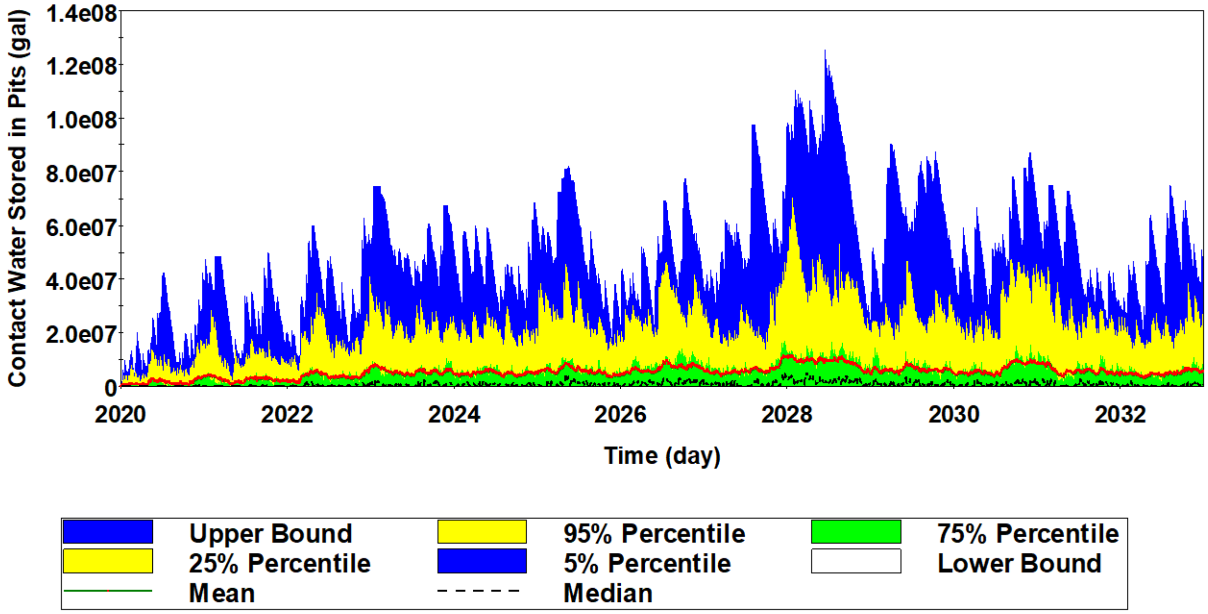
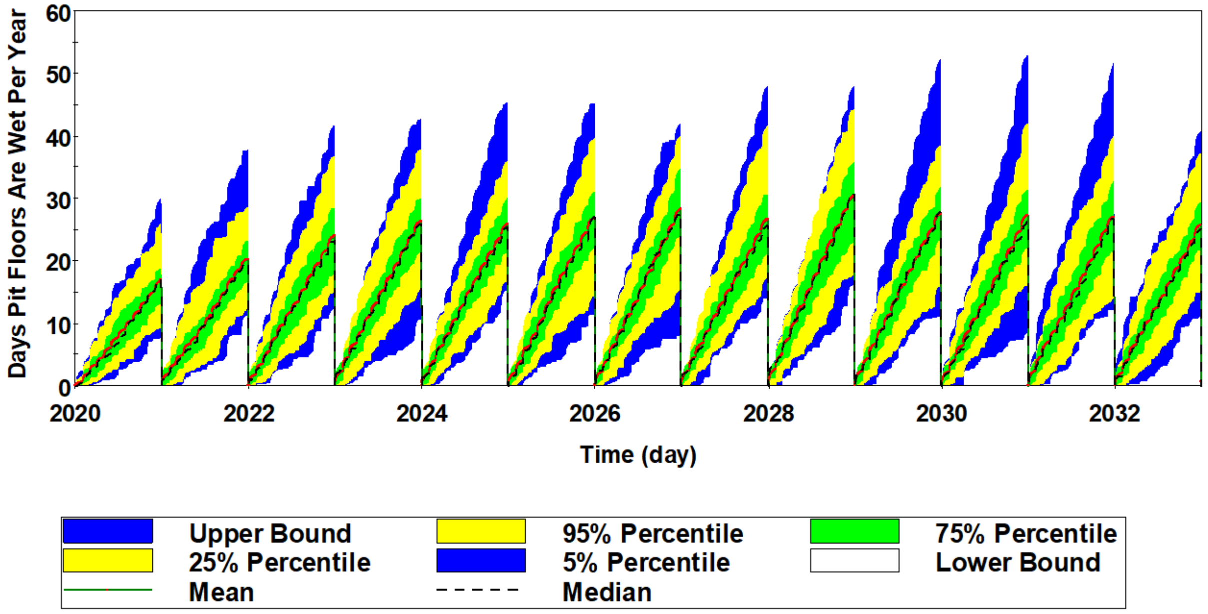


Figure 6.8 Days Pit Floor is Wet



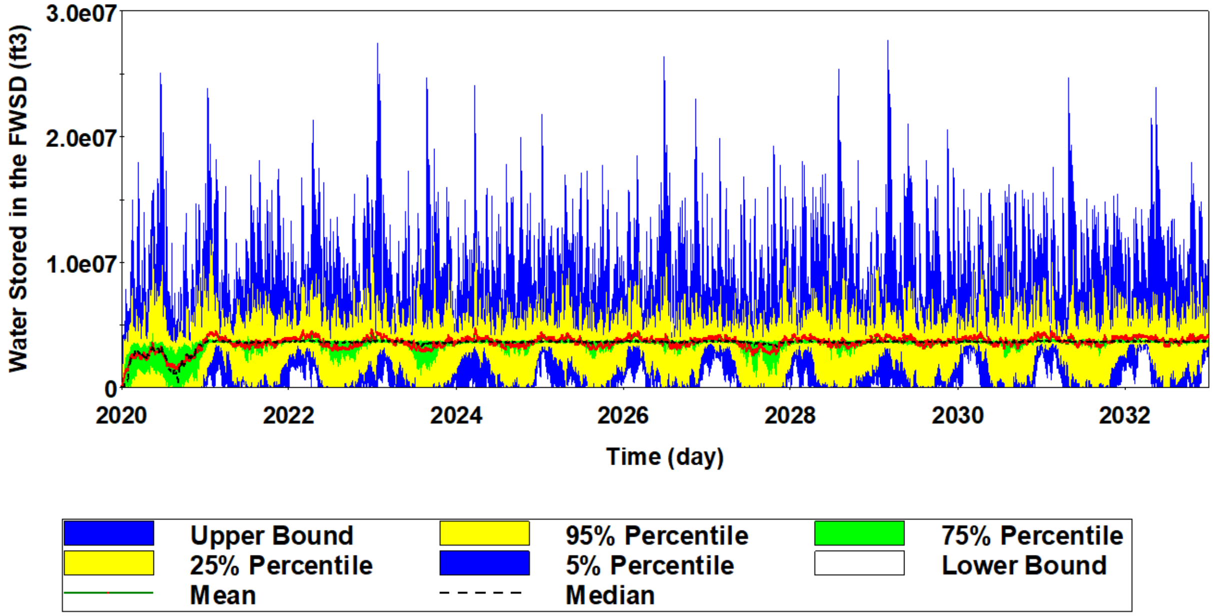
6.10. Fresh Water Storage Area

The amount of water stored in the FWSA was determined by the model. Inputs include direct precipitation, runoff from the upstream basin, pit depressurization water, effluent from the CWTP, and some retention of flow from Haile Gold Mine Creek. Outputs from the reservoir include evaporation, infiltration, Mill and mine demands for non-contact water, minimum flow releases (100 gpm) and other water releases.

The maximum amount of water stored in the FWSA was set at about 3.72 million cubic feet which equates to a water surface elevation of 470 feet. This value was taken from the facility's stage-storage capacity developed by NewFields. An initial Reservoir storage value of 100,000 cubic feet at the start of the model run on January 1, 2020 was assumed. Throughout operations, water in excess of the 3.72 million cubic feet was modeled to be released downstream of mine workings subject to a maximum assumed release rate of 34 cfs (15,200 gpm). This release rate is based on the hydraulics of the reservoir outlet piping system. **Figure 6.9** shows the amount of water stored in the FWSA as predicted by the model. The result does not limit storage to the freeboard elevation of 485 but rather illustrates total volumes above the controlled maximum release rate of 34 cfs.

As the figure indicates, it is expected to take a little over a year for the reservoir to fill. Once it initially fills, the reservoir is expected to remain at or near full throughout operations for most meteorological conditions. For the 95th percentile result, the maximum predicted storage volume is approximately 13 million cubic feet, which equates to a water surface elevation of approximately 479 feet or six feet below the spillway crest. At the spillway crest elevation of 485 feet, the reservoir can hold approximately 24.3 million cubic feet. Upper bound results are predicted to exceed this value only occasionally indicating that there is only slight change water will flow through the spillway. In extreme drought conditions results suggest there is the potential that the FWSA would empty.

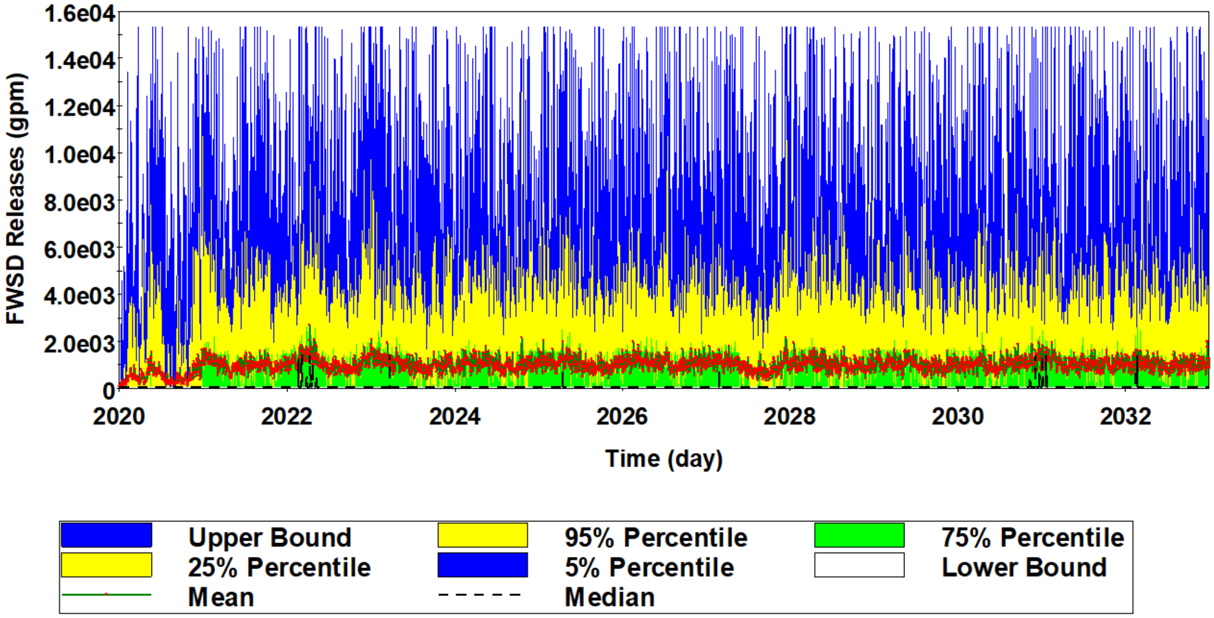
Figure 6.9 Predicted Fresh Water Storage Reservoir Contents



Excess water from the FWSA not needed at the mine will be released via outlet pipes that run through dam and along pit benches. Predicted release rates are presented on **Figure 6.10**. Minimum required releases of 100 gpm occur at all times, so this is the minimum amount released.

Figure 6.10 indicates that releases are predicted to range up to approximately 15,200 gpm (34 cfs) for upper bound results. Average releases are expected to range from approximately 200 gpm to 1,800 gpm.

Figure 6.10 Releases from the FWSA



7.0 Conclusions

The water balance model is an important tool to allow the mine to understand anticipated volumes of water generated, required, stored and treated over the life of mine operations. This report presents results of a probabilistic water balance that estimates water volumes from January 1, 2020 through December 31, 2032 based on a daily time scale. The following main conclusions can be drawn from the water balance.

- The TSF Reclaim Pond has adequate capacity to store all process and meteorological water predicted to occur for the full range of precipitation conditions. Free water volumes in the TSF Reclaim Pond are expected to show seasonal variability with more water stored in the cooler winter months when evaporation losses are less.
- The TSF Reclaim Pond will be a significant source of water for Mill water requirements. The maximum amount of reclaim that can be used at the Mill is 1,575 gpm. Mean results predict that reclaim is predicted to reach 1,575 gpm in winters and dip to approximately 1,200 gpm in the middle of summer. In wetter than average conditions, reclaim may stay at or near 1,575 gpm throughout the year. Only in extreme drought conditions is reclaim expected to drop below about 800 gpm.

- A significant amount of contact water will be produced from the PAG facilities, the pits and groundwater pumping (excluding pit depressurization pumping, which is considered non-contact water). Only minor amounts of contact water is required for operations, so much of this water will need to be stored, treated and released to the FWSA. A CWTP capacity of 2,000 gpm and 29 million gallons of storage at the 29 Pond are recommended. With these capacities excess contact water will still exist in the pits for about 20-25 days per year throughout operations for average precipitation conditions and up to approximately 50 days per year for extreme wet conditions.
- With the amount of non-contact water produced at the mine and the amount of water treatment occurring, a significant amount of water will be sent to the FWSA. After the FWSA initially fills, it is expected that it will remain at or near full throughout operations. Adequate water is always expected to meet the minimum required release of 100 gpm. After the FWSA initially fills, typical releases are expected to range from about 200 gpm to 1,800 gpm.

8.0 References

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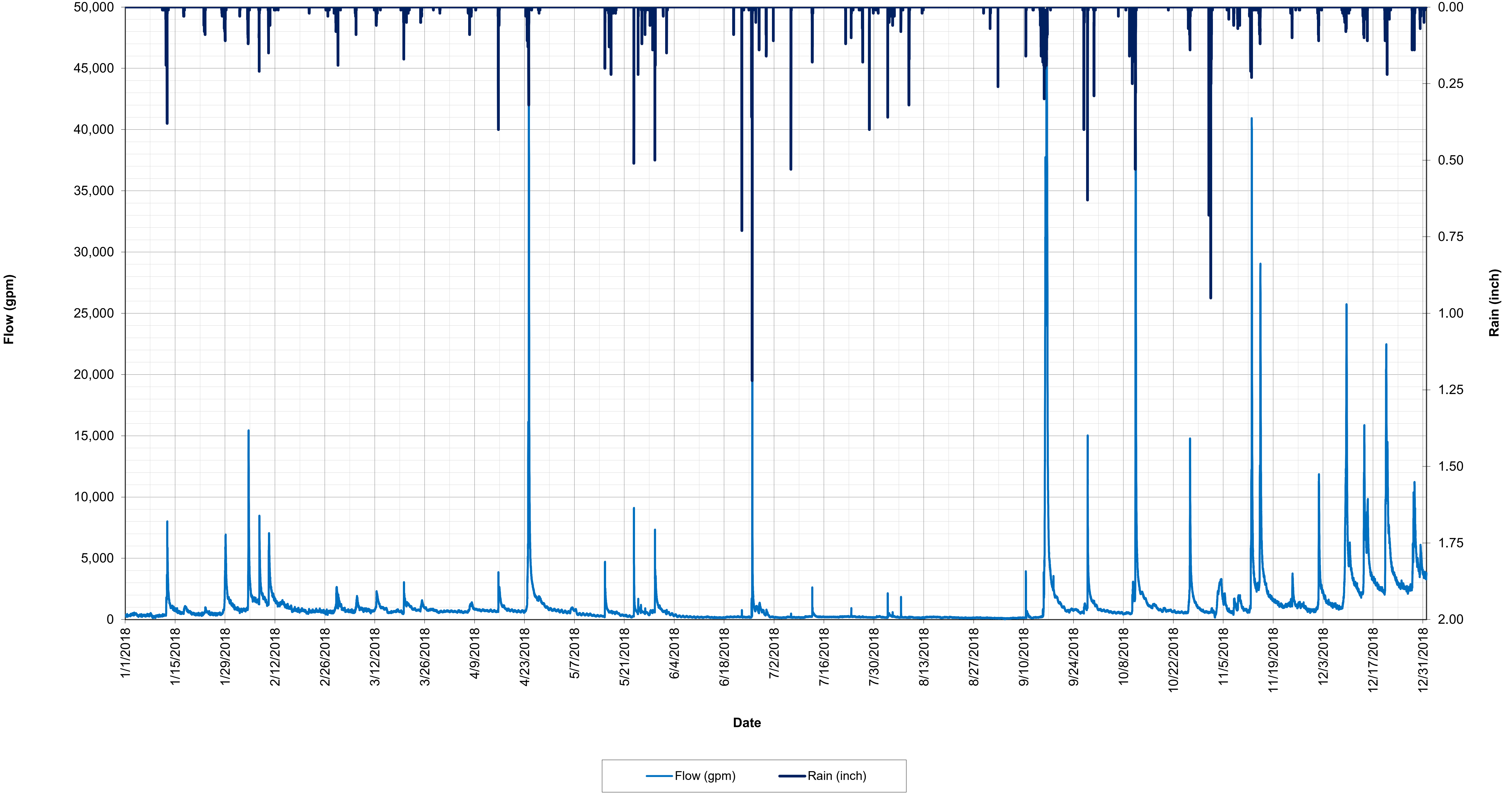
SW-03
2018 Hydrograph



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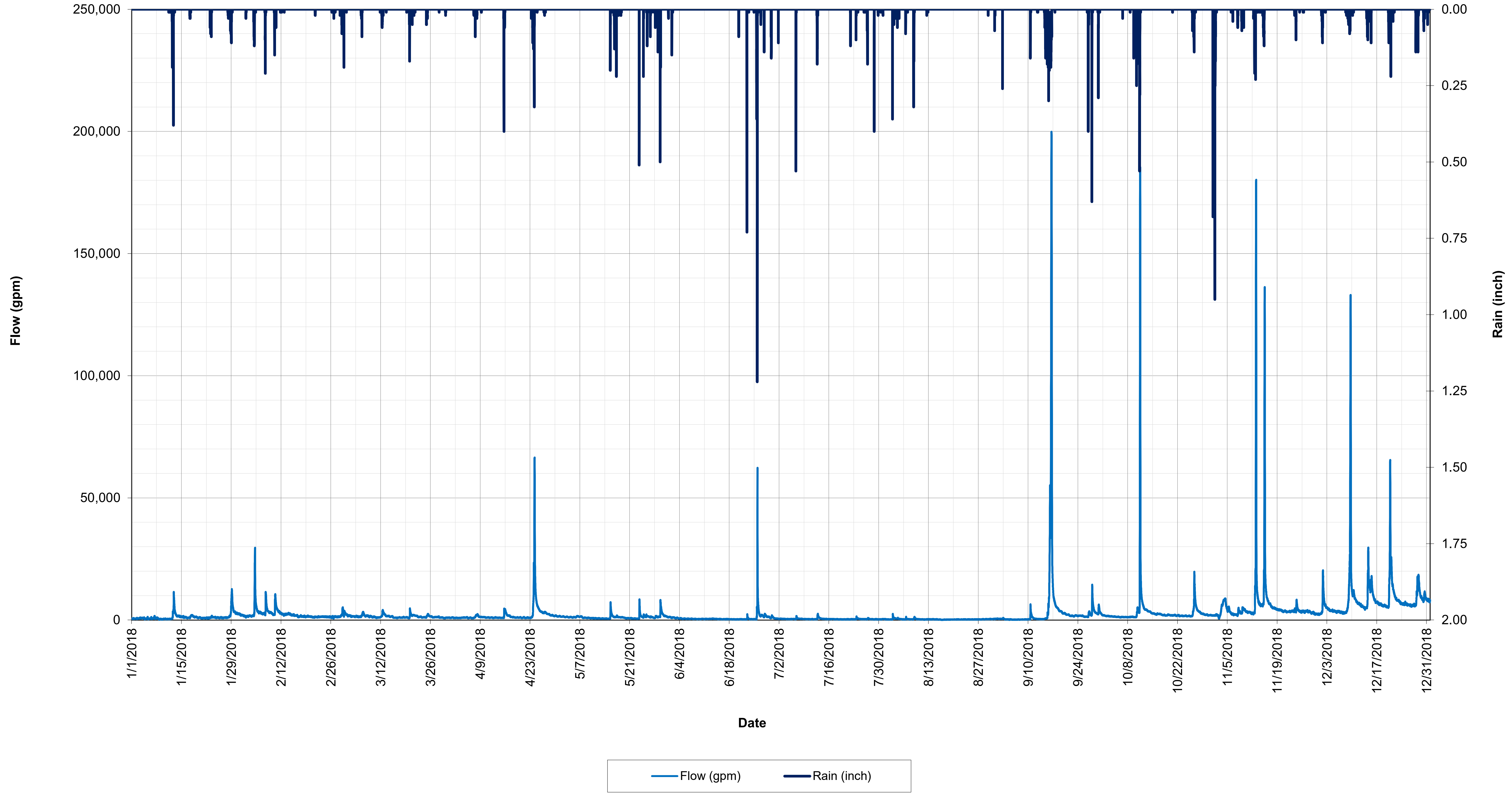
SW-04
2018 Hydrograph



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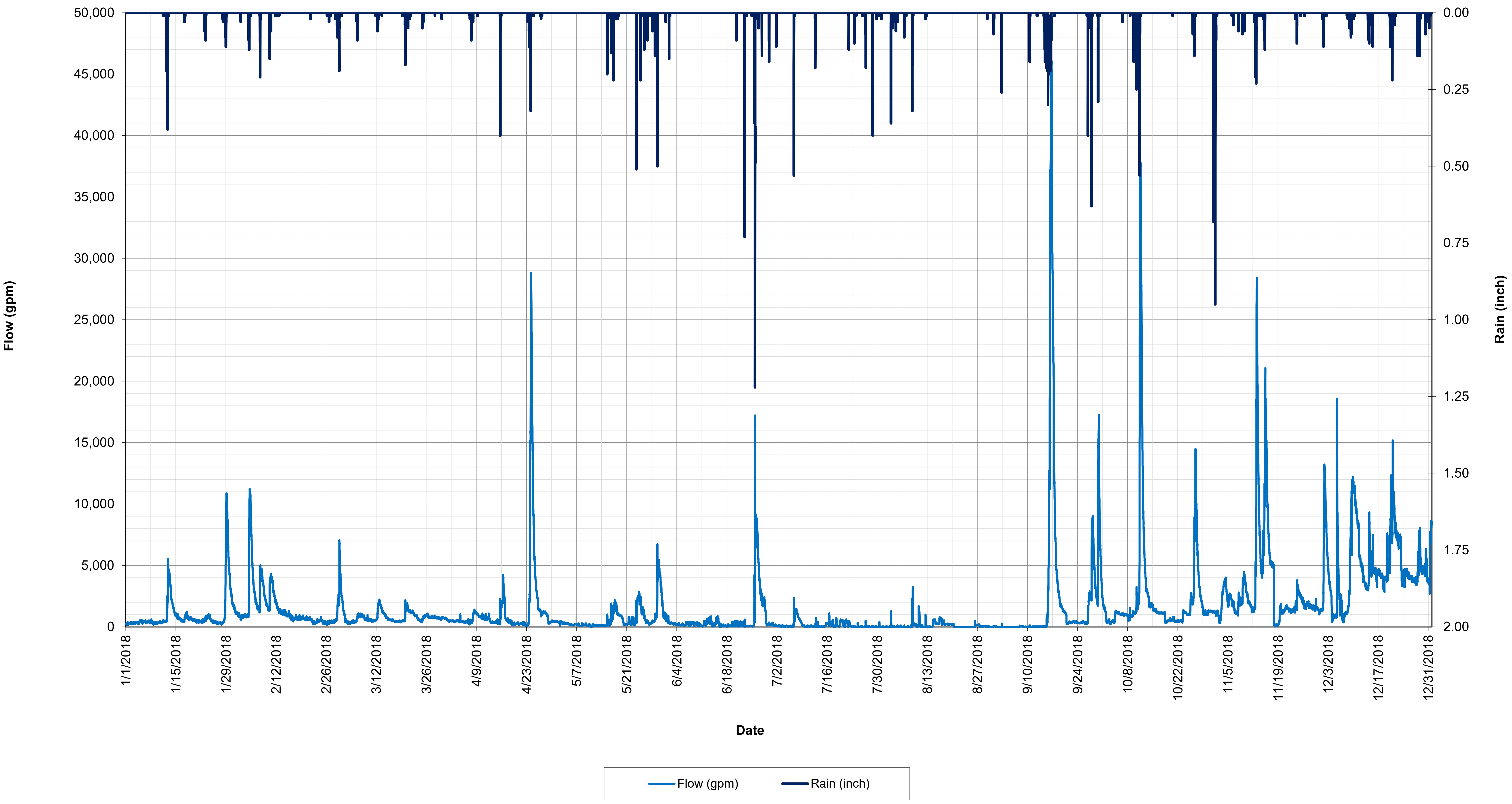

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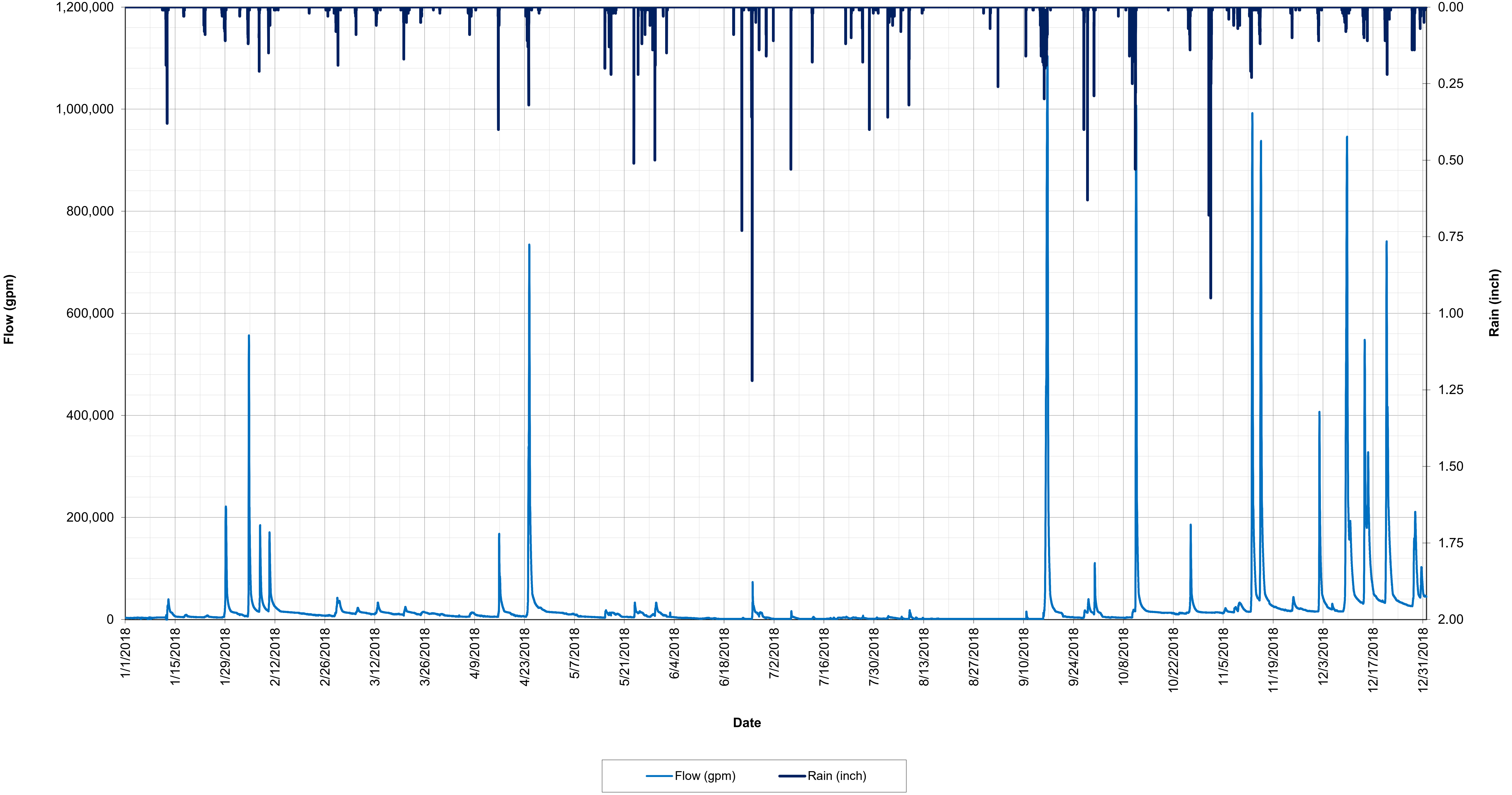


First Quarter 2019

Groundwater and Surface Water Monitoring Report

Haile Gold Mine

Kershaw, South Carolina

May 9, 2019

Prepared for:

OceanaGold – Haile Operation
6911 Snowy Owl Road
Kershaw, SC 29067

Prepared by:

NewFields, LLC
9400 Station Street, Suite 300
Lone Tree, CO 80124

SIGNATURE PAGE

This *First Quarter 2019 Groundwater and Surface Water Monitoring Report* has been prepared by NewFields Mining Design & Technical Services, LLC on behalf of OceanaGold – Haile Operation. We attest, to the best of our knowledge, information and belief that this *First Quarter 2019 Groundwater and Surface Water Monitoring Report* has been prepared within normal bounds and standards of professional practice exercised by environmental consultants for a site in this particular geographic and geologic setting, and is consistent with applicable regulations. This *First Quarter 2019 Groundwater and Surface Water Monitoring Report* has been reviewed by the undersigned professionals.

NewFields Mining Design & Technical Services, LLC

Lucas Kingston, P.G.
(South Carolina Professional Geologist #2666)

WILLIAM L. KINGSTON
No. 2666

Lucas Kingston

May 9, 2019
Date

Brian Wellington, P.E.

B Wellington

May 9, 2019
Date

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1. INTRODUCTION

The First Quarter 2019 Groundwater and Surface Water Monitoring Report (First Quarter Monitoring Report) was prepared for OceanaGold – Haile Operation (Haile) in compliance with reporting requirements described in the Groundwater and Surface Water Monitoring Plan (MP) (NewFields, 2015) for the Haile Gold Mine Site (Site). The First Quarter Monitoring Report also includes data collected from pit depressurization wells. The Site location is illustrated on Figure 1. A summary of the MP and the First Quarter Monitoring Report objectives are described in the following subsections.

1.1. Monitoring Plan Summary

In early 2015, Haile developed the MP in conjunction with the South Carolina Department of Health and Environmental Control (SC DHEC). The MP describes groundwater and surface water monitoring requirements for the various phases of mine development and closure. The overall objectives of the MP are as follows:

- Monitor changes in groundwater and surface water conditions that may result from mining activities, pit depressurization and mine closure and
- Monitor areas adjacent to mine facilities that will contain contact or non-contact water to confirm that unacceptable constituent migration is not occurring.

The MP specifies monitoring of groundwater levels, groundwater quality, surface water quality, stream flow quantity and stream geomorphology. It also includes water level and water quality monitoring for pit lakes that develop during closure and post closure.

The MP specifies a phased approach to groundwater monitoring to meet the project needs during the following phases of mine development and closure:

1. Preproduction through Mine Year 1;
2. Early mine development (Mine Year 2 – 4);
3. Mid mine life development (Mine Year 5 – 8);
4. Late mine development (Mine Year 9 – 14); and
5. Closure and post closure.

Similarly, the MP specifies surface water monitoring in a phased approach. Based on a review of mine plans, two (2) phases of surface water monitoring are specified:

1. Preproduction through Mine Year 14 and
2. Closure and Post Closure.

For each phase, the MP specifies:

- Existing wells and surface water stations that require monitoring;
- New monitoring wells and surface water monitoring stations planned for installation;
- Field parameters and water quality analytes;
- Monitoring frequency; and
- An overview of data evaluation.

The Preproduction phase started in the third quarter of 2015 and continued through fourth quarter of 2016. Mine Year 1 occurred in 2017 and this reporting period marks the start of Mine Year 3. During the first quarter (Q1) 2019, open pit mining and pit depressurization continued at Mill Zone and Snake Pits. Pre-stripping at Red Hill and Haile pits and construction of the water storage detention structure were initiated. Activities also included the draining of Ledbetter reservoir.

1.2. Report Objectives

The objectives of the First Quarter Monitoring Report are to provide the following:

- An accounting of the monitoring performed;
- Monitoring results for groundwater and surface water; and
- Volumes pumped from Mill Zone and Snake Pit depressurization wells.

2. GROUNDWATER MONITORING NETWORK

The MP designates 22 wells for both water quality and water level monitoring for Mine Years 2 through 4. Fourteen (14) monitoring wells were operational and available for water level, field parameters and water quality monitoring during Q1 2019 as indicated in the sampling matrix presented in Table 1 and illustrated on Figure 2. The installation of four wells designated in the MP (MW-15-01 through MW-15-04) was delayed to avoid well destruction by large construction equipment in high traffic areas adjacent to the TSF embankment. With the construction of the TSF complete, the wells can be installed and included in the monitoring network. An additional four wells (MW-16-13, MW-15-15 through MW-17) designated in the MP for Mine Year 2 for water quality and water level monitoring and one well (MW-16-14) for Mine Year 2 designated for water level monitoring only should also be installed.

The MP designates an additional five wells for water level monitoring only (MW-10-03, PZ-11-03, PZ-11-06, PZ-11-09 and PZ-13-24). These wells were operational and available for monitoring purposes during Q1 2019 as indicated in Table 1.

3. SURFACE WATER MONITORING NETWORK

The MP designates monitoring at 14 surface water monitoring stations. The required monitoring varies by location and includes stream flow quantity, water quality and/or geomorphology surveys. The 14 stations were operational and available for designated monitoring in Q1 2019 at locations illustrated on Figure 2 and summarized in Table 1.

The installation and maintenance of three of the 14 surface water stations designated in the MP were funded by the United States Geological Survey (USGS) in second quarter 2015. The stream flow gages are outside of the Site permit boundary at locations illustrated on Figure 2 and include:

1. SW-6 (USGS Station Number 021313485, Buffalo Creek at Mt. Pisgah);
2. SW-13 (USGS Station Number 02131455, Little Lynches River near Kershaw); and
3. SW-15 (USGS Station Number 02131452, Little Lynches River above Kershaw).

The USGS collected stream depth data at these stations from Q3 2015 through Q1 2019, which are available on the National Water Information System (NWIS) website (http://waterdata.usgs.gov/nwis). The USGS plans to develop stream flow rating curves for the new stations to correlate stream depths with stream flow quantity measurements.

4. GROUNDWATER AND SURFACE WATER MONITORING

Haile completed the Q1 2019 sampling event from February 21st through March 12th for groundwater and March 14th and 18th for surface water; water levels were collected from water-level only wells (see Table 1) on January 18th and from supplementary wells on January 8th. The following subsections describe the quarter's monitoring at locations designated in the MP and present data quality assessment results.

4.1. Groundwater Level Monitoring

In Q1, static water levels were measured in 24 groundwater monitoring wells, which included wells not specified in the MP to supplement the dataset. DW-8 was measured as dry and the water level in PZ-11-03 was not measured due to lack of access. In addition to monitoring well measurements, pore pressures in six vibrating wire piezometers (VWPs) installed around the perimeters of Mill Zone Pit (VWP-16-02C, -03C, and -04C) and Snake Pit (VWP-16-06C, -07C and -08C) were included in the assessment. The groundwater monitoring wells and vibrating wire piezometers that were monitored for water level in Q1 are illustrated in Figure 2. Water level data and calculated water level elevations are presented in Table 2.

Hydrographs that illustrate historic and Q1 groundwater elevations at MP wells are provided in Appendix A. Water levels were generally higher compared to Q4 2018 but were mostly within historic data ranges. Wells that recorded water levels above historic ranges include MW-15-05 (adjacent to the eastern permit boundary) and MW-15-07A (on an eastern tributary to HGMC).

4.2. Groundwater and Surface Water Quality

An accounting of groundwater and surface water monitoring and sampling conducted for Q1 is summarized in Table 1. A total of 27 groundwater and surface water samples were collected from MP locations in Q1 2019. Fourteen (14) groundwater samples and 13 surface water samples were submitted to the laboratory, Test America Laboratories, Inc. (Test America) of Savannah, Georgia, for analysis. All monitoring and sampling were performed in accordance with the applicable Sampling and Analysis Plan for Surface Water and Groundwater (SAP) (North Wind, Inc., 2015).

Field parameter results for groundwater and surface water obtained in Q1 2019 are presented in Table 3. Laboratory water quality analytical results for groundwater are presented in Table 4a for the CPS wells and Table 4b for the bedrock wells. Laboratory analytical water quality results for surface water are presented in Table 5.

North Wind, Inc. (North Wind) performed a data quality assessment on the laboratory data based upon the most recently promulgated versions of the analytical methods and the National Functional Guidelines for Inorganic Superfund Data Review (USEPA, 2010). The laboratory noted non-compliance relating to missed holding times, a low recovery in a matrix spike, a high percent difference in a matrix spike duplicate and missed criteria for mercury’s lab control samples. Missed holding times were qualified with “H” values by the lab and the others were reviewed during the assessment and qualified with “J” values to denote an estimated concentration. A review of the data quality assessment indicates that data quality is sufficient to meet monitoring objectives.

The Q1 2019 analytical results indicate that CPS well concentrations were below dissolved and total UBCLs.

Dissolved and total manganese concentrations in bedrock well MW-10-02 (1,100 ug/L) exceeded the UBCLs (980 and 1,000 ug/L, respectively). MW-10-02 is located at an upgradient location at the permit boundary (Figure 2); therefore, potential impacts from Site activities are unlikely. The other bedrock sample results were below the UBCLs.

Time series graphs of pH for MP wells are presented in Appendix B. Groundwater measurements are for CPS and bedrock wells are provided in Figure B-1 and B-2, respectively. The graphs indicate that pH values documented in Q1 were generally within the range of historic readings. PZ-13-12 is an exception and pH increased from values typically below 5 standard units (S.U.) to 5.7 SU.

Surface water station SW-19 reported a concentration of total aluminum (360 ug/L) that when corrected for seasonality (408.5 ug/L) exceeded the station’s UBCL (381.40 ug/L). Surface water station SW-18 also reported total concentrations of manganese (33 ug/L) in Q1 that exceeded the UBCL (15.7 ug/L), as well as a concentration of total iron (330 ug/L) that when corrected for seasonality (415.6 ug/L) exceeded the station's UBCL (371.0 ug/L).

Surface water stations SW-8, SW-9, and SW-12A exceeded the respective station's UBCL for total nitrogen. The total dissolved solids (TDS) were also elevated, but not above the UBCL, in these stations. Based on a discussion with OGC, the timing of the elevated concentrations coincides with the draining of Ledbetter reservoir and the discharge of reservoir waters into HGMC.

Time series graphs of pH were created for surface water and are presented in Appendix B. The graphs indicate that pH values documented in Q1 were generally within the range of historic readings for a number of stations. Exceptions include SW-18 (HGMC) and SW-24 (Unnamed tributary) that reported pH values above the historic range. Others stations reported pH below historic range including:

- SW-2 (upstream of the TSF on a tributary to Camp Branch Creek) and SW-3 (downstream of the TSF)
- SW-5 (on Little Lynches River at upstream permit boundary and upstream of confluence with Camp Branch Creek) and SW-12A (on Little Lynches River at downstream permit boundary and downstream of confluence with HGMC).

4.3. Stream Flow Quantity

During Q1 2019, the USGS collected stream gage depths at SW-6, SW-13 and SW-15. The measured depths are available on the National Water Information System (NWIS) website (http://waterdata.usgs.gov/nwis). As described in Section 3, the stream gage depths will be converted to stream flow quantities once rating curves have been developed by the USGS.

Stream hydrographs for stations equipped with transducers and data loggers, along with daily precipitation, are presented in Appendix C. Review of transducer data for SW-3, SW-4, SW-8, SW-9, SW-19 and SW-24 indicate more precisely the relationship between precipitation events and hydraulic responses at the surface water stations. An accounting of the stream flow quantity monitoring is presented in Table 6.

5. PIT DEPRESSURIZATION REPORTING

Pit depressurization was performed at Mill Zone and Snake Pits during Q1. Wells DW-15-05, and DW-15-09 were operating at the Mill Zone Pit, and wells PW-09-01, DW-16-01R, DW-16-03, DW-16-04R, DW-17-13 and DW-18-11 were operating at Snake Pit. Well DW-15-07A at the Mill Zone Pit and well DW-18-12 at Snake Pit did not were operated during Q1. Well locations are illustrated in Figure 3. Each well is equipped with an electric submersible pump, and a cumulative flow meter that allows for measurement of instantaneous flow rate and cumulative volume pumped. A summary of monthly pumped volumes for each depressurization well is provided in Table 7.

All the water pumped from the Mill Zone Pit depressurization wells was used for dust suppression during Q1; therefore, there was no discharge to HGMC via the Mill Zone Pit outlet structure. Water pumped from the Snake Pit depressurization wells was used for dust suppression or discharged to HGMC during Q1. The well discharge entered HGMC near PW-09-01. Dissolved oxygen (DO) is measured on HGMC at SW-8, which is located near the Mill Zone Pit outlet structure (Figure 3). The DO value measured at SW-8 during the Q1 sampling event was 6.31 mg/L, which is above the State of South Carolina water quality standards that identify a DO level of 4 mg/L as the lower limit for Class A (non-trout) water (USEPA, 1988). Temperature measured at SW-8 during the Q1 sampling event was 23.2^{o}C.

6. REPORTED COMMUNITY COMPLAINTS RELATED TO WATER

Haile reports that no community complaints related to groundwater or surface water were raised in Q1 2019.

7. SUMMARY

This First Quarter Monitoring Report provides an accounting of the monitoring performed in Q1 2019 at groundwater monitoring wells and surface water monitoring stations. The report presents water levels, field parameter results, laboratory analytical results, stream flow quantity rates, data quality assessments and volumes pumped from the Mill Zone Pit and Snake Pit depressurization wells. A more detailed discussion of monitoring results will be provided in the 2019 First Semi-Annual Groundwater and Surface Water Monitoring Report.

8. REFERENCES

Haile Gold Mine Inc. 2014, Letter to South Carolina Department of Environmental Department of Environmental Control (SC DHEC) re: SAC 1992-24122-41A, Haile Gold Mine, Water Quality Certification, Request for Information, June 9.

National Water Information System (NWIS) website, stream gage data, http://waterdata.usgs.gov/nwis.

NewFields, 2015, Groundwater and Surface Water Monitoring Plan for Haile Gold Mine – Kershaw, SC., March.

North Wind, Inc., 2015, Sampling and Analysis Plan for Surface Water and Groundwater – Haile Gold Mine – Kershaw, SC. North Wind, Inc., April.

U.S. Environmental Protection Agency (USEPA), 1988. State Water Quality Standards Summary: South Carolina. EPA/440/5-88-076. Office of Water Regulations and Standards, Washington, D.C.

USEPA, 2010, Office of Superfund Remediation and Technology Innovations (OSRTI), National Functional Guidelines for Inorganic Superfund Data Review, January.

TABLES

Table 1
Groundwater and Surface Water Monitoring Matrix, First Quarter 2019
Haile Gold Mine

Monitoring Location I.D.	First Quarter, 2019				
	Field Parameters	Water Level	Water Quality Sampling	Stream Flow	Channel Geomorphology
Groundwater Monitoring Wells in the Monitoring Plan (MP)					
MW-10-02	x	x	x	NA	NA
MW-10-03	NA	x	NA	NA	NA
MW-10-05s	x	x	x	NA	NA
MW-10-05d	x	x	x	NA	NA
MW-10-06	x	x	x	NA	NA
MW-10-10	x	x	x	NA	NA
MW-15-05	x	x	x	NA	NA
MW-15-06	x	x	x	NA	NA
MW-15-07A	x	x	x	NA	NA
MW-15-08A	x	x	x	NA	NA
MW-15-09	x	x	x	NA	NA
MW-15-10	x	x	x	NA	NA
MW-15-11	x	x	x	NA	NA
MW-15-12	x	x	x	NA	NA
PZ-11-03	NA	x	NA	NA	NA
PZ-11-06	NA	x	NA	NA	NA
PZ-11-09	NA	x	NA	NA	NA
PZ-13-12	x	x	x	NA	NA
PZ-13-24	NA	x	NA	NA	NA
Surface Water Monitoring Stations in the MP					
SW-1	x	NA	x	NA	NA
SW-2	x	NA	x	NA	NA
SW-3	x	NA	x	x	NA
SW-4	x	NA	x	x	NA
SW-5	x	NA	x	NA	NA
SW-6*	x	NA	x	*	NA
SW-8	x	NA	x	x	NA
SW-9	x	NA	x	x	NA
SW-12A	x	NA	x	NA	NA
SW-13*	x	NA	x	*	NA
SW-15*	x	NA	NA	*	NA
SW-18	x	NA	x	NA	NA
SW-19	x	NA	x	x	NA
SW-24	x	NA	x	x	NA

Notes:

x - Monitoring completed

NA - Not applicable, not specified in the Groundwater and Surface Water Monitoring Plan (NewFields, 2015)

* United States Geological Survey is developing a stream flow rating curve for this station

Table 2
Groundwater Elevations, First Quarter 2019
Haile Gold Mine

Monitoring Well I.D.	Northing	Easting	Ground Surface Elevation (famsl)	TOC Elevation (famsl)	Drilled Depth (fbgs)	Screened Interval (fbgs)	Well Materials (Riser/ Screen & Slot Size)	Hydrogeologic Unit Intercepted by Screened Interval	First Quarter 2019		
									Date	Depth to Water (fbtoc)	Groundwater Elevation (famsl)
Coastal Plain Sand Wells											
MW-10-06	590644.06	2138707.31	575.20	577.68	53.0	23 - 43	2" PVC / 2" PVC	Coastal Plain Sand	2/21/2019	8.63	569.05
MW-10-10	584524.89	2137651.97	560.20	562.6	52.0	22 - 42	2" PVC / 2" PVC	Coastal Plain Sand	2/21/2019	12.76	549.84
MW-15-05	582597.42	2144586.13	529.09	533.13	50.0	10.8 - 49.5	2" PVC/ 2" PVC #30	Coastal Plain Sand	2/26/2019	6.90	526.23
MW-15-06	580569.07	2138582.38	554.65	557.06	68.5	9.9 - 68	2" PVC/ 2" PVC #30	Coastal Plain Sand	3/11/2019	26.89	530.17
MW-15-07A**	578270.48	2143898.67	504.28	507.20	45.0	10 - 45	2" PVC/ 2" PVC #10	Coastal Plain Sand	2/27/2019	11.21	495.99
MW-15-08A**	576801.13	2136279.46	527.65	530.40	40.0	10 - 40	2" PVC/ 2" PVC #10	Coastal Plain Sand	2/28/2019	24.71	505.69
PZ-11-03	577595.00	2147011.00	516.30	518.88	30.0	25- 30	2" PVC	Coastal Plain Sand		No access	
PZ-11-06	582069.00	582069.00	508.56	511.39	30.0	25 - 30	2" PVC	CPS and Saprolite	1/18/2019	5.92	505.47
PZ-13-12	585909.01	2138844.36	562.46	565.19	22.0	16.5 - 21.1	2" PVC / 2" PVC #30	Coastal Plain Sand	2/26/2019	10.95	554.24
Bedrock Wells											
DMW-1*	575477.00	2137464.00	453.40	456.50	45.0	35 - 45	4" PVC / 4" PVC #10	Bedrock	1/8/2019	11.78	444.72
DMW-8*	575275.47	2138531.49	459.54	463.04	38.0	28 - 38	2" PVC / 2" PVC #10	Saprolite		>41.50 Dry	<421.54
MW-09-03*	573283.09	2137206.43	420.30	421.98	800.0	260 - 780	4" PVC / 4" PVC #30	Bedrock	1/8/2019	29.67	392.31
MW-09-05*	576948.00	2139193.12	512.10	513.08	800.0	300-780	4" PVC / 4" PVC #30	Bedrock	1/8/2019	25.45	487.63
MW 10-02	577294.17	2136975.63	498.70	499.96	130.0	101 - 126	4" PVC / 4" PVC #30	Saprolite and Saprock	3/4/2019	0.00	499.96
MW 10-03	575727.90	2134438.17	524.80	525.47	160.0	129.5 - 154.5	4" PVC / 4" PVC	Saprolite and Bedrock	1/18/2019	15.84	509.63
MW 10-04*	573073.02	2136275.88	427.50	428.63	400.0	98 - 178	4" PVC / 4" PVC	Bedrock	1/8/2019	60.56	368.07
MW 10-05s	569387.37	2134774.77	365.80	368.12	90.0	30 - 90	4" PVC / 4" PVC #30	Saprolite and Bedrock	3/12/2019	14.81	353.31
MW 10-05d	569405.88	2134765.46	365.10	366.68	400.0	180 - 380	4" PVC / 4" PVC #30	Saprolite and Bedrock	3/12/2019	14.95	351.73
MW 15-09	573430.50	2134484.17	461.69	464.46	98.7	11.8 - 98.3	2" PVC/ 2" PVC #30	Saprolite and Bedrock	2/27/2019	10.85	453.61
MW 15-10	571080.82	2133853.42	366.24	369.51	99.5	12.6 - 99	2" PVC/ 2" PVC #30	Saprolite and Bedrock	2/28/2019	9.75	359.76
MW 15-11	582952.16	2133918.12	445.01	447.63	200.0	103.2 - 198.3	2" PVC/ 2" PVC #30	Saprolite and Bedrock	3/6/2019	4.40	443.23
MW-15-12	583011.10	2133917.76	446.42	449.19	51.0	12.2 - 50.7	2" PVC/ 2" PVC #30	Saprolite and Bedrock	3/7/2019	6.15	443.04
PZ-11-09	571999.00	2138874.00	440.82	443.56	30.0	25 - 30	2" PVC	Saprolite	1/18/2019	11.30	432.26
PZ-13-10*	574800.08	2135463.99	518.18	520.33	510.0	200 - 490	2" PVC/ 2" PVC #30	Bedrock	1/8/2019	52.45	467.88
PZ-13-24	576178.05	2130578.78	444.21	446.12	44.0	34.2 - 43.5	2" PVC/ 2" PVC #30	Bedrock	1/18/2019	26.81	419.31
VWP-16-02C*	573902.82	2137254.01	406.00	236.5***	--	--	Fully Grouted VWP	Bedrock	3/12/2019	--	273.56
VWP-16-03C*	575179.40	2137606.99	433.90	264.5***	--	--	Fully Grouted VWP	Bedrock	3/12/2019	--	336.61
VWP-16-04C*	574364.09	2135968.43	480.80	304.9***	--	--	Fully Grouted VWP	Bedrock	3/12/2019	--	280.57
VWP-16-06C*	575661.17	2142850.00	523.80	214.0***	--	--	Fully Grouted VWP	Bedrock	3/12/2019	--	326.14
VWP-16-07C*	576739.21	2141979.75	497.20	323.7***	--	--	Fully Grouted VWP	Bedrock	3/12/2019	--	327.43
VWP-16-08C*	574467.49	2141545.87	524.60	293.6***	--	--	Fully Grouted VWP	Bedrock	3/12/2019	--	385.46

Notes:

famsl - feet above mean sea level

TOC - top of casing

fbgs - feet below ground surface

fbtoc - feet below top of casing

VWP - vibrating wire piezometer

PVC - polyvinyl chloride

* Monitoring well not specified in Groundwater and Surface Water Monitoring Plan (NewFields, 2015), but monitored to compliment groundwater elevation data.

** Monitoring wells installed in Q3 2016 to replace MW-15-07 and MW-15-08.

*** VWP instrument installation elevation

Table 3
Groundwater and Surface Water Field Parameter Data, First Quarter 2019
Haile Gold Mine

Monitoring Location	Date / Time	Depth to Water (fbtoc)	pH (SU)	Conductivity (uS/cm)	Temperature (°C)	Dissolved Oxygen (mg/L)
Surface Water First Quarter 2019						
SW-1	3/18/19 8:40 AM	NA	4.61	17.50	14.7	11.01
SW-2	3/18/19 9:10 AM	NA	4.11	45.00	19.9	8.95
SW-3	3/18/19 12:05 PM	NA	4.77	29.80	17.4	11.23
SW-4	3/14/19 10:30 AM	NA	6.16	44.50	22.4	8.15
SW-5	3/18/19 1:10 PM	NA	5.27	64.40	16.7	12.36
SW-6	3/14/19 9:05 AM	NA	5.20	34.30	11.2	7.22
SW-8	3/14/19 11:30 AM	NA	5.97	1536	23.2	6.31
SW-9	3/18/19 10:30 AM	NA	5.02	96.70	14.7	8.82
SW-12A	3/18/19 11:00 AM	NA	5.10	234.0	16.0	12.02
SW-13	3/14/19 9:20 AM	NA	6.21	267.2	14.1	7.20
SW-18	3/18/19 9:45 AM	NA	5.00	20.96	14.4	8.94
SW-19	3/14/19 11:05 AM	NA	4.30	32.60	21.3	6.11
SW-24	3/14/19 10:00 AM	NA	4.64	22.50	20.7	6.61
Groundwater First Quarter 2019						
CPS Wells						
MW-10-06	2/21/19 10:40 AM	8.63	4.46	42.00	17.5	6.29
MW-10-10	2/21/19 12:45 PM	12.76	4.50	36.10	18.9	7.90
MW-15-05	2/26/19 1:00 PM	6.90	4.85	24.56	16.5	6.24
MW-15-06	3/11/19 9:30 AM	26.89	5.27	29.02	18.1	7.17
MW-15-07A	2/27/19 12:30 PM	11.21	4.76	18.89	18.2	7.41
MW-15-08A	2/28/19 10:05 AM	24.71	4.55	28.08	19.1	6.86
PZ-13-12	2/26/19 10:05 AM	10.95	5.73	22.79	17.7	6.71
Bedrock Wells						
MW-10-02	3/4/19 11:50 AM	0.00	6.62	120.8	17.7	0.30
MW-10-05s	3/12/19 1:15 PM	14.81	6.47	165.7	17.3	0.66
MW-10-05d	3/12/19 11:20 AM	14.95	8.64	298.0	17.4	0.65
MW-15-09	2/27/19 10:25 AM	10.85	5.52	50.90	17.7	3.53
MW-15-10	2/28/19 12:35 PM	9.75	6.73	210.5	17.4	2.97
MW-15-11	3/6/19 11:25 AM	4.40	7.13	233.1	16.7	2.99
MW-15-12	3/7/19 11:40 AM	6.15	6.07	173.0	16.9	2.12

Notes:

fbtoc - feet below top of casing

SU - standard pH unit

uS/cm - microsiemens / centimeter

°C - degrees Celsius

mg/L - milligrams per liter

Table 4a

Summary of Groundwater Analytical Results - CPS Wells, First Quarter 2019

Haile Gold Mine

Analyte	Units	CPS Dissolved UBCL	CPS Total UBCL	MW-10-06		MW-10-10		MW-15-05		MW-15-06		MW-15-07A		MW-15-08A		PZ13-12	
				February 21, 2019		February 21, 2019		February 26, 2019		March 11, 2019		Febraury 27, 2019		February 28, 2019		February 26, 2019	
				Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total
Aluminum	ug/L	35000	75000	--	--	--	--	100 U	100 U	3100	690	100 U	100 U	100 U	380	--	--
Arsenic	ug/L	10.6	14	--	--	--	--	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	--	--
Calcium	ug/L	--	--	690	740	1300	1500	1000	1100	1400	1100	500 U	500 U	520	550	500 U	500 U
Copper	ug/L	110	150	--	--	--	--	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	--	--
Iron	ug/L	77000	110000	--	--	--	--	100 U	100 U	850	940	100 U	100 U	100 U	160	--	--
Magnesium	ug/L	--	--	660	710	630	690	500 U	500 U	590	500 U	500 U	500 U	500 U	500 U	500 U	500 U
Manganese	ug/L	1100	3000	--	--	--	--	5.0 U	5.0 U	17	28	5.0 U	5.0 U	5.1	6.3	--	--
Mercury	ug/L	0.6	0.3	--	--	--	--	0.20 U	0.20 U*:J	0.20 U	0.20 U	0.20 U	0.20 U*:J	0.20 U	0.20 U*:J	--	--
Nickel	ug/L	58	0.3	--	--	--	--	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	--	--
Potassium	ug/L	--	--	1000 U	1000 U	1300	1200	1000 U	1000 U	1300	2700	1000 U	1000 U	1000	1100	2400	2200
Sodium	ug/L	--	--	2100	2400	1000 U	1100	1200	1000 U	2100	1800	1100	1000 U	1700	1700	2700	2700
Zinc	ug/L	500	730	--	--	--	--	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	--	--
Acidity as CaCO3	mg/L	--	--	--	20 U	--	20 U	--	20 U	--	20 U	--	20 U	--	20 U	--	20 U
Alkalinity	mg/L	--	--	--	5.0 U	--	5.0 U	--	5.0 U	--	5.0 U	--	5.0 U	--	5.0 U	--	6.3
Ammonia	mg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bicarbonate Alkalinity as CaCO3	mg/L	--	--	--	5.0 U	--	5.0 U	--	5.0 U	--	5.0 U	--	5.0 U	--	5.0 U	--	6.3
Carbonate Alkalinity as CaCO3	mg/L	--	--	--	5.0 U	--	5.0 U	--	5.0 U	--	5.0 U	--	5.0 U	--	5.0 U	--	5.0 U
Chloride	mg/L	--	--	--	4.4	--	2.6	--	2.0	--	2.3	--	1.7	--	1.8	--	1.2
Cyanide, Weak Acid Dissociable	mg/L	--	--	--	0.010 U	--	0.010 U	--	--	--	--	--	--	--	--	--	0.010 U
Fecal Coliform	#/100ml	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nitrate as N	mg/L	--	--	--	1.2	--	1.4	--	0.39	--	1.1	--	0.28	--	0.74 H:J	--	0.17 H:J
Silica	ug/L	--	20000	--	--	--	--	3200	--	13000	--	3500	--	4800	--	--	--
Sulfate	mg/L	--	--	--	1.3	--	1.0 U	--	2.0	--	1.0 U	--	1.0 U	--	1.4	--	1.0 U
Total Dissolved Solids - measured	mg/L	--	440	--	30	--	22	--	17	--	31	--	7.0	--	20	--	17
Total Suspended Solids	mg/L	--	--	--	--	--	--	--	1.0 U	--	360	--	1.0 U	--	29	--	--

Notes:

UBCL = Upper Background Concentration Limit
-- indicates constituent not analyzed
U = Non-Detect
H = Holding time exceedance
J = Value estimated
; separates lab qualifiers from data validation flags
* = LCS or LCSD is outside acceptance limits

CPS = Coastal Plain Sediments
ug/L = micrograms/liter
mg/L = milligrams/liter
#/100ml = number of organisms/100 milliliters

Bold Indicates exceedance of upper background concentration limit (UBCL)
Samples from wells MW-10-06, MW-10-10 and PZ-11-12 were analyzed for "List A" analytes (Appendix A, Groundwater and Surface Water Monitoring Plan, NewFields, 2015)
Samples from wells MW-15-05, MW-15-06, MW-15-07A and MW-15-08A were analyzed for "List B" analytes (Appendix A, Groundwater and Surface Water Monitoring Plan, NewFields, 2015)

Table 4b
Summary of Groundwater Analytical Results - Bedrock Wells, First Quarter 2019
Haile Gold Mine

Analyte	Units	Bedrock Dissolved UBCL	Bedrock Total UBCL	MW-10-02		MW-10-05S		MW-10-05D		MW-15-09		MW-15-10		MW-15-11		MW-15-12	
				March 4, 2019		March 12, 2019		March 12, 2019		March 11, 2019		February 28, 2019		March 6, 2019		March 7, 2019	
				Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total
Aluminum	ug/L	240	1100	100 U	100 U	100 U	270	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U
Antimony	ug/L	7.9	5	--	--	5.0 U	5.0 U	5.0	5.0 U	--	--	--	--	5.0 U	5.0 U	5.0 U	5.0 U
Arsenic	ug/L	38	21	3.0 U	3.0 U	12	7.7	12	12	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U
Boron	ug/L	210	120	--	--	100 U	100 U	100 U	100 U	--	--	--	--	100 U	100 U	100 U	100 U
Calcium	ug/L	--	--	6400	6200	15000	13000	5400	5200	3100	3000	12000	12000	23000	23000	12000	12000
Chromium	ug/L	5	5.6	--	--	5.0 U	5.0 U	5.0 U	5.0 U	--	--	--	--	5.0 U	5.0 U	5.0 U	5.0 U
Chromium(III)	mg/L	--	12.1	--	--	--	0.010 U	--	0.010 U	--	--	--	--	--	0.010 U	--	0.010 U
Chromium(VI)	mg/L	--	35	--	--	--	0.010 UH:J	--	0.10 UH F1:J	--	--	--	--	--	0.010 UH:J	--	0.10 UH:J
Copper	ug/L	6	10	5.0 U	--	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Iron	ug/L	6700	7500	4300	4600	100 U	560	100 U	100 U	100 U	100 U	1900	4300	220	270	100 U	100 U
Lead	ug/L	1.5	3.3			2.5 U	2.5 U	2.5 U	2.5 U	--	--	--	--	2.5 U	2.5 U	2.5 U	2.5 U
Magnesium	ug/L	--	--	2100	2100	5200	5900	690	670	1400	1400	8000	7700	10000	11000	11000	11000
Manganese	ug/L	980	1000	**1100**	**1100**	140	150	5.0 U	5.0 U	49	49	820	780	200	200	41	43
Mercury	ug/L	0.2	0.2	0.20 UF2:J	0.20 UF1:J	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U*:J	0.20 U	0.20 U*:J	0.20 U	0.20 U	0.20 U	0.20 U
Nickel	ug/L	13	17	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.8	6.2	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Potassium	ug/L	--	--	1000 U	1000 U	1300	1100	1500	1200	1000 U	1000 U	1500	1400	1300	1200	1000 U	1000 U
Selenium	ug/L	2.8	3.3	--	--	2.5 U	2.5 U	2.5 U	2.5 U	--	--	--	--	2.5 U	2.5 U	2.5 U	2.5 U
Sodium	ug/L	--	--	10000	9900	15000	15000	61000	59000	3500	3100	15000	15000	7500	8200	4800	5200
Thallium	ug/L	5	5	--	--	1.0 U	1.0 U	1.0 U	1.0 U	--	--	--	--	1.0 U	1.0 U	1.0 U	1.0 U
Zinc	ug/L	100	88	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Acidity as CaCO3	mg/L	--	--	--	20 U	--	20 U	--	20 U	--	20 U	--	21	--	20 U	--	36
Alkalinity	mg/L	--	--	--	35	--	76	--	88	--	12	--	100	--	100	--	73
Ammonia	mg/L	--	--	--	--	--	0.28	--	0.32	--	--	--	--	--	0.25 UF1:J	--	0.36
Bicarbonate Alkalinity as CaCO3	mg/L	--	--	--	35	--	76	--	87	--	12	--	100	--	100	--	73
Carbonate Alkalinity as CaCO3	mg/L	--	--	--	5.0 U	--	5.0 U	--	5.0 U	--	5.0 U	--	5.0 U	--	5.0 U	--	5.0 U
Chloride	mg/L	--	--	--	1.5	--	2.5	--	25	--	3.3	--	4.0	--	2.5	--	3.7
Cyanide, Weak Acid Dissociable	mg/L	--	--	--	--	--	0.010 U	--	0.010 U	--	--	--	--	--	0.010 U	--	0.010 U
Fecal Coliform	#/100ml	--	--		--	--	12	--	2 U	--	--	--	--	--	14	--	28
Nitrate as N	mg/L	--	--	--	0.050 UH:J	--	0.050 UH:J	--	0.050 UH:J	--	0.050 U	--	0.050 UH:J	--	0.050 U	--	0.13
Oil and Grease - TPH	mg/L	--	--	--	--	--	0.25 U	--	0.25 U	--	--	--	--	--	0.25 U	--	0.25 U
orthophosphate	mg/L	--	--	--	--	--	3.9 U	--	4.0 U	--	--	--	--	--	3.6 U	--	3.7 U
Silica	ug/L	41000	41795	--	--	--	0.050 UH:J	--	0.050 UH:J	--	--	--	--	--	0.050 U	--	0.050 U
Sulfate	mg/L	--	--	33000	--	25000	--	8700	--	7200	--	31000	--	32000	--	31000	--
Total Dissolved Solids - measured	mg/L	--	280	--	11	--	7.4	--	14	--	4.3	--	5.1	--	5.9	--	4.0
Total Nitrogen	mg/L	--	--	--	99	--	130	--	200	--	31	--	140	--	150	--	120
Total Suspended Solids	mg/L	--	--	--	1.0 U	--	180	--	1.0 U	--	1.0 U	--	1.2	--	1.0 U	--	1.0 U

Notes:

UBCL = Upper Background Concentration Limit
-- indicates constituent not analyzed
U = Non-Detect
J = Value estimated
H = Holding time exceedance
F1 = MS/MSD recovery outside of acceptance limits.
F2 = MS/MSD %RPD is outside acceptance limits
* = LCS or LCSD is outside acceptance limits
: = separates lab qualifiers from data validation flags

ug/L = micrograms/liter
mg/L = milligrams/liter
#/100ml = number of organisms/100 milliliters

Bold Indicates exceedance of upper background concentration limit (UBCL)
Samples from wells MW-10-02, MW-15-09 and MW-15-10 were analyzed for "List B" analytes (Appendix A, Groundwater and Surface Water Monitoring Plan, NewFields, 2015)
Samples from wells MW-10-05S, MW-10-05D, MW-15-11 and MW-15-12 were analyzed for "List C" analytes (Appendix A, Groundwater and Surface Water Monitoring Plan, NewFields, 2015)

Table 5
Summary of Surface Water Analytical Results, First Quarter 2019
Haile Gold Mine

Analyte	Units	SW-01			SW-02			SW-03			SW-04			SW-05			SW-06			SW-08		
		March 18, 2019			March 18, 2019			March 18, 2019			March 14, 2019			March 18, 2019			March 14, 2019			March 14, 2019		
		Dissolved	UBLC Total	Total	Dissolved	UBLC Total	Total	Dissolved	UBLC Total	Total	Dissolved	UBLC Total[1]	Total	Dissolved	UBLC Total	Total	Dissolved	UBLC Total[1]	Total	Dissolved	UBLC Total	Total
Aluminum	ug/L	220	1051.0	230	100 U	1051.0	100 U	210	768.5	560	310		210	260	1737	310	250		230	100 U	1250.0	230
Antimony	ug/L	--		--	--		--	5.0 U	5.0	5.0 U	--		--	--	5.0	--	--		--	--		--
Arsenic	ug/L	3.0 U	2.5	3.0 U	3.0 U	2.5	3.0 U	3.0 U	2.5	3.0 U	3.0 U		3.0 U	3.0 U	2.5	3.0 U	3.0 U		3.0 U	3.0 U	3.2	3.0 U
Boron	ug/L	--		--	--		--	100 U	100.0	100 U	--		--	--		--	--		--	--		--
Cadmium	ug/L	--		--	--		--	0.50 U	0.5	0.50 U	--		--	--		--	--		--	--		--
Calcium	ug/L	500 U		500 U	2400		2500	1500		1600	2400		2400	3800		3900	1000		740	270000		270000
Chromium	ug/L	--		--	--		--	5.0 U	5.0	5.0 U	--		--	--		--	--		--	--		--
Chromium(III)	mg/L	--		--	--		--	--	1.0	0.010 U	--		--	--		--	--		--	--		--
Chromium(VI)	mg/L	--		--	--		--	--	1.0	0.010 UH:J	--		--	--		--	--		--	--		--
Copper	ug/L	5.0 U	5.0	5.0 U	5.0 U	5.0	5.0 U	5.0 U	5.0	5.0 U	5.0 U		5.0 U	5.0 U	5.4	5.0 U	5.0 U		5.0 U	5.0 U	5.0	5.0 U
Iron	ug/L	140	3322.0	160	100 U	3322.0	210	200	4982.0	560	440		480	530	2056	800	460		490	350	6527.0	710 (1689.2)
Lead	ug/L	--		--	--		--	2.5 U	1.5	2.5 U	--		--	--		--	--		--	--		--
Magnesium	ug/L	500 U		500 U	980		1000	1000		1100	1500		1500	2000		2000	650		630	60000		61000
Manganese	ug/L	11	920.0	11	90	920.0	92	17	93.2	53	58		60	5.0 U	1100	60	31		27	6100	3276.0	6300
Mercury	ug/L	0.20 U	0.2	0.20 U	0.20 U	0.2	0.20 U	0.20 U	0.2	0.20 UF1 F2:J	0.20 U		0.20 U	0.20 U	0.2	0.20 U	0.20 UF2:J		0.20 U	0.20 U	0.2	0.20 U
Nickel	ug/L	5.0 U	5.0	5.0 U	5.0 U	5.0	5.0 U	5.0 U	5.0	5.0 U	5.0 U		5.0 U	5.0 U	5.0	5.0 U	5.0 U		5.0 U	23	37.0	23
Potassium	ug/L	1000 U		1000 U	1100		1100	1000 U		1000 U	1000 U		1000 U	1500		1400	1000		1000 U	5000		4700
Selenium	ug/L	--		--	--		--	2.5 U	2.5	2.5 U	--		--	--		--	--		--	--		--
Sodium	ug/L	1200		1100	2400		2300	2200		2200	2200		2500	5200		4800	1500		1900	10000		10000
Thallium	ug/L	--		--	--		--	1.0 U	1.0	1.0 U	--		--	--		--	--		--	--		--
Zinc	ug/L	20 U	85.0	20 U	20 U	85.0	20 U	20 U	52.8	20 U	20 U		20 U	20 U	375	20 U	20 U		20 U	20 U	198.6	20 U
Acidity as CaCO3	mg/L	--		20 U	--		20 U	--		20 U	--		20 U	--		20 U	--		20 U	--		20 U
Alkalinity	mg/L	--		5.0 U	--		5.2	--		8.1	--		9.8	--		18	--		5.0 U	--		5.5
Ammonia	mg/L	--		0.25 U	--		0.25 U	--		0.25 U	--		29	--		0.25 U	--		0.32	--		3.6
Bicarbonate Alkalinity as CaCO3	mg/L	--		5.0 U	--		5.2	--		8.1	--		9.8	--		18	--		5.0 U	--		5.5
Carbonate Alkalinity as CaCO3	mg/L	--		5.0 U	--		5.0 U	--		5.0 U	--		5.0 U	--		5.0 U	--		5.0 U	--		5.0 U
Chloride	mg/L	--		2.0	--		3.0	--		2.4	--		2.4	--		4.8	--		2.4	--		5.0
Cyanide, Weak Acid Dissociable	mg/L	--		--	--		--	--		0.010 U	--		--	--		--	--		--	--		--
Fecal Coliform	#/100ml	--		--	--		--	--		14	--		--	--		--	--		--	--		--
Nitrate as N	mg/L	--		0.075	--		0.64	--		0.14	--		0.12	--		0.24	--		0.15	--		2.0 E:J
Oil and Grease - TPH	mg/L	--		0.28	--		0.74	--		0.36	--		0.25 U	--		0.47	--		0.41	--		3.1
orthophosphate	mg/L	--		--	--		--	--		3.7 U	--		--	--		--	--		--	--		--
Silica	ug/L	--		0.050 U	--		0.061	--		0.050 UF1:J	--		0.050 U	--		0.050 U	--		0.050 U	--		0.050 UF1:J
Sulfate	mg/L	3100	11824	--	7200	11824	--	8100	15421	--	10000		--	15000	24486	--	4400		--	3300	10455.0	--
Total Dissolved Solids - measured	mg/L	--		1.3	--		7.2	--		2.5	--		2.2	--		4.5	--		1.3	--		950
Total Nitrogen	mg/L	--	89.8	14	--	89.8	29	--	101.5	32	--		39	--	157.6	52	--		33	--	439.9	**1300 (1300.6)**
Total Suspended Solids	mg/L	--		6.2	--		1.5	--		4.6	--		4.0	--		6.0	--		6.4	--		4.1
Turbidity	NTU	--		1.8	--		1.5	--		4.6	--		6.6	--		6.6	--		3.2	--		1.6

Notes:

UBCL = Upper Background Concentration Limit
-- Indicates analyte not sampled
U = Non-Detect
H = Holding time exceedance
J = Value estimated
F1 = MS and/or MSD recovery is outside acceptance limits
F2 = MS/MSD %RPD is outside acceptance limits
; separates lab qualifiers from data validation flags
1. No historic data are available, UBCLs were not developed

ug/L = micrograms/liter
mg/L = milligrams/liter
#/100ml = number of organisms/100 milliliters
NTU = nephelometric turbidity units

Bold Indicates exceedance of upper background concentration limit (UBCL)
Samples from SW-1, SW2, SW-6, SW-8, SW-9, SW-13, SW-18, SW-19 and SW-24 were analyzed for "List D" analytes (Appendix A, Groundwater and Surface Water Monitoring Plan, NewFields, 2015
Samples from SW-3 and SW-12A were analyzed for "List E" analytes (Appendix A, Groundwater and Surface Water Monitoring Plan, NewFields, 2015

x(y) = Laboratory result [x] followed by the concentration in parentheses that is adjusted for seasonality [y], e.g., 790 (545)

Table 5
Summary of Surface Water Analytical Results, First Quarter 2019
Haile Gold Mine

Analyte	Units	SW-09			SW-12A			SW-13			SW-18			SW-19			SW-24		
		March 18, 2019			March 18, 2019			March 14, 2019			March 18, 2019			March 14, 2019			March 14, 2019		
		Dissolved	UBLC Total	Total	Dissolved	UBLC Total	Total	Dissolved	UBLC Total	Total	Dissolved	UBLC Total	Total	Dissolved	UBLC Total	Total	Dissolved	UBLC Total	Total
Aluminum	ug/L	100 U	1503.0	310	170	1747.0	580	410	1733.0	210	340	507.0	420 (480.5)	320	381.40	**360 (408.5)**	220	995.9	260
Antimony	ug/L	--		--	5.0 U	5.0	5.0 U	--		--	--		--	--		--	--		--
Arsenic	ug/L	3.0 U	3.5	3.0 U	3.0 U	2.5	3.0 U	3.0 U	5.2	3.0 U	3.0 U	2.5	3.0 U	3.0 U	2.5	3.0 U	3.0 U	9.9	3.0 U
Boron	ug/L	--		--	100 U	100.0	100 U	--		--	--		--	--		--	--		--
Cadmium	ug/L	--		--	0.50 U	0.5	0.50 U	--		--	--		--	--		--	--		--
Calcium	ug/L	160000		160000	27000		29000	13000		12000	500 U		500 U	760		750	500 U		500 U
Chromium	ug/L	--		--	5.0 U	5.0	5.0 U	--		--	--		--	--		--	--		--
Chromium(III)	mg/L	--		--	--	1.0	0.010 U	--		--	--		--	--		--	--		--
Chromium(VI)	mg/L	--		--	--	10.0	0.010 UH:J	--		--	--		--	--		--	--		--
Copper	ug/L	5.0 U	5.0	5.0 U	5.0 U	5.6	5.0 U	5.0 U	1.9	5.0 U	5.0 U	5.0	5.0 U	5.0 U	38.0	5.0 U	5.0 U	5.0	5.0 U
Iron	ug/L	170	5186.0	1600	510	3343.0	1300	760	4365.0	800 (1336.6)	270	371.0	**330 (415.6)**	210	879.4	250 (431.5)	150	4140.0	170 F1 F2:J
Lead	ug/L	--		--	2.5 U	1.5	2.5 U	--		--	--		--	--		--	--		--
Magnesium	ug/L	32000		32000	6500		6900	4000		3700	500 U		500 U	610		600	500 U		500 U
Manganese	ug/L	910	5900.0	980	81	1700.0	210	230	788.4	240 (361.8)	25	15.7	**27**	49	100.0	45	13	368.0	15
Mercury	ug/L	0.20 U	0.2	0.20 U	0.20 U	0.2	0.20 U	0.20 U	0.2	0.20 U	0.20 U	0.2	0.20 U	0.20 U	0.20	0.20 U	0.20 U	1.1	0.20 U
Nickel	ug/L	9.8	49.0	11	5.0 U	5.0	5.0 U	5.0 U	5.2	5.0 U	5.0 U	5.0	5.0 U	5.0 U	56.0	5.0 U	5.0 U	5.0	5.0 U
Potassium	ug/L	3300		2900	1800		1700	1700		1400	1000 U		1000 U	1000 U		1000 U	1000 U		1000 U
Selenium	ug/L	--		--	2.5 U	2.5	2.5 U	--		--	--		--	--		--	--		--
Sodium	ug/L	7700		7500	5300		5400	4300		3900	1000 U		1000 U	1200		1100	1000 U		1000 U
Thallium	ug/L	--		--	1.0 U	1.0	1.0 U	--		--	--		--	--		--	--		--
Zinc	ug/L	20 U	470.0	20 U	20 U	150.0	20 U	20 U	42.9	20 U	20 U	5800.0	20 U	20 U	80.0	20 U	20 U	598.0	20 U
Acidity as CaCO3	mg/L	--		20 U	--		20 U	--		20 U	--		20 U	--		20 U	--		20 U
Alkalinity	mg/L	--		5.0 U	--		32	--		14	--		5.0 U	--		5.0 U	--		5.0 U
Ammonia	mg/L	--		0.85	--		0.25 U	--		0.27	--		0.25 U	--		0.25 U	--		0.88
Bicarbonate Alkalinity as CaCO3	mg/L	--		5.0 U	--		32	--		14	--		5.0 U	--		5.0 U	--		5.0 U
Carbonate Alkalinity as CaCO3	mg/L	--		5.0 U	--		5.0 U	--		5.0 U	--		5.0 U	--		5.0 U	--		5.0 U
Chloride	mg/L	--		4.3	--		4.8	--		4.0	--		1.9	--		2.2	--		1.7
Cyanide, Weak Acid Dissociable	mg/L	--		--	--		0.010 U	--		--	--		--	--		--	--		--
Fecal Coliform	#/100ml	--		--	--		8	--		--	--		--	--		--	--		--
Nitrate as N	mg/L	--		1.3	--		0.38	--		0.33	--		0.050 U	--		0.050 U	--		0.13
Oil and Grease - TPH	mg/L	--		1.9	--		0.78	--		0.61	--		0.35	--		0.41	--		0.40
orthophosphate	mg/L	--		--	--		3.8 U	--		--	--		--	--		--	--		--
Silica	ug/L	--		0.050 U	--		0.050 U	--		0.050 U	--		0.050 UH:J	--		0.050 U	--		0.050 U
Sulfate	mg/L	6300	12377.0	--	11000		--	13000		--	3600		--	4900		--	4200		--
Total Dissolved Solids - measured	mg/L	--		530	--		83	--		36	--		1.1	--		4.7	--		1.1
Total Nitrogen	mg/L	--	249.2	**790**	--	136.5	**150**	--	160.0	99	--	89.3	14 (15)	--	93.30	35 (36.4)	--	211.9	31
Total Suspended Solids	mg/L	--		11	--		16	--		10	--		3.2	--		16	--		2.2
Turbidity	NTU	--		3.1	--		98	--		9.6	--		5.1	--		2.9	--		2.0

Notes:

UBCL = Upper Background Concentration Limit
-- Indicates analyte not sampled
U = Non-Detect
H = Holding time exceedance
J = Value estimated
F1 = MS and/or MSD recovery is outside acceptance limits
F2 = MS/MSD %RPD is outside acceptance limits
; separates lab qualifiers from data validation flags

ug/L = micrograms/liter
mg/L = milligrams/liter
#/100ml = number of organisms/100 milliliters
NTU = nephelometric turbidity units

Bold Indicates exceedance of upper background concentration limit (UBCL)
Samples from SW-1, SW2, SW-6, SW-9, SW-13, SW-18, SW-19 and SW-24 were analyzed for "List D" analytes (Appendix A, Groundwater and Surface Water Monitoring Plan, NewFields, 2015
Samples from SW-3 and SW-12A were analyzed for "List E" analytes (Appendix A, Groundwater and Surface Water Monitoring Plan, NewFields, 2015

Table 6
Accounting of Stream Flow Quantity Monitoring, First Quarter 2019
Haile Gold Mine

Surface Water Location I.D. [1]	Type	Location Description	Purpose	First Quarter 2019 Data
Camp Branch Creek				
SW-4	Downstream of mine facilities	Lower Camp Branch Creek	Monitor Lower Camp Branch Creek Basin at confluence with Little Lynches River	See hydrographs presented in Appendix C
SW-3	Downstream of mine facilities, Permit Boundary location	Upper Camp Branch Creek below the TSF at permit boundary	Monitor Upper Camp Branch Creek Basin 1) at the permit boundary and 2) downstream of the TSF	See hydrographs presented in Appendix C
Little Lynches River and Tributaries				
SW-15	Upstream of mine facilities	Little Lynches River, upstream of confluence with Camp Branch Creek	Monitor background in Little Lynches River upstream of permit boundary	Installed by USGS, rating curve under development.
SW-13	Downstream of mine facilities	Little Lynches River, monitor waters downstream of mine facilities and permit boundary	Monitor waters downstream permit boundary	Installed by USGS, rating curve under development.
SW-24	Downstream of mine facilities	Unnamed tributary along southeast side of permit boundary that flows into Little Lynches River	Monitor waters that originate along southeast permit boundary	See hydrographs presented in Appendix C
Haile Gold Mine Creek				
SW-19	Downstream of mine facilities	Upper Haile Gold Mine Creek	Monitor Upper Haile Gold Mine Creek downstream of mine facilities	See hydrographs presented in Appendix C
SW-8	Downstream of mine facilities	Lower Haile Gold Mine Creek	Monitor Lower Haile Gold Mine Creek downstream of mine facilities	See hydrographs presented in Appendix C
SW-9	Downstream of mine facilities	Lower Haile Gold Mine Creek at permit boundary	Monitor Lower Haile Gold Mine Creek 1) at the permit boundary and 2) downstream of mine facilities	See hydrographs presented in Appendix C
Adjacent Watershed				
SW-6	Background in adjacent watershed	Buffalo Creek to east of site	Monitor in adjacent basin to assess natural hydrology changes unrelated to mine activities	Installed by USGS, rating curve under development.

Notes:

USGS - United States Geological Survey

TSF - Tailings Storage Facility

1. Surface water monitoring stations IDs are designated in Groundwater and Surface Water Monitoring Plan (NewFields, 2015)

Table 7
Depressurization Well Pumping Volumes, First Quarter 2019
Haile Gold Mine

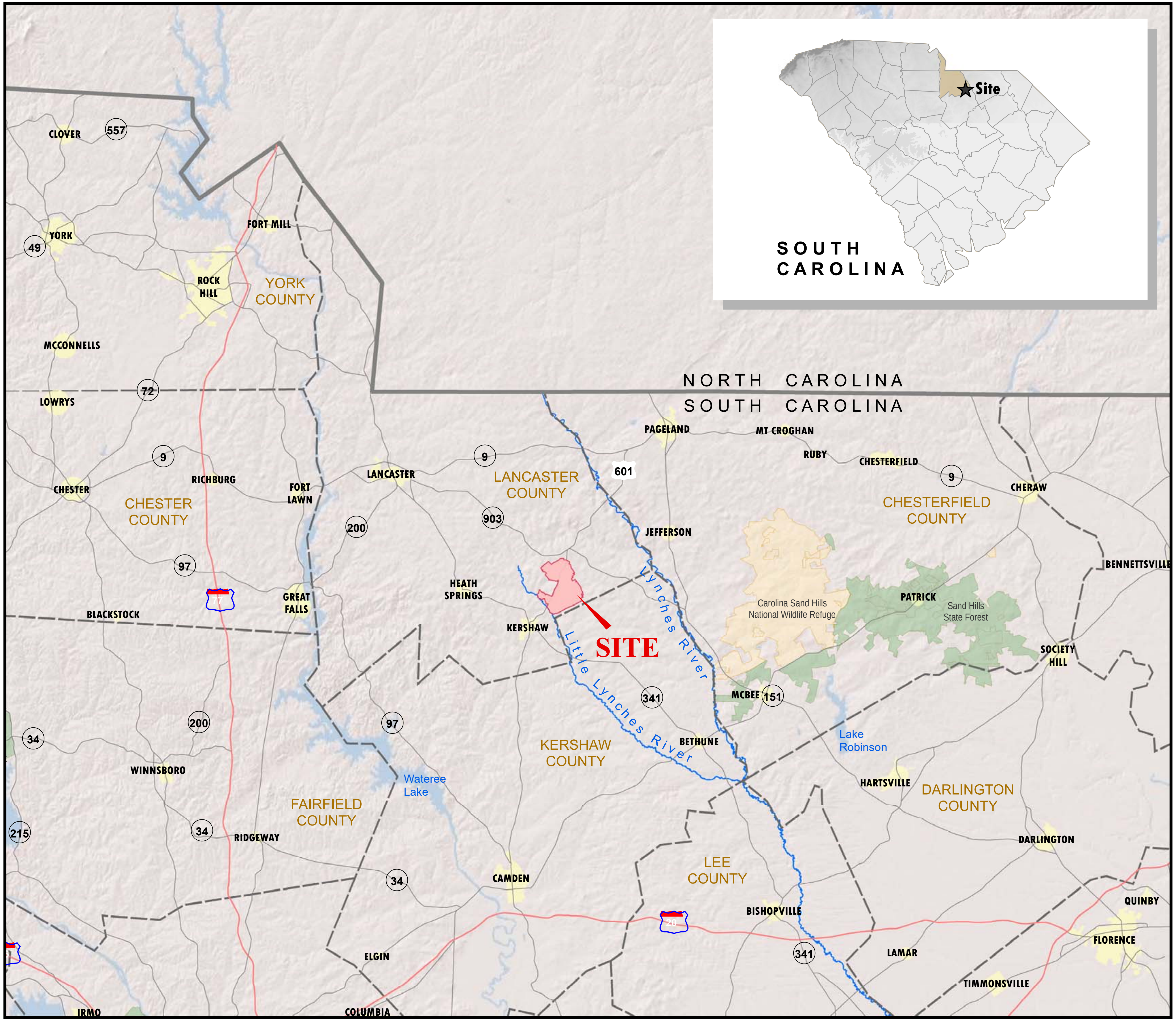
Depressurization Well I.D.	First Quarter 2019				Total Since Start of Pumping (acre-feet)
	Jan 2019	Feb 2019	Mar 2019	Q1 Total	
	(acre-feet)	(acre-feet)	(acre-feet)	(acre-feet)	
Mill Zone Pit					
DW-15-05	0.7	0.7	0.7	2.1	24.3
DW-15-07A	0.0	0.0	0.0	0.0	17.8
DW-15-09	2.9	1.9	2.4	7.2	258.5
Subtotal	3.6	2.6	3.1	9.3	*Mill Zone Pit Total:*
Mill Zone Pit pump volume from nonoperating wells prior to Q1 2019: 807.0*					*1,107.6*
Snake Pit					
PW-09-01	4.8	9.8	9.8	24.5	499.7
DW-16-01R	0.0	3.0	5.9	8.9	8.9
DW-16-03	12.9	10.1	11.0	34.0	381.4
DW-16-04R	3.0	6.1	13.4	22.6	22.6
DW-17-13	2.4	2.1	2.2	6.7	22.2
DW-18-11	11.1	13.5	5.8	30.3	41.5
DW-18-12	0.0	0.0	0.0	0.0	2.0
Subtotal	34.2	44.6	48.2	127.0	*Snake Pit Total:*
*Snake Pit pump volume from nonoperating wells** prior to Q1 2019: 755.6*					*1,733.9*
Combined Mill Zone and Snake Pits					
Total	**37.8**	**47.2**	**51.3**	**136.3**	2,841.6

Notes:

*Mill Zone Pit nonoperating wells: DW-15-01, DW-15-02, DW-15-03, DW-15-04, DW-15-06, DW-15-07, DW-15-08, DW-15-10

**Snake Pit nonoperating wells: DW-16-01, DW-16-04

FIGURES

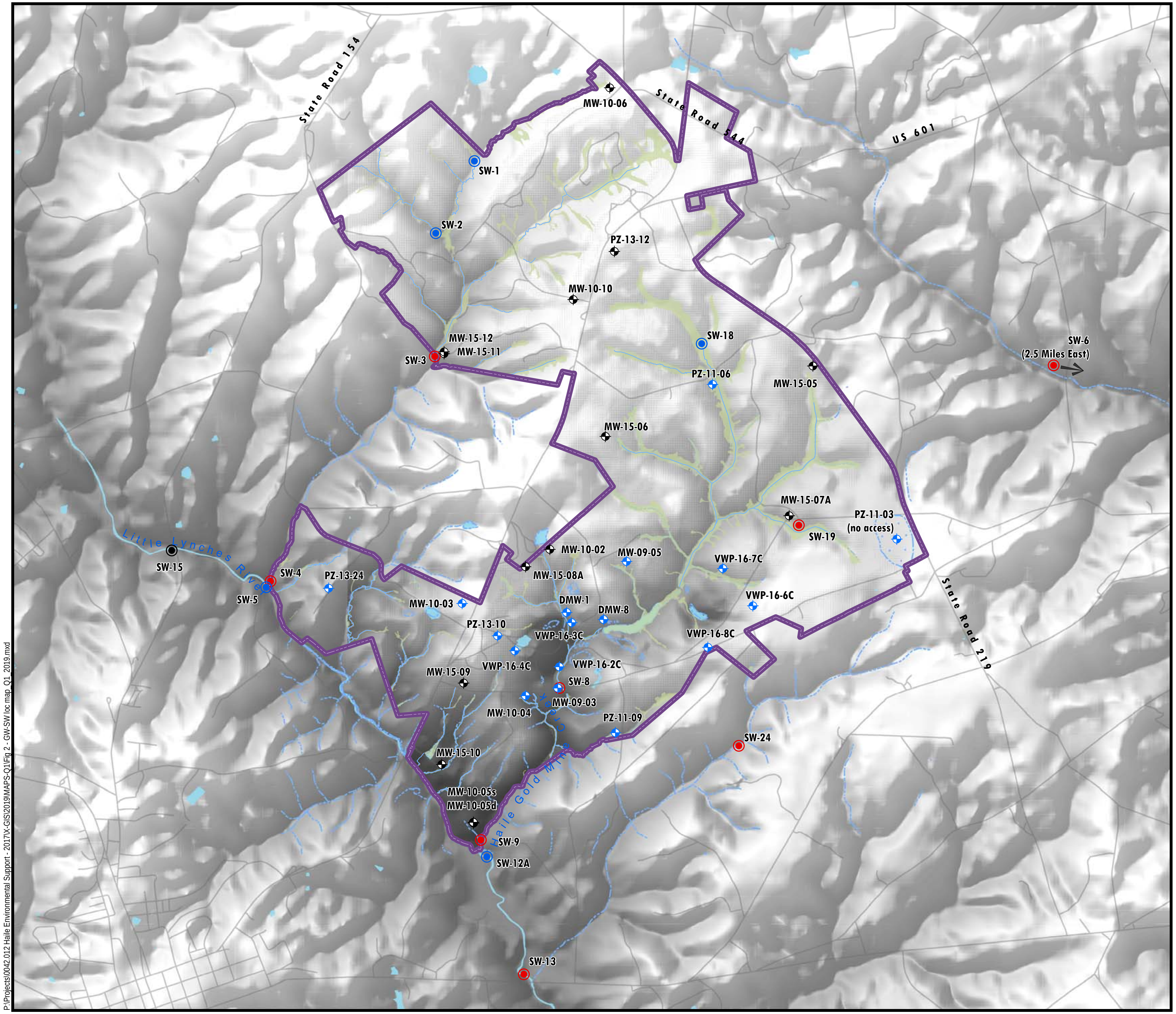


N

0 2.5 5 10
Miles

NewFields	CLIENT	HAILE GOLD MINE	
PROJECT	FIRST QUARTER 2019 GROUNDWATER AND SURFACE WATER MONITORING REPORT		
TITLE	SITE LOCATION MAP	FILENAME Fig 1 - SiteLocationMap.mxd	
		FIGURE NO. 1	REV A

P:\Projects\0042.012 Haile Environmental Support - 2017\X-GIS\2019\MAPS-Q1\Fig 1 - SiteLocationMap.mxd



Legend

— Streams

— Roads

▭ Permit_Boundary

🟩 Wetlands

Q1 2019 Monitoring Locations

Groundwater Monitoring

⊕ Water Level and Water Quality

⊕ Water Level Monitoring

Surface Water Monitoring

● Stream Flow

🔵 Water Quality

🔴 Water Quality and Stream Flow

Source:
From Groundwater and Surface Water Monitoring Plan
(NewFields, 2015a)

Notes:

Monitoring wells and vibrating wire piezometers DMW-1, DMW-8, MW-09-03, MW-09-05, MW-10-04, PZ-13-10, VWP-16-02C, VWP-16-03C, VWP-16-04C, VWP-16-06C, VWP-16-07C, and VWP-16-08C are not specified in the Monitoring Plan but were monitored to supplement groundwater elevation data.

N

0 1,000 2,000 4,000
Feet

NewFields

CLIENT HAILE GOLD MINE

PROJECT FIRST QUARTER 2019 GROUNDWATER AND SURFACE WATER MONITORING REPORT

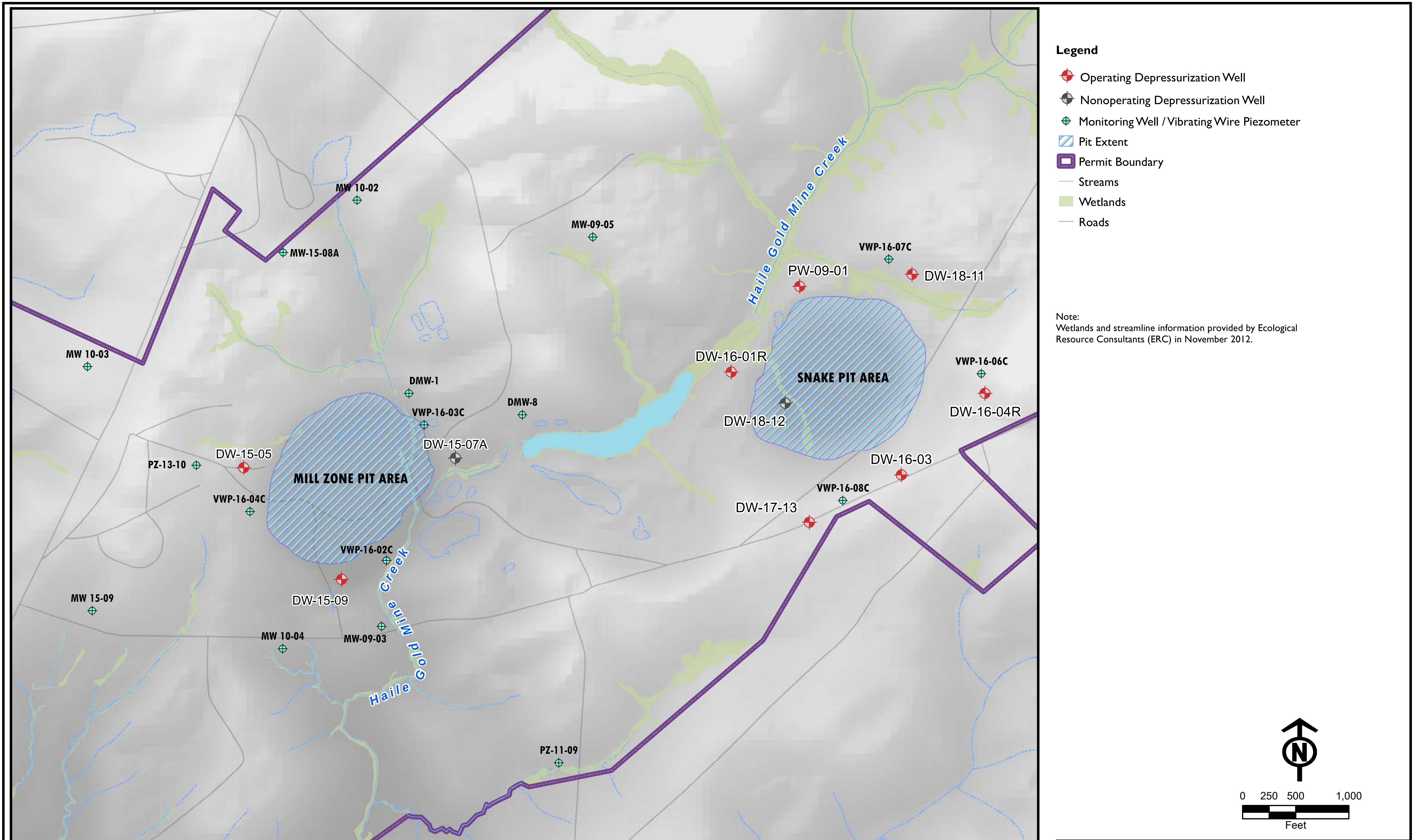
TITLE GROUNDWATER AND SURFACE WATER SAMPLE LOCATION MAP, FIRST QUARTER 2019

FILENAME Fig 2 - GW-SW loc map_Q1_2019.mxd

FIGURE NO. 2

REV A

P:\Projects\0042.012 Haile Environmental Support - 2017\X-GIS\2019\MAPS-Q1\Fig 2 - GW-SW loc map_Q1_2019.mxd



Note:
Wetlands and streamline information provided by Ecological Resource Consultants (ERC) in November 2012.

NewFields

CLIENT
HAILE GOLD MINE

PROJECT
FIRST QUARTER 2019 GROUNDWATER AND SURFACE WATER MONITORING REPORT

TITLE
DEPRESSURIZATION WELL MONITORING LOCATION MAP
FIRST QUARTER 2019

FILENAME
Fig 3 - Depr_Q1_2019.mxd

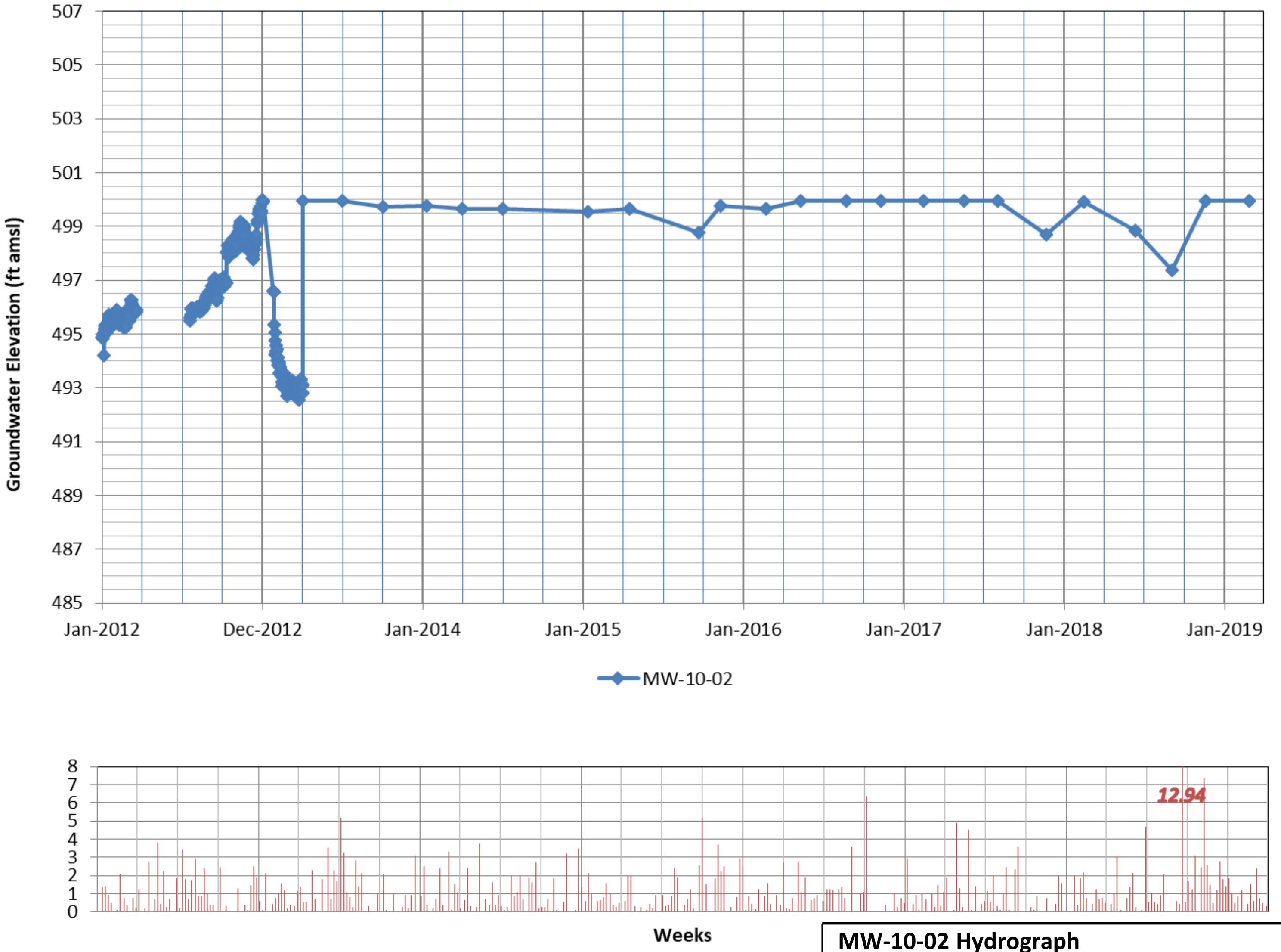
FIGURE NO.
3

REV
A

P:\Projects\0042.012 Haile Environmental Support - 2017\X-GIS\2019\MAPS-Q1\Fig 3 - Depr_Q1_2019.mxd

APPENDIX A

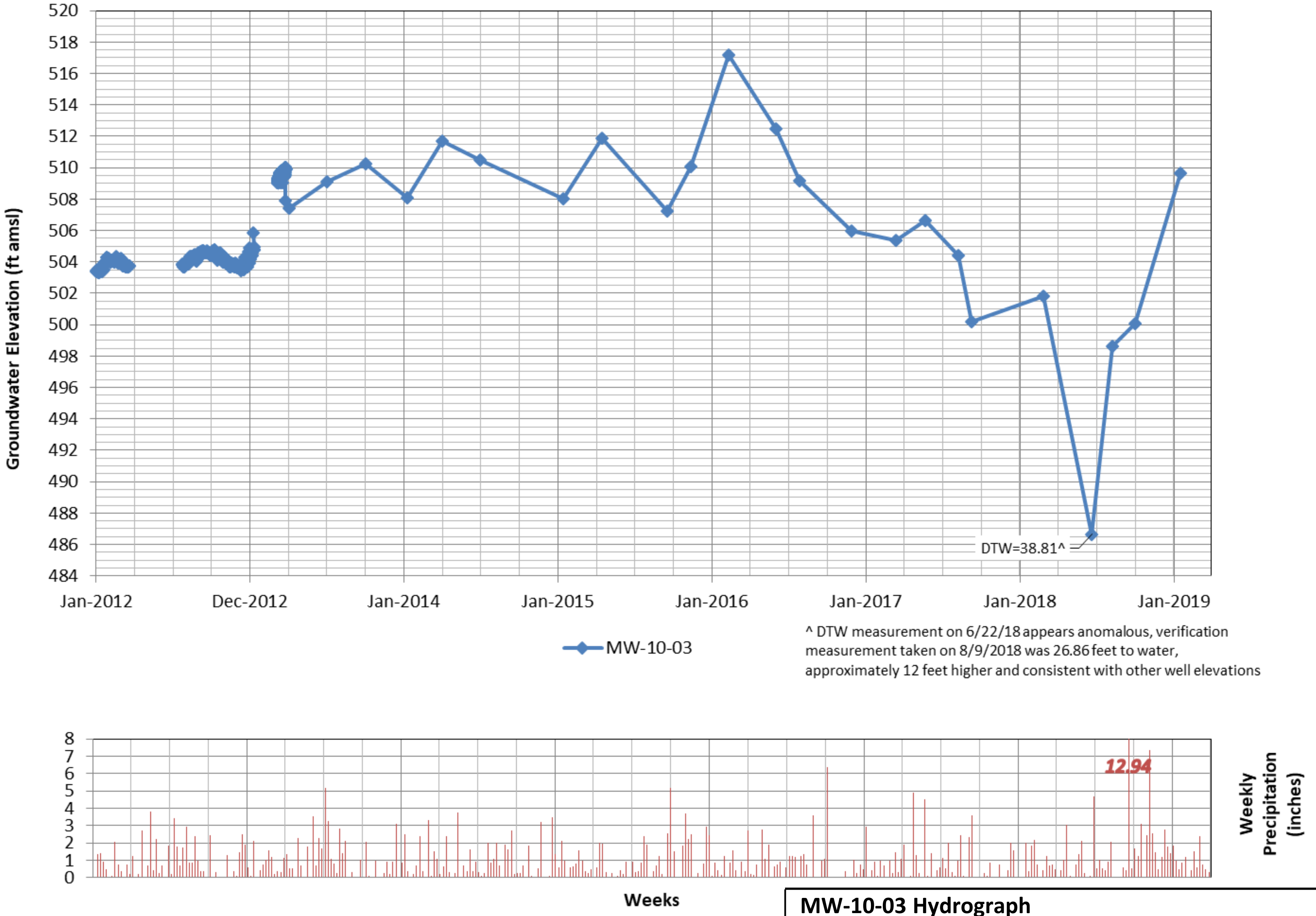
Groundwater Monitoring Well Hydrographs



MW-10-02 Hydrograph

First Quarter 2019 Groundwater and Surface Water Monitoring Report

By: KKS	Date: 4-29-2019	Project No. 475.0042.012
NewFields		**Figure A-1**



^ DTW measurement on 6/22/18 appears anomalous, verification measurement taken on 8/9/2018 was 26.86 feet to water, approximately 12 feet higher and consistent with other well elevations

MW-10-03 Hydrograph

First Quarter 2019 Groundwater and Surface Water Monitoring Report

By: KKS	Date: 5-3-2019	Project No. 475.0042.012
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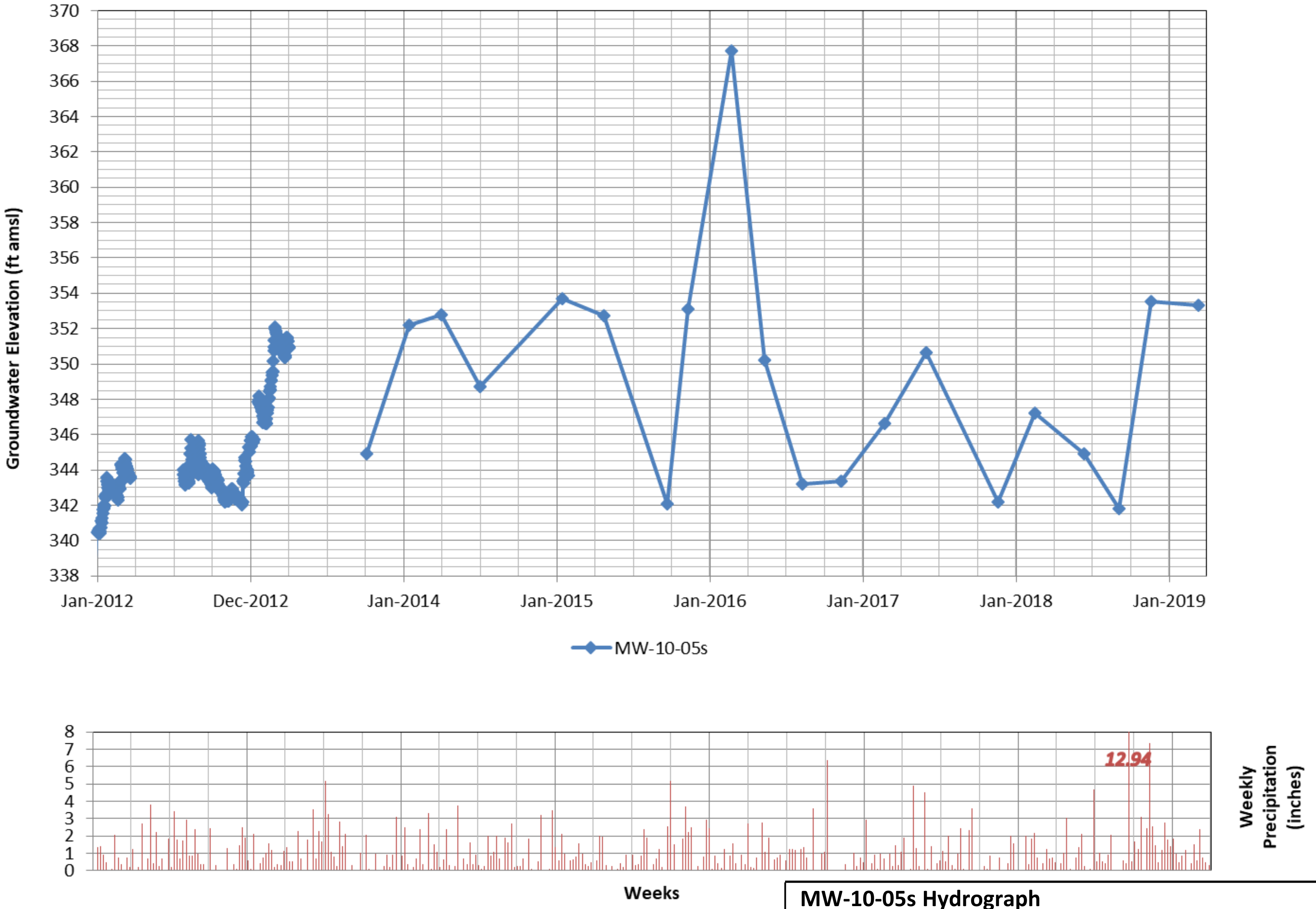

MW-10-05s Hydrograph

First Quarter 2019 Groundwater and Surface Water Monitoring Report

By: KKS	Date: 4-29-2019	Project No. 475.0042.012
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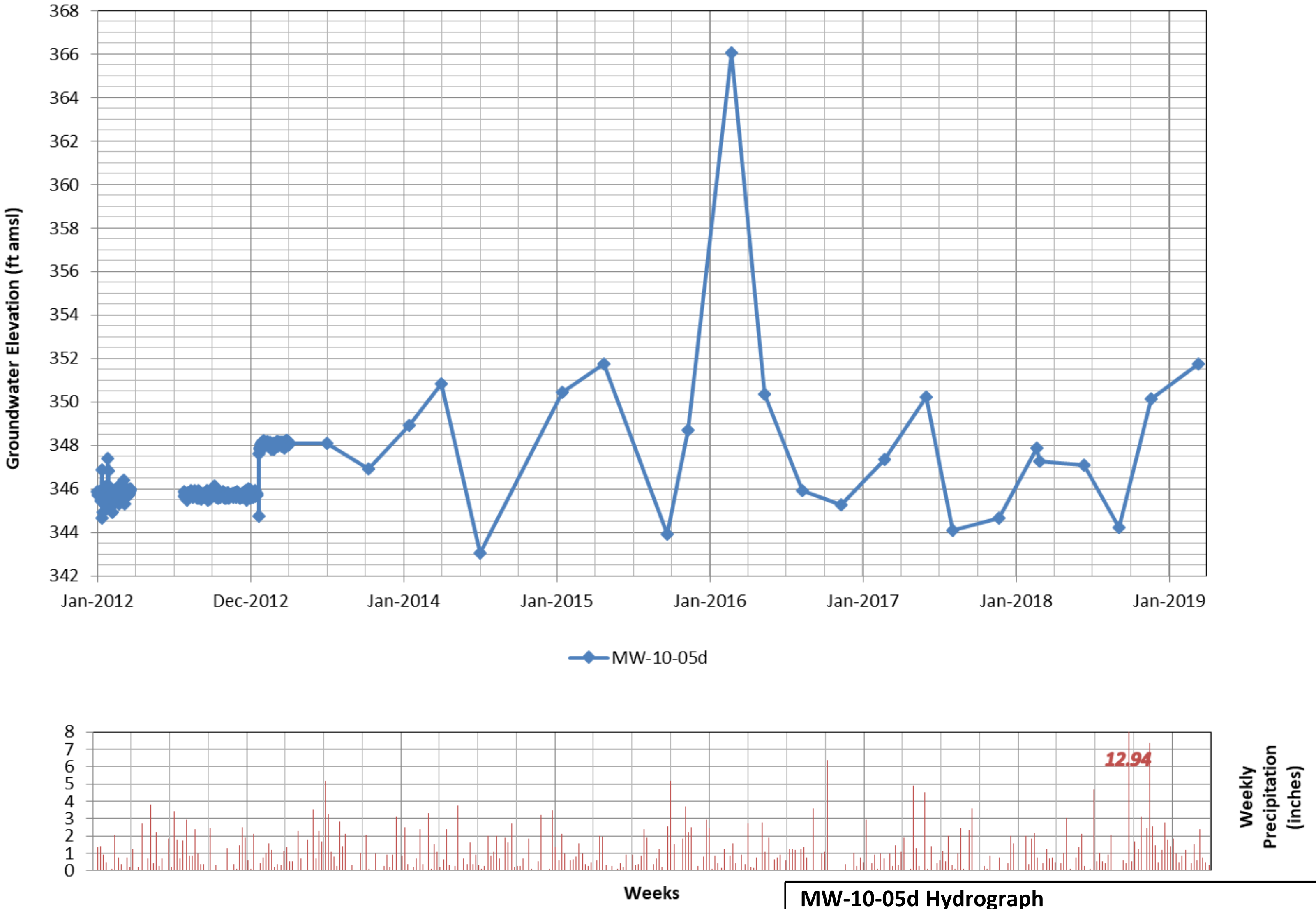

MW-10-05d Hydrograph

First Quarter 2019 Groundwater and Surface Water Monitoring Report

By: KKS	Date: 4-29-2019	Project No. 475.0042.012
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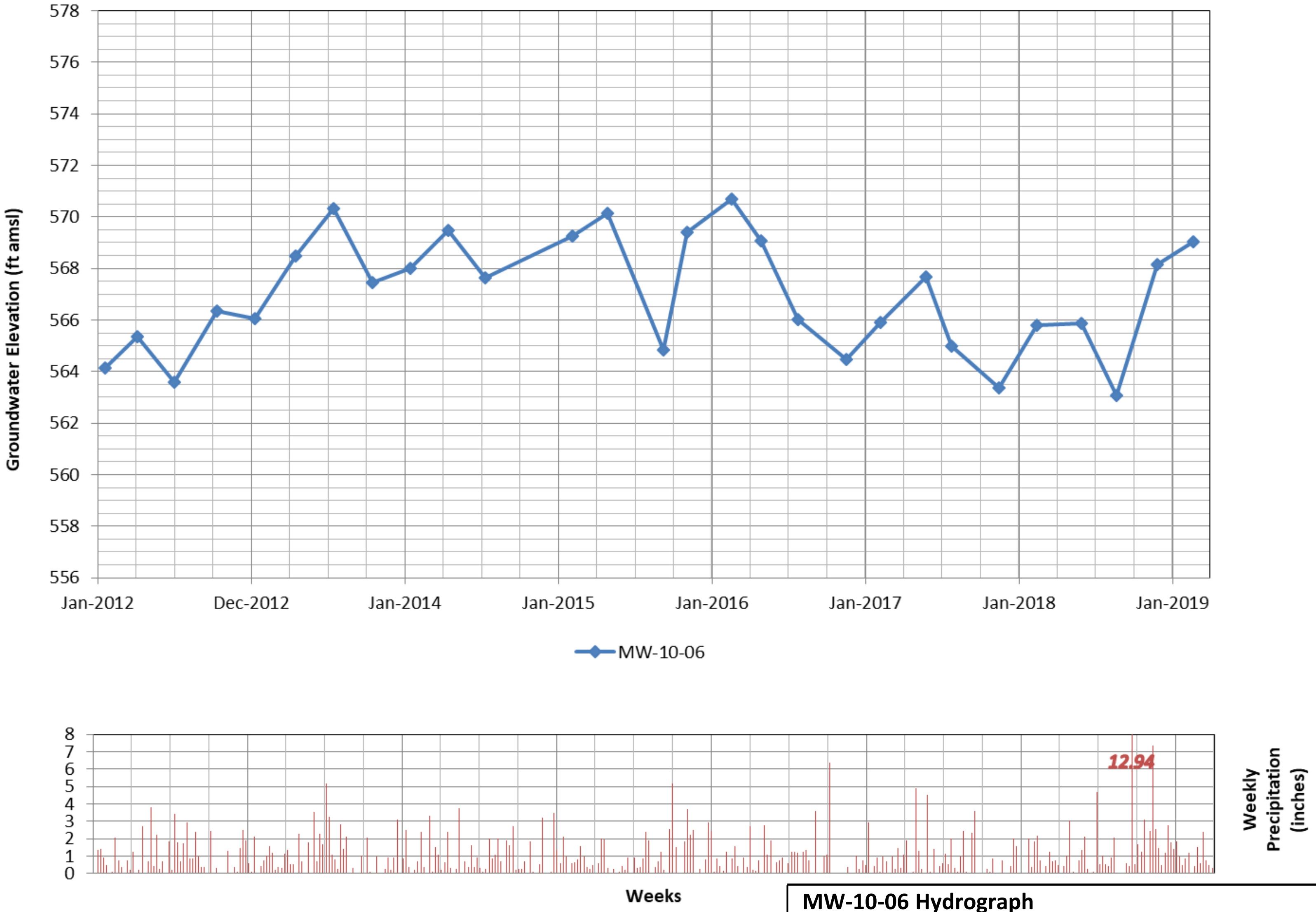

MW-10-06 Hydrograph

First Quarter 2019 Groundwater and Surface Water Monitoring Report

By: KKS	Date: 4-29-2019	Project No. 475.0042.012
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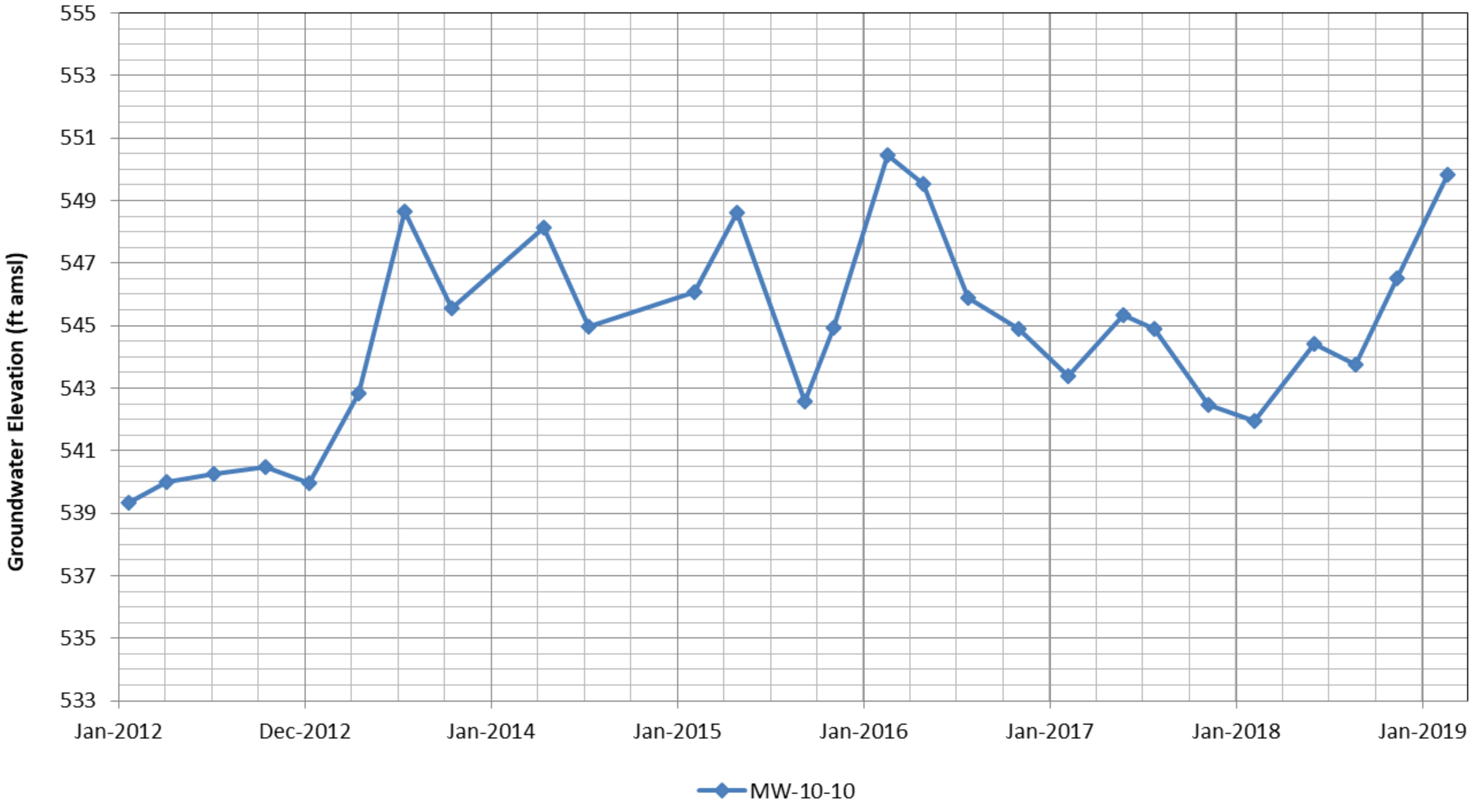
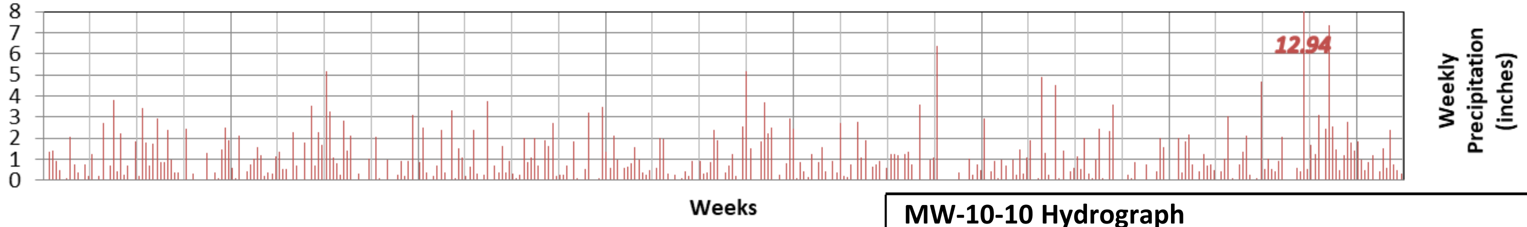
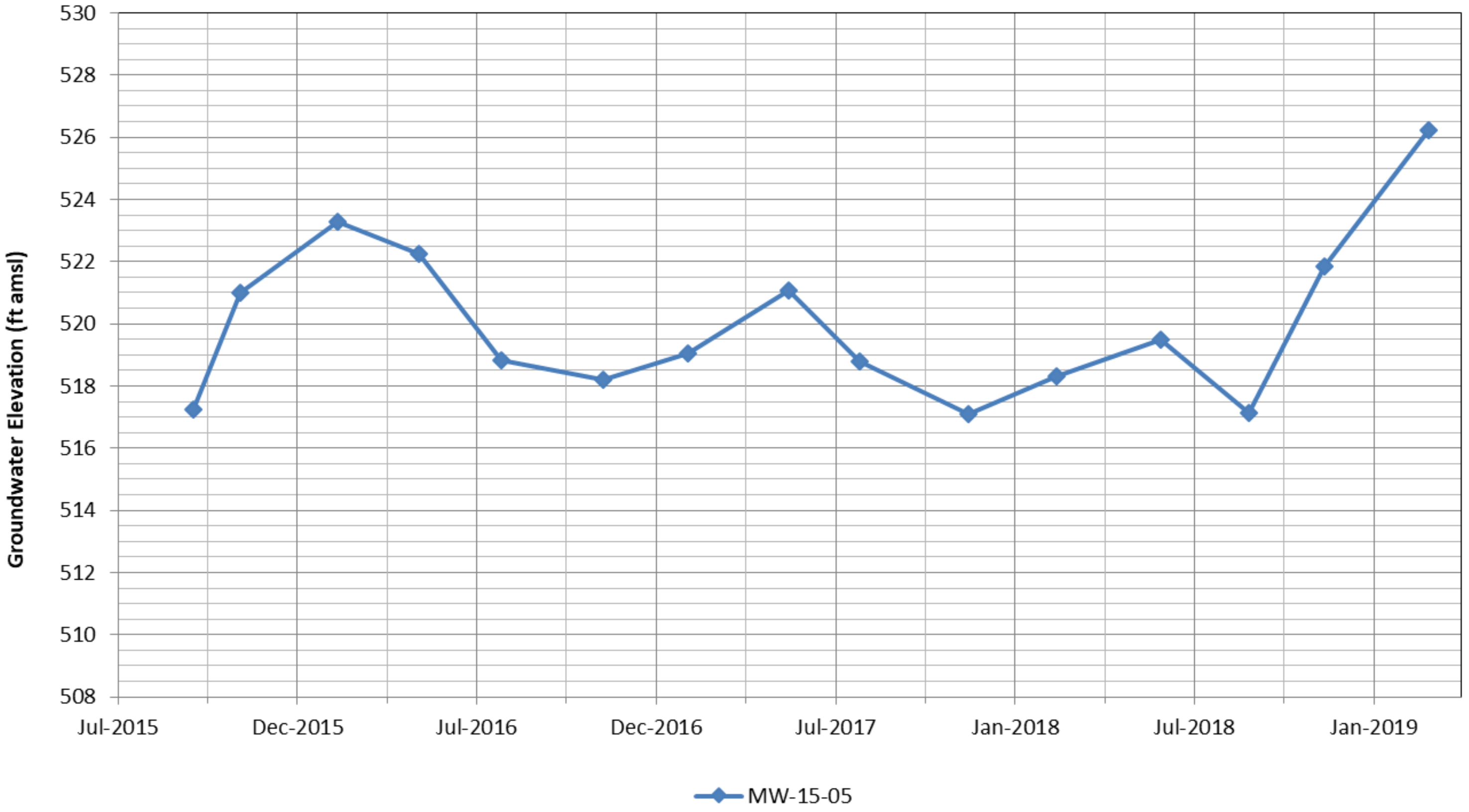


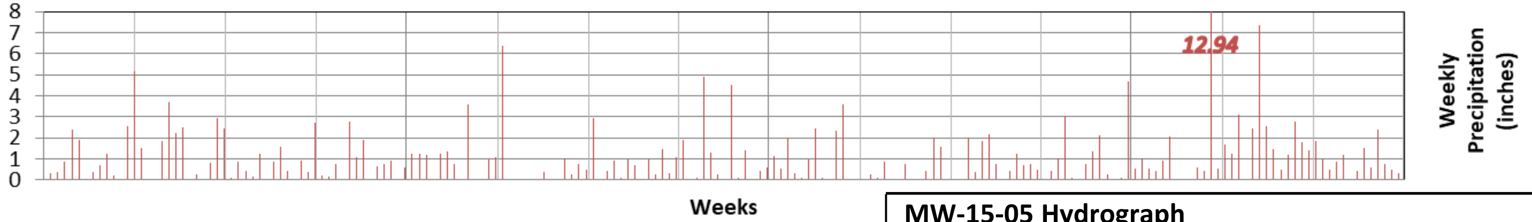


MW-10-10 Hydrograph

First Quarter 2019 Groundwater and Surface Water Monitoring Report

By: KKS	Date: 4-29-2019	Project No. 475.0042.012
NewFields		**Figure A-6**





MW-15-05 Hydrograph

First Quarter 2019 Groundwater and Surface Water Monitoring Report

By: KKS	Date: 4-29-2019	Project No. 475.0042.012
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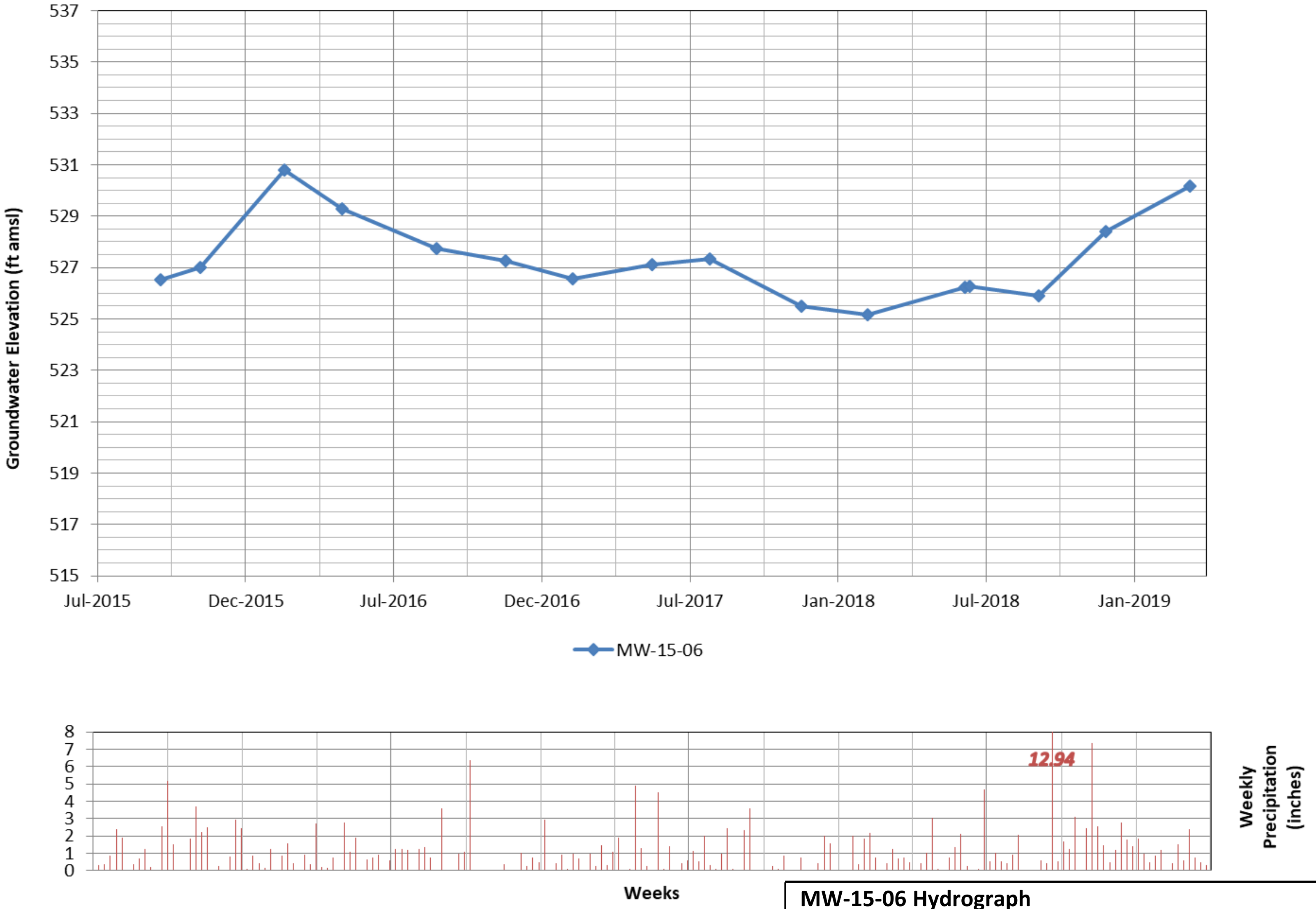

MW-15-06 Hydrograph

First Quarter 2019 Groundwater and Surface Water Monitoring Report

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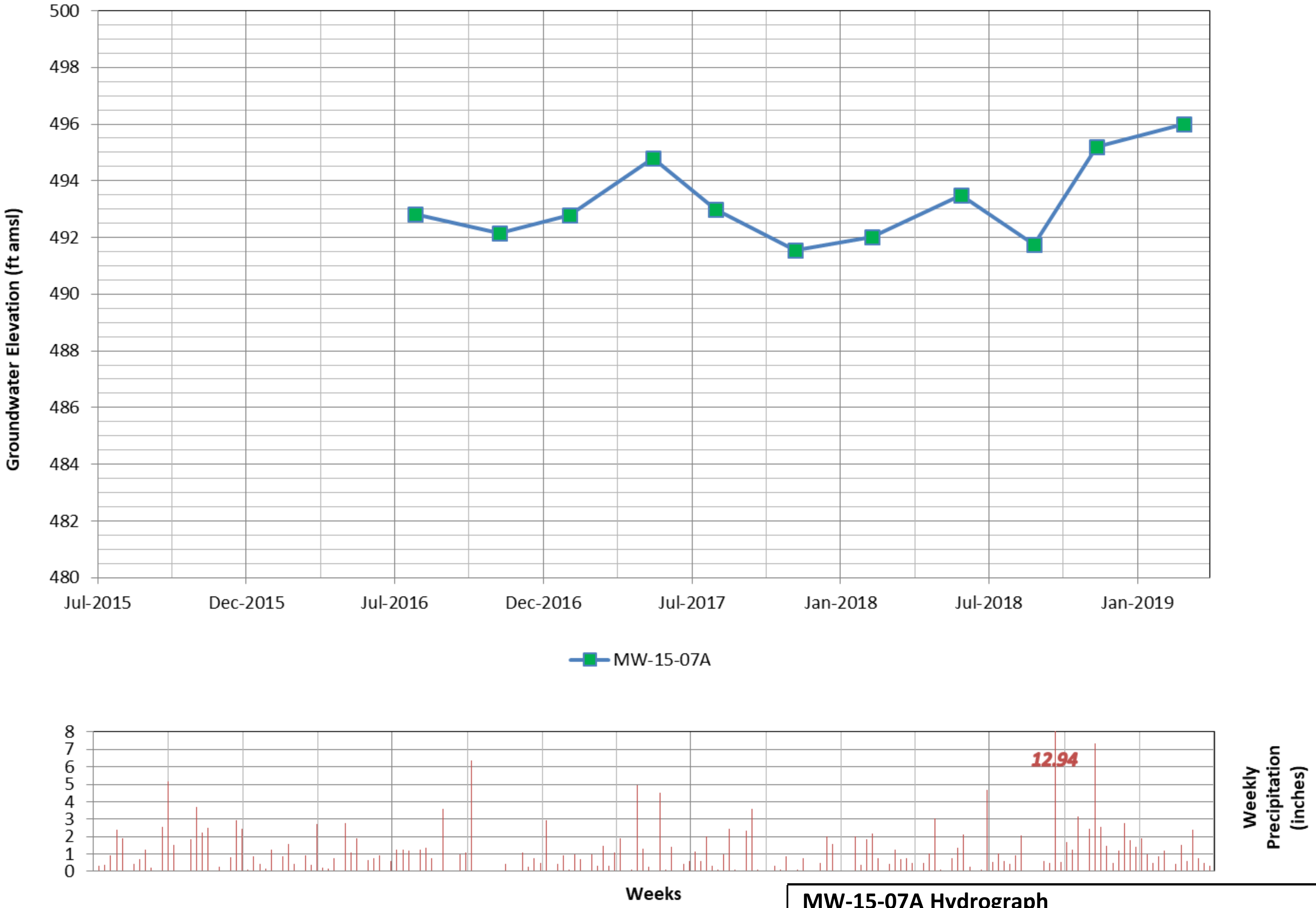

MW-15-07A Hydrograph

First Quarter 2019 Groundwater and Surface Water Monitoring Report

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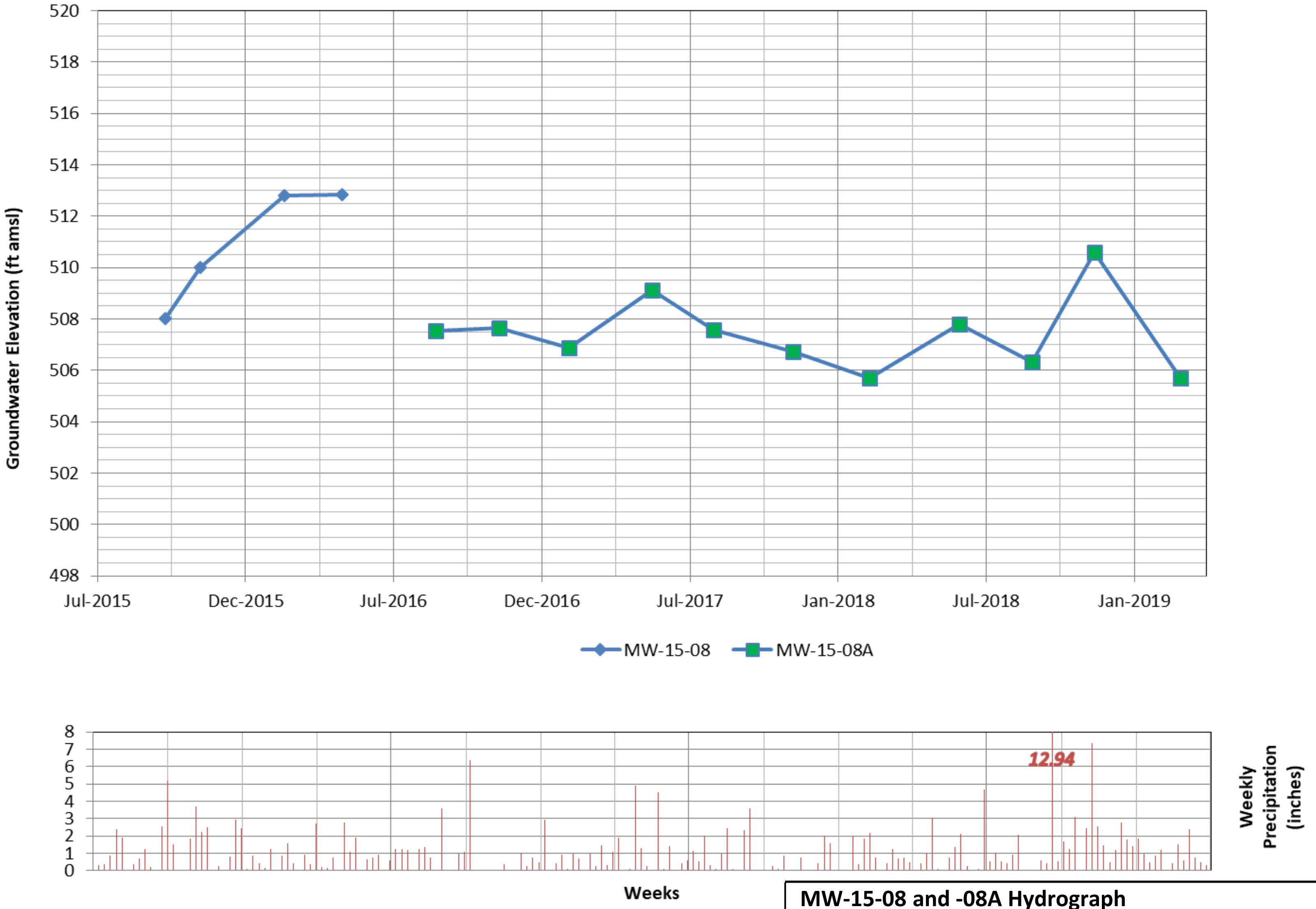

MW-15-08 and -08A Hydrograph

First Quarter 2019 Groundwater and Surface Water Monitoring Report

By: KKS	Date: 4-29-2019	Project No. 475.0042.012
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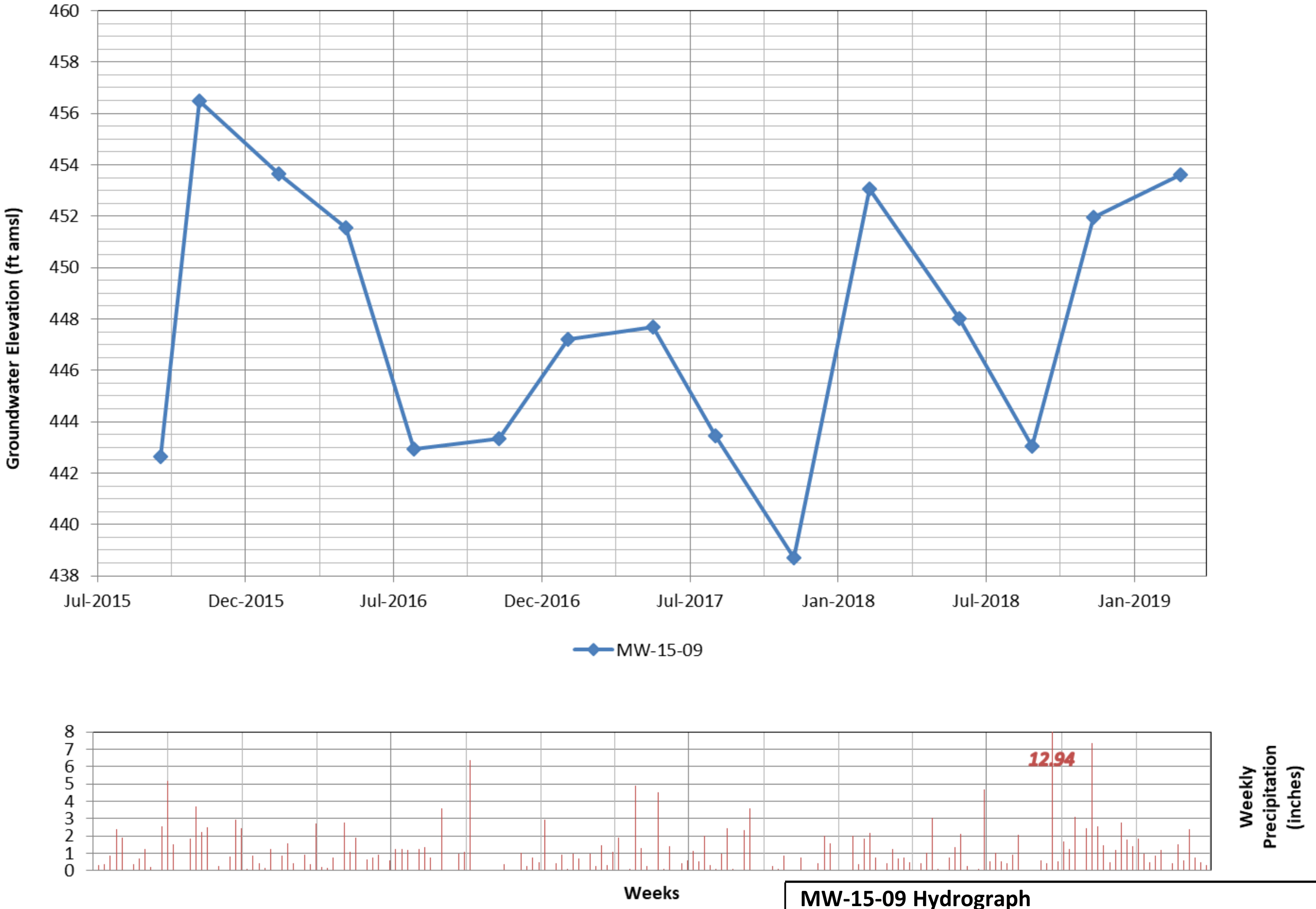

MW-15-09 Hydrograph

First Quarter 2017 Groundwater and Surface Water Monitoring Report

By: JWR	Date: 4-10-2017	Project No. 475.0042.012
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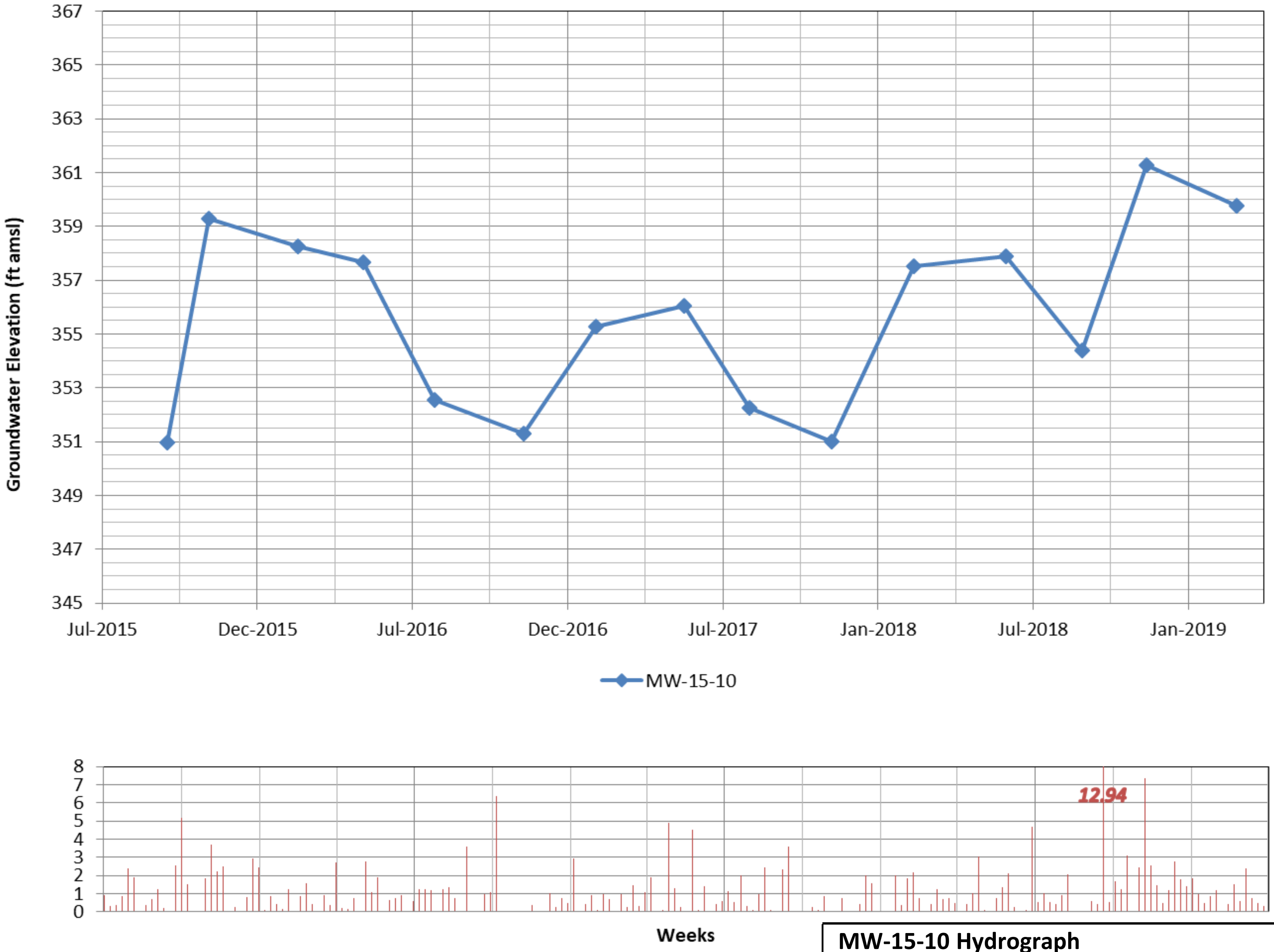

MW-15-10 Hydrograph

First Quarter 2019 Groundwater and Surface Water Monitoring Report

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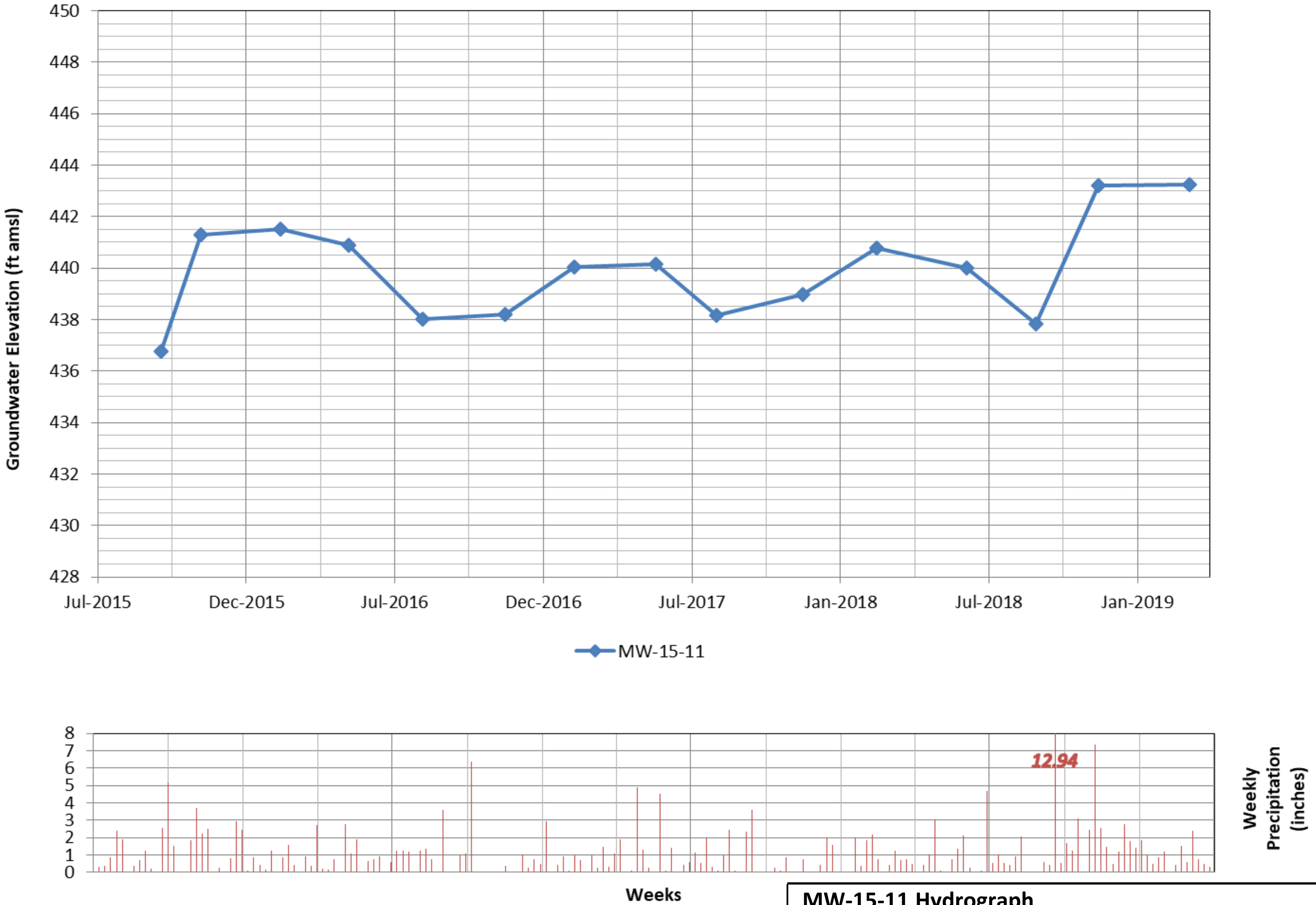


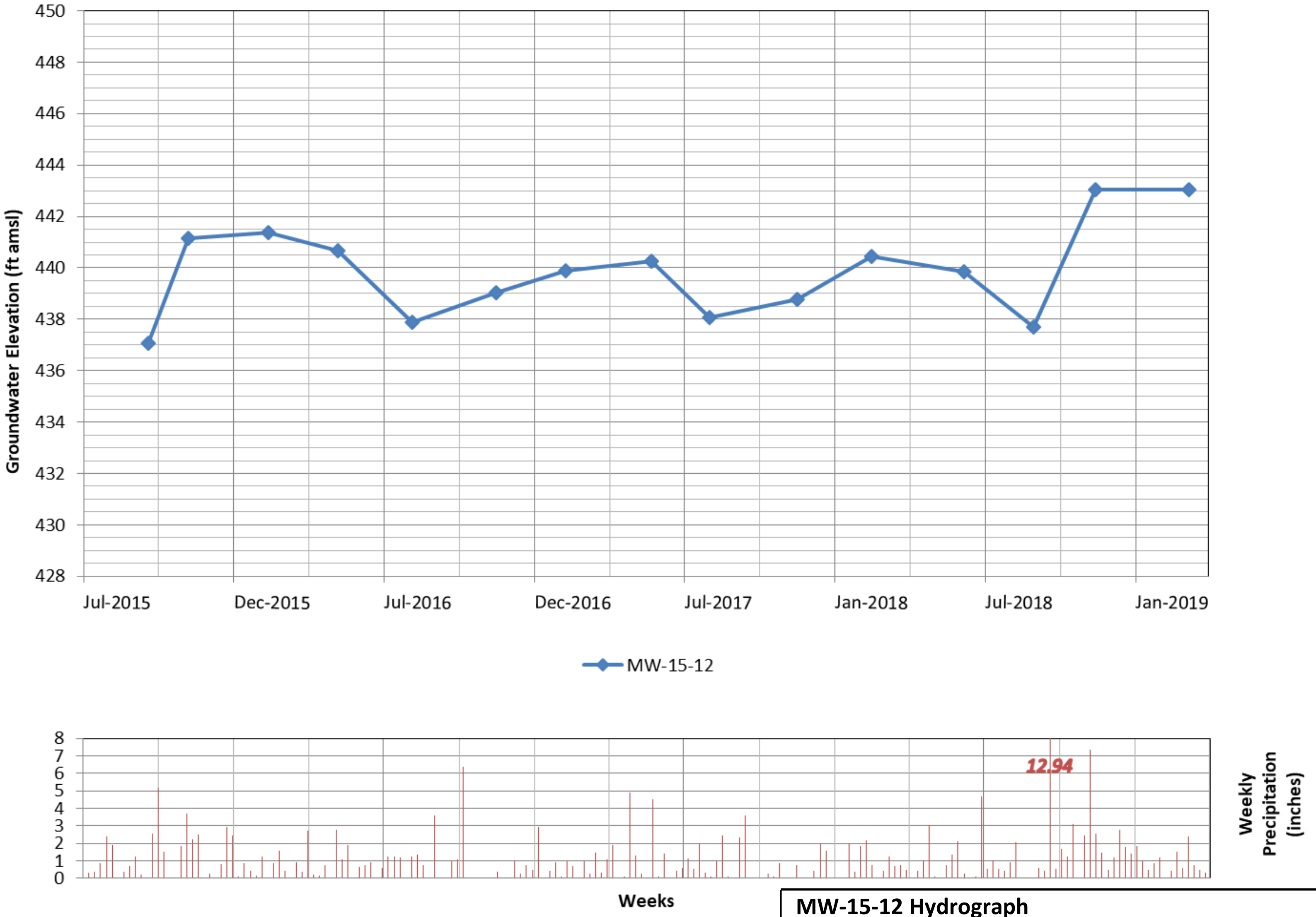
MW-15-11 Hydrograph

First Quarter 2019 Groundwater and Surface Water Monitoring Report

By: KKS
Date: 4-29-2019
Project No. 475.0042.012

NewFields

Figure A-13



MW-15-12 Hydrograph

First Quarter 2019 Groundwater and Surface Water Monitoring Report

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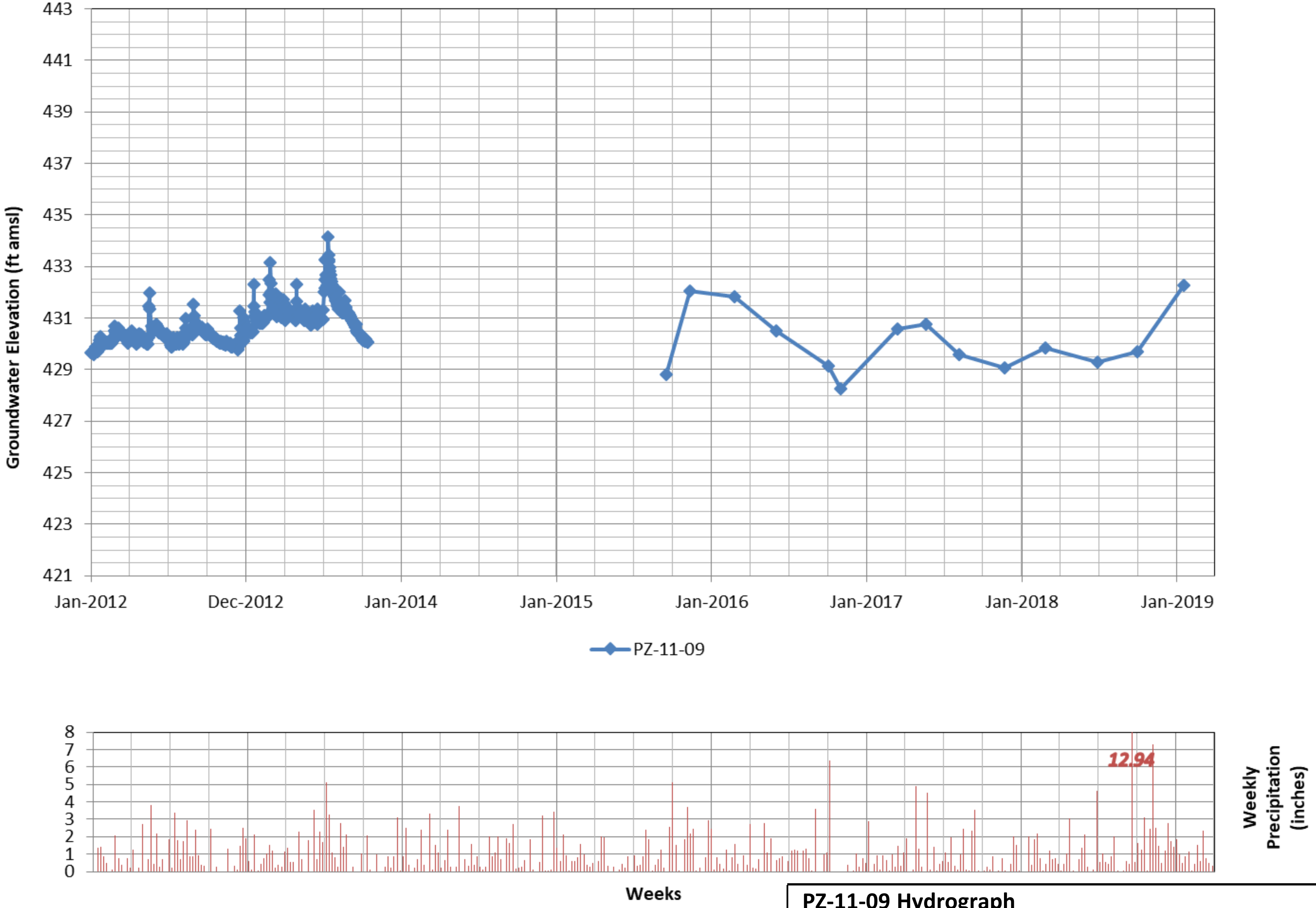


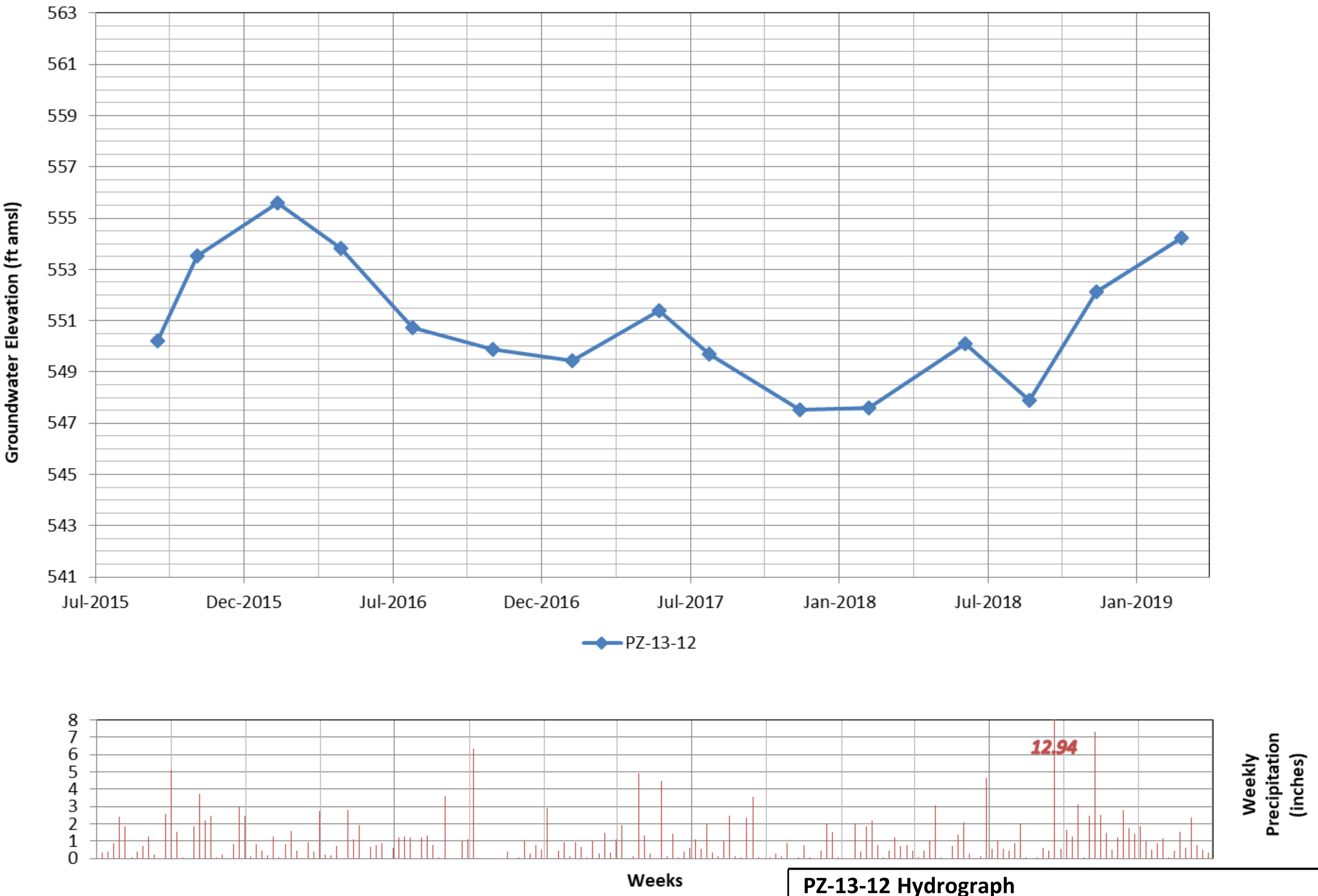
PZ-11-09 Hydrograph

First Quarter 2019 Groundwater and Surface Water Monitoring Report

By: KKS	Date: 5-3-2019	Project No. 475.0042.012

NewFields

Figure A-15



PZ-13-12 Hydrograph

First Quarter 2019 Groundwater and Surface Water Monitoring Report

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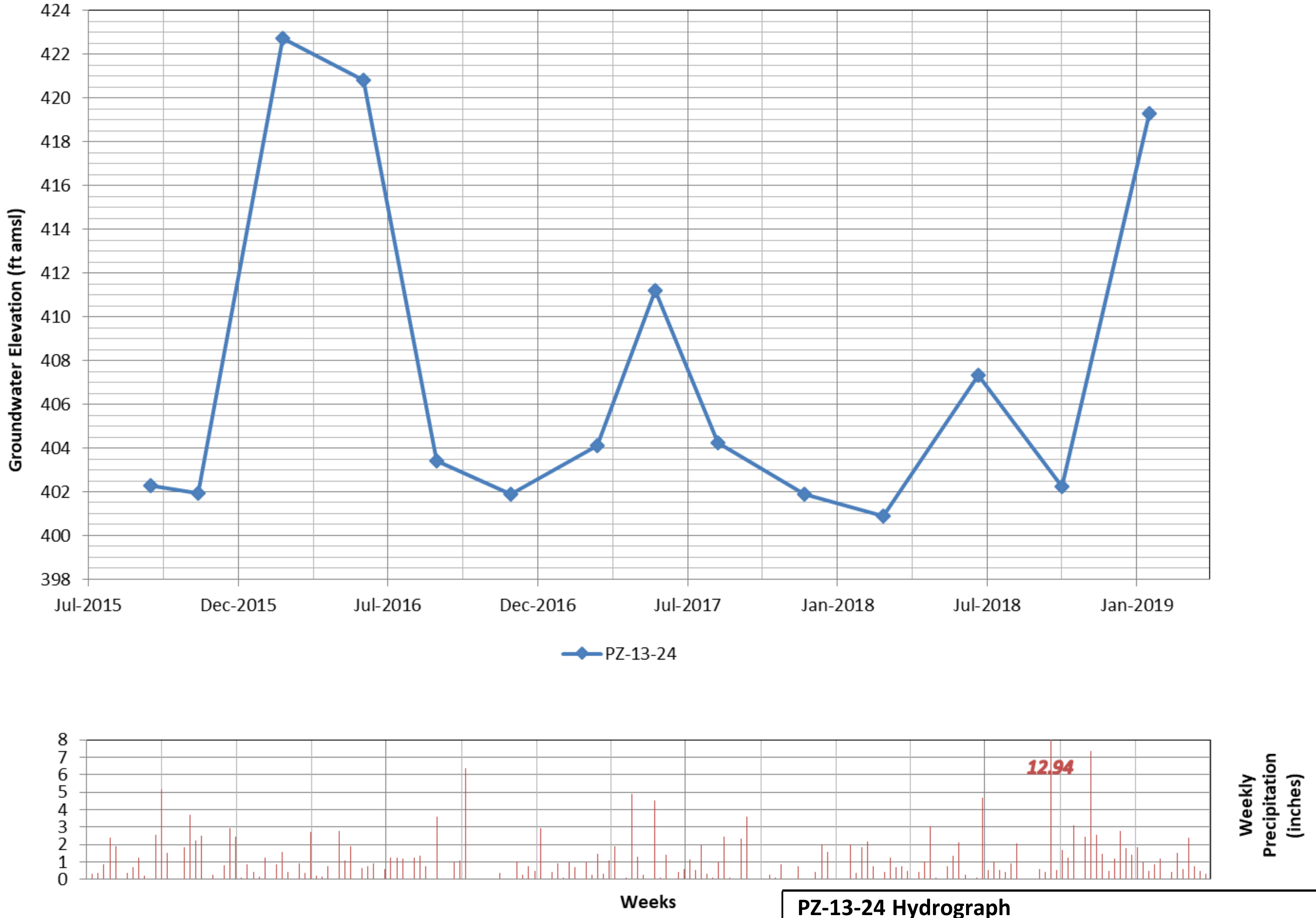
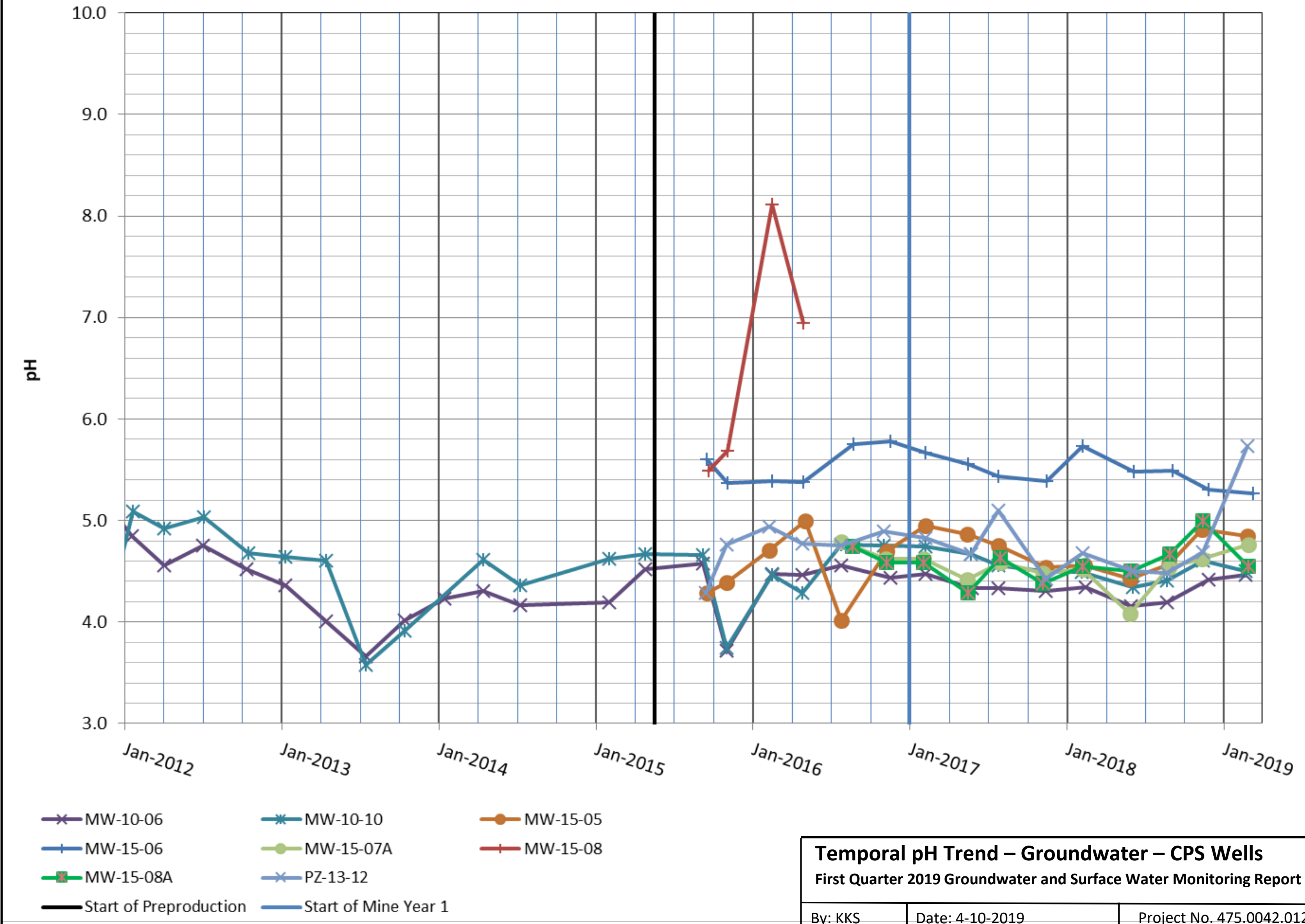


PZ-13-24 Hydrograph **First Quarter 2019 Groundwater and Surface Water Monitoring Report**		
By: KKS	Date: 5-3-2019	Project No. 475.0042.012
NewFields		**Figure A-17**

APPENDIX B

Time Series Graphs of pH at Groundwater and Surface Water Monitoring Locations



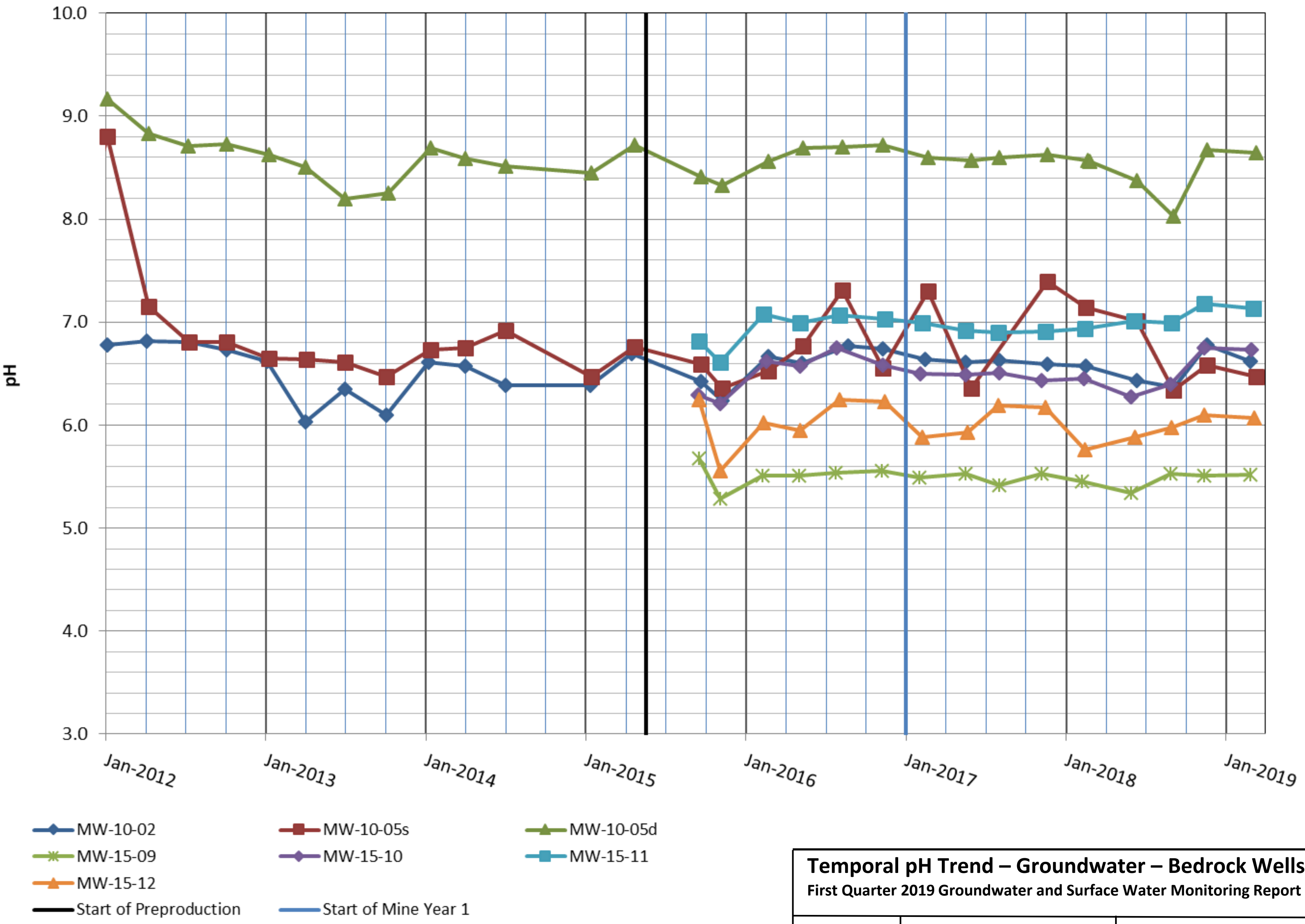
Temporal pH Trend – Groundwater – CPS Wells

First Quarter 2019 Groundwater and Surface Water Monitoring Report

By: KKS	Date: 4-10-2019	Project No. 475.0042.012

NewFields

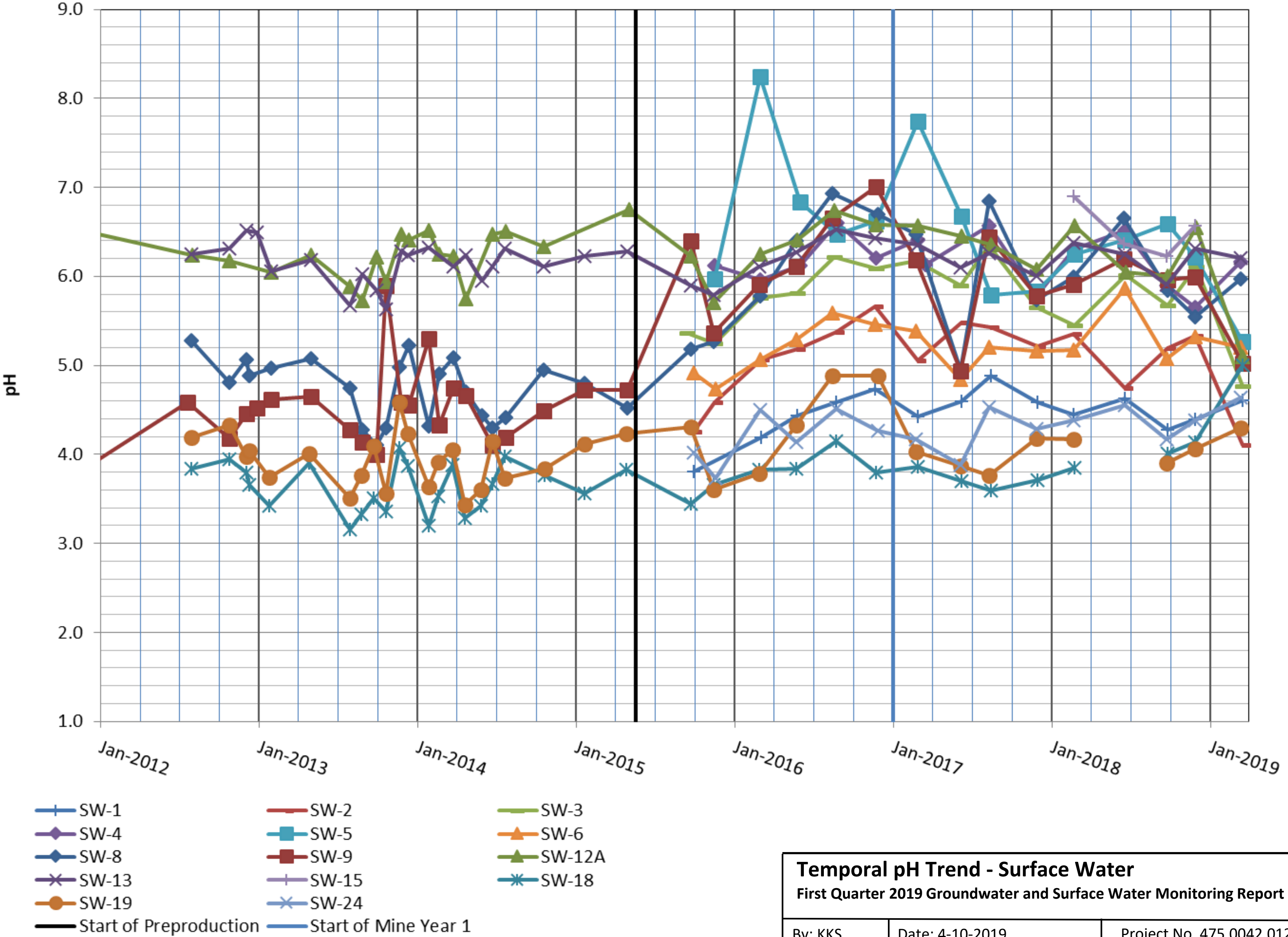
Figure B-1



Temporal pH Trend – Groundwater – Bedrock Wells

First Quarter 2019 Groundwater and Surface Water Monitoring Report

By: KKS	Date: 4-10-2019	Project No. 475.0042.012
NewFields		**Figure B-2**



Temporal pH Trend - Surface Water

First Quarter 2019 Groundwater and Surface Water Monitoring Report

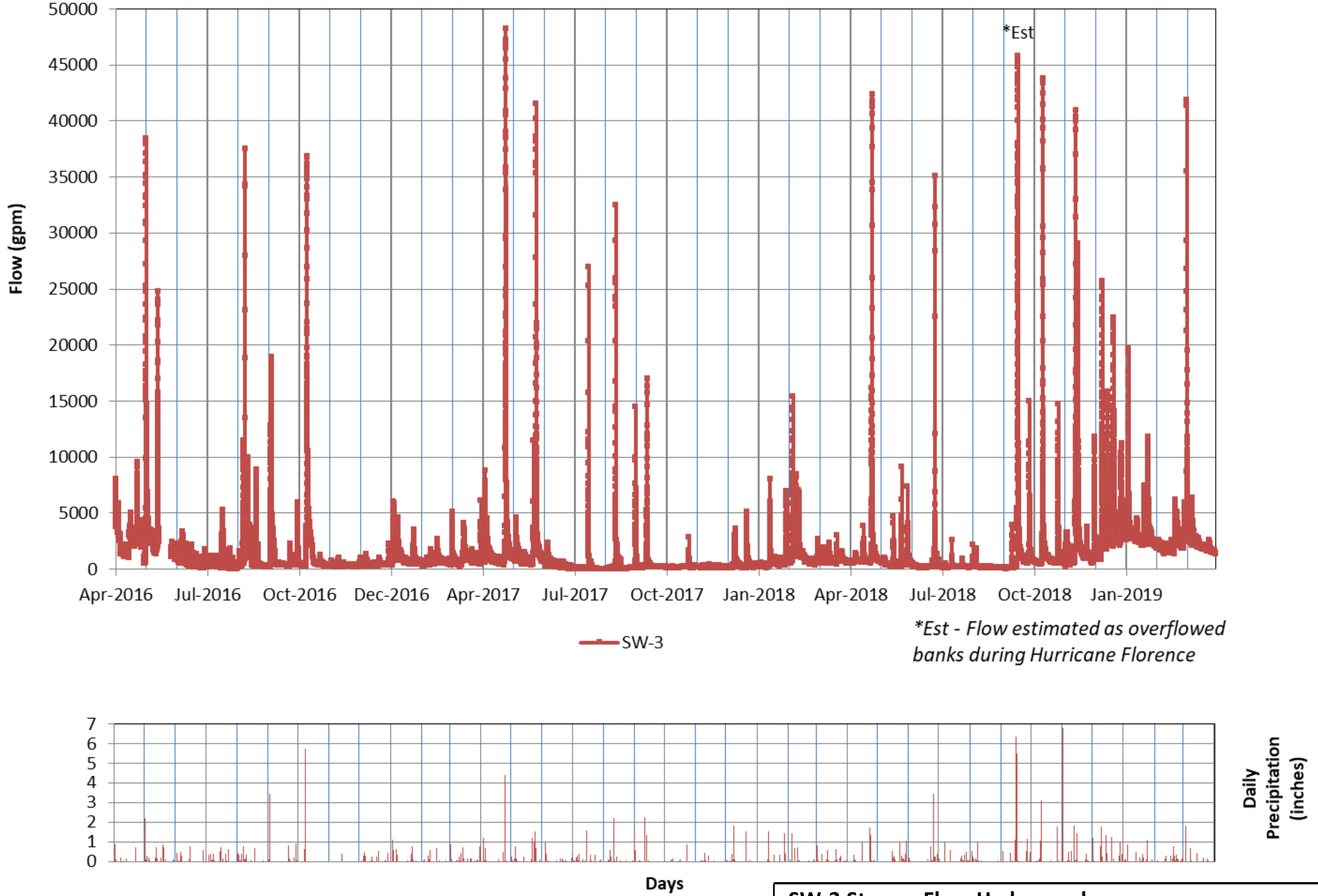
By: KKS	Date: 4-10-2019	Project No. 475.0042.012

NewFields

Figure B-3

APPENDIX C

Stream Flow Hydrographs



**Est - Flow estimated as overflowed banks during Hurricane Florence*

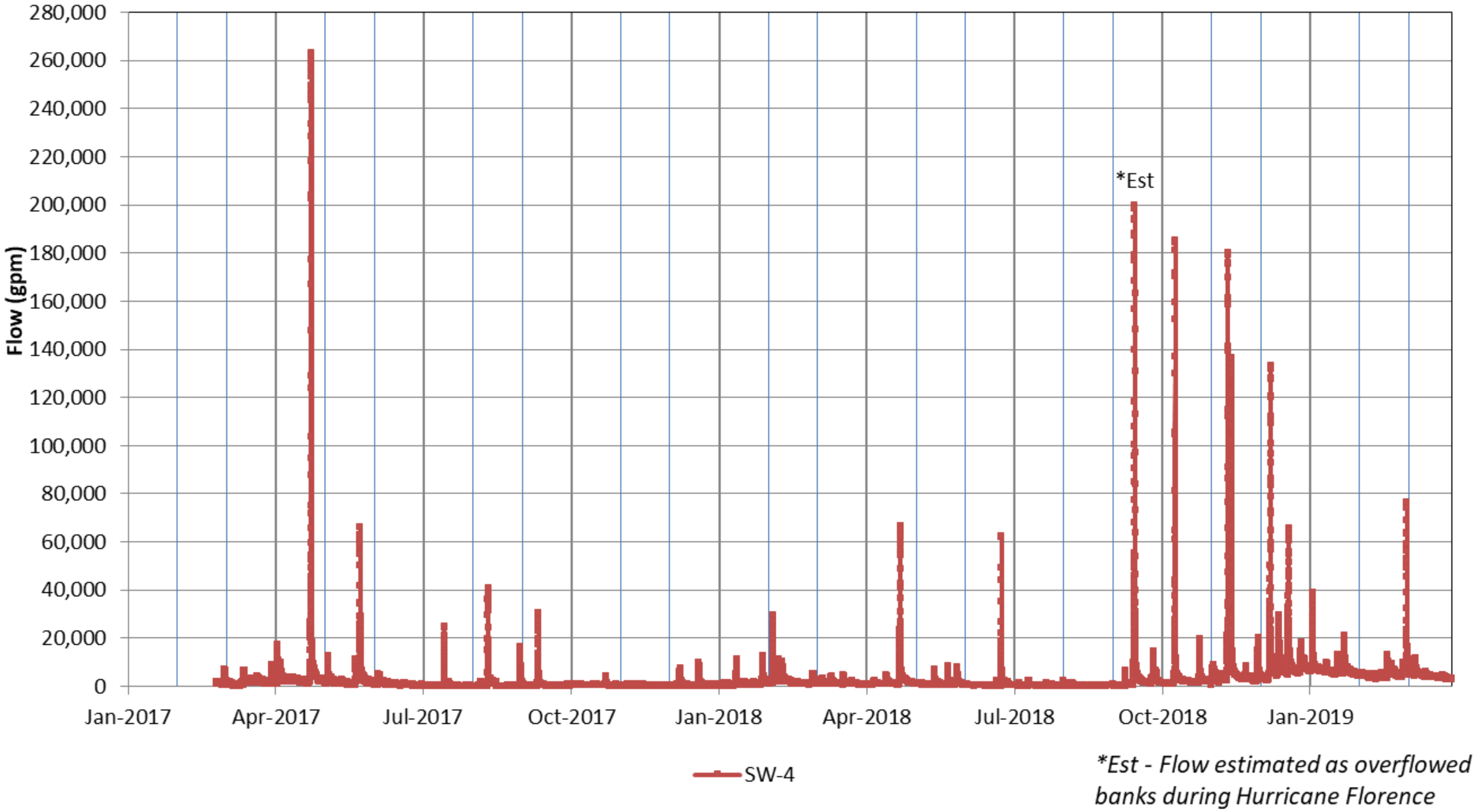
SW-3 Stream Flow Hydrograph

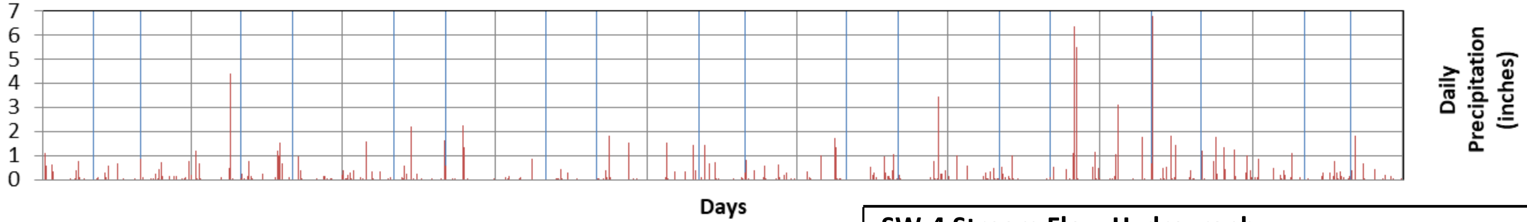
First Quarter 2019 Groundwater and Surface Water Monitoring Report

By: KKS	Date: 4-10-2019	Project No. 475.0042.012

NewFields

Figure C-1

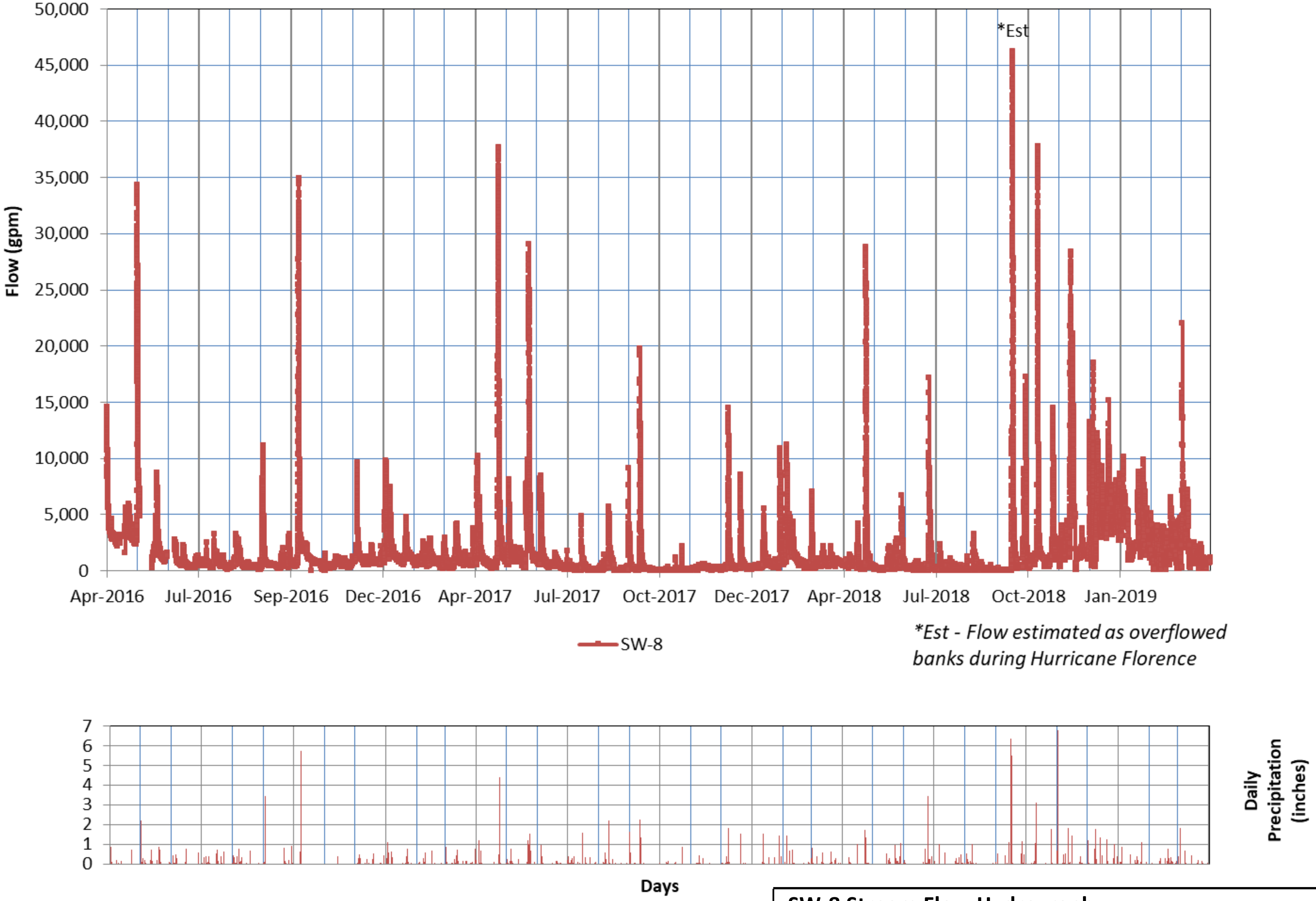




SW-4 Stream Flow Hydrograph

First Quarter 2019 Groundwater and Surface Water Monitoring Report

By: KKS	Date: 4-10-2019	Project No. 475.0042.012
NewFields		**Figure C-2**

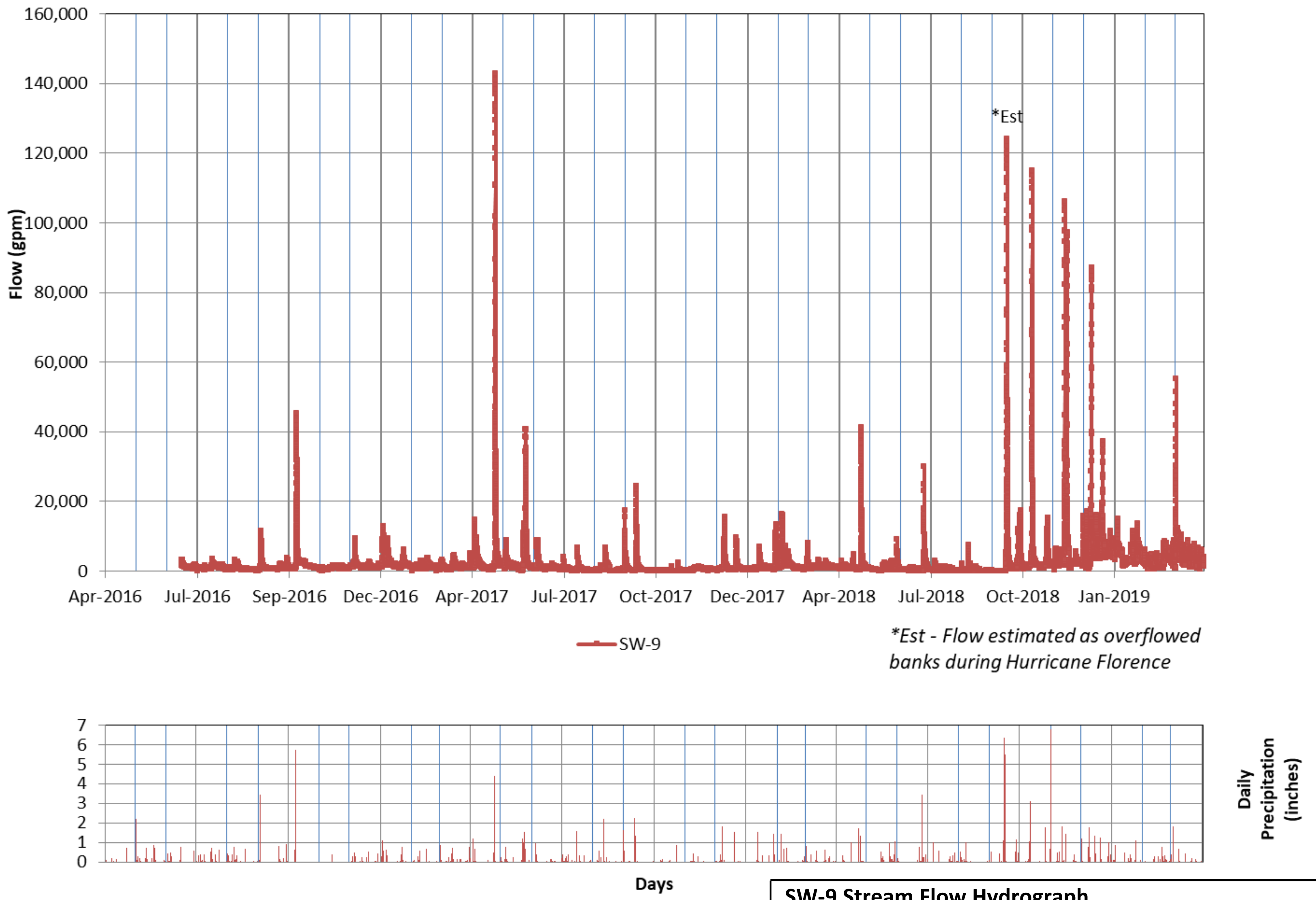


**Est - Flow estimated as overflowed banks during Hurricane Florence*

SW-8 Stream Flow Hydrograph

First Quarter 2019 Groundwater and Surface Water Monitoring Report

By: KKS	Date: 4-10-2019	Project No. 475.0042.012
NewFields		**Figure C-3**



**Est - Flow estimated as overflowed banks during Hurricane Florence*

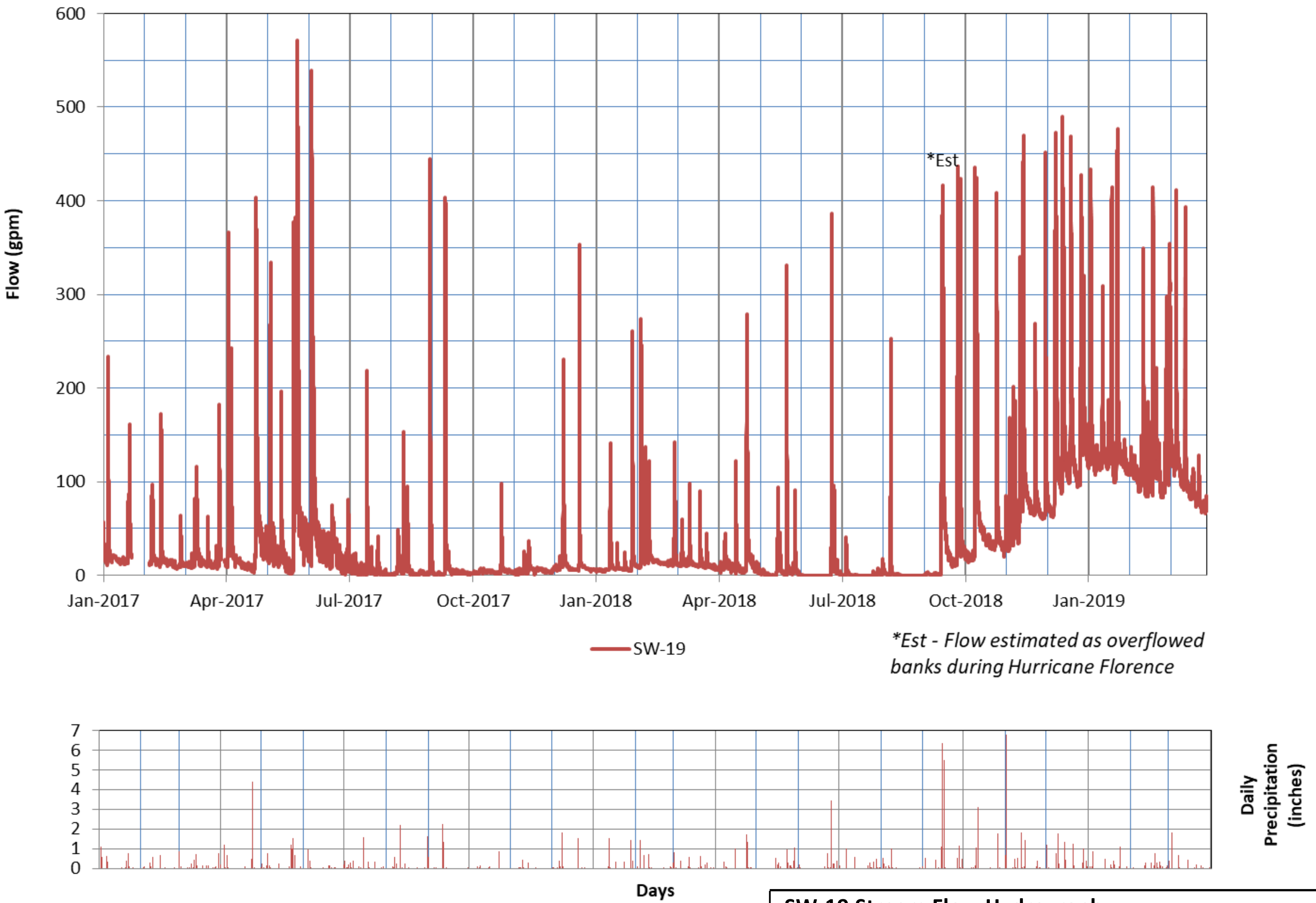
SW-9 Stream Flow Hydrograph

First Quarter 2019 Groundwater and Surface Water Monitoring Report

By: KKS	Date: 4-10-2019	Project No. 475.0042.012

NewFields

Figure C-4



**Est - Flow estimated as overflowed banks during Hurricane Florence*

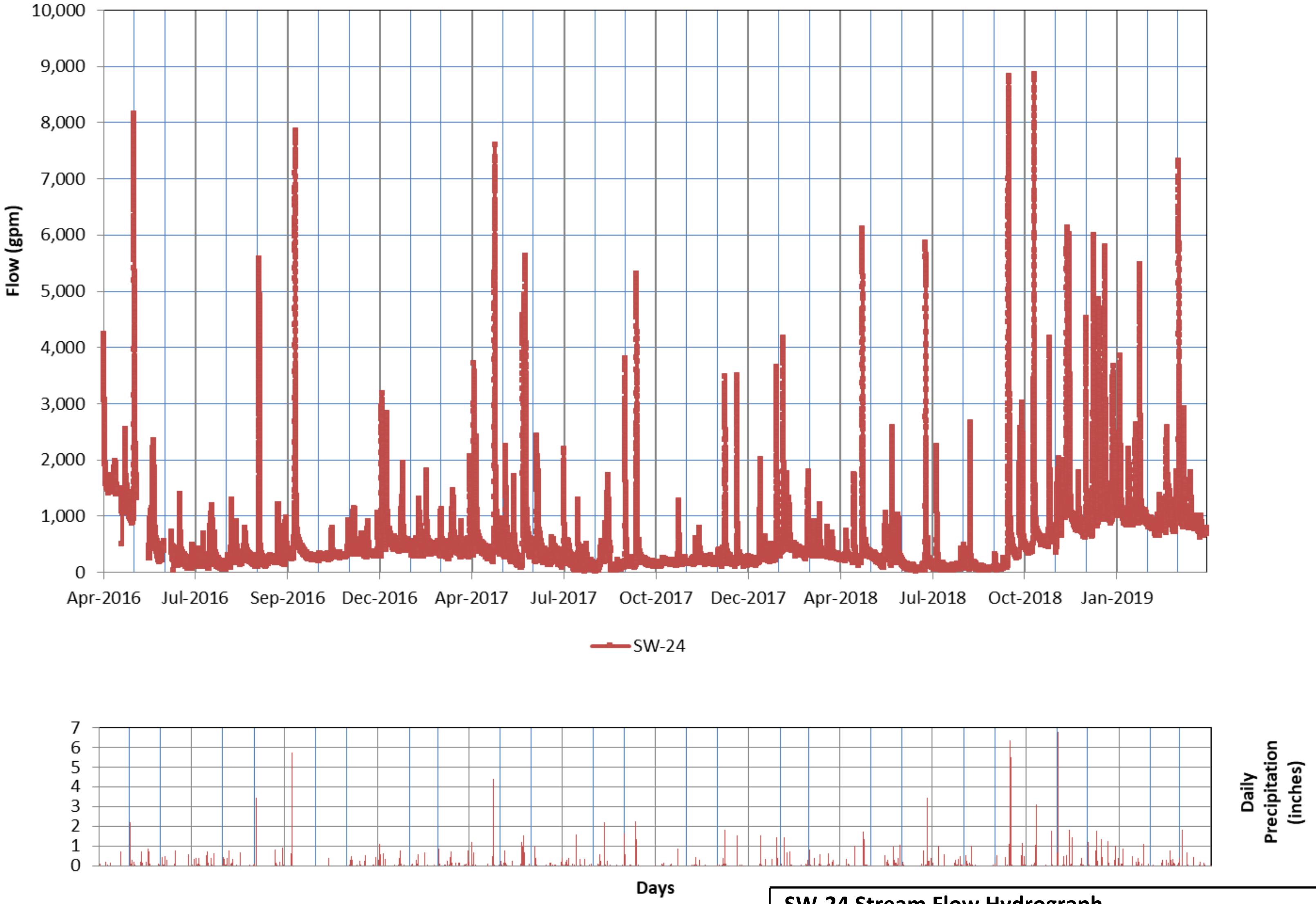
SW-19 Stream Flow Hydrograph

First Quarter 2019 Groundwater and Surface Water Monitoring Report

By: KKS	Date: 4-10-2019	Project No. 475.0042.012

NewFields

Figure C-5



SW-24 Stream Flow Hydrograph

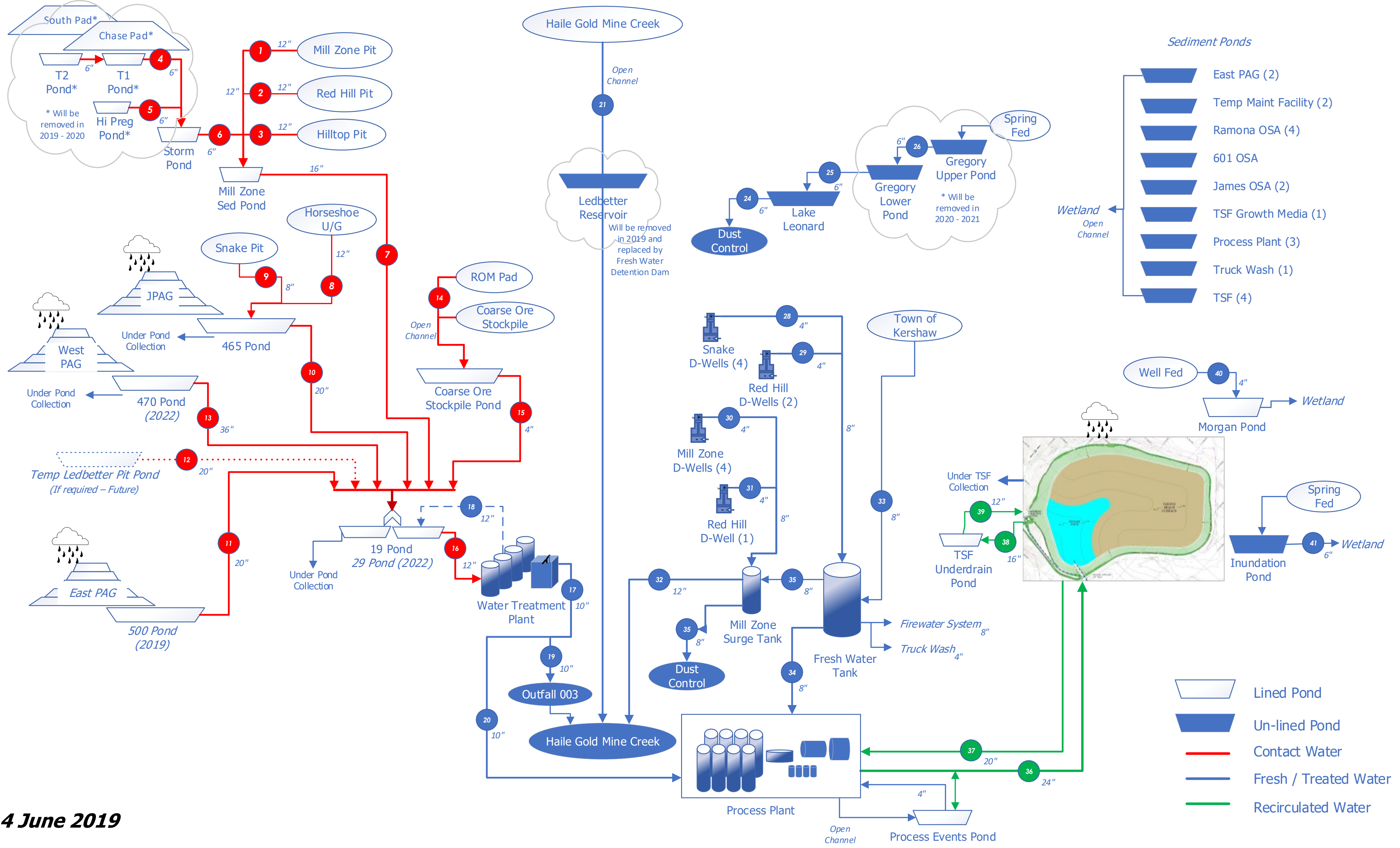
First Quarter 2019 Groundwater and Surface Water Monitoring Report

By: KKS	Date: 4-10-2019	Project No. 475.0042.012

NewFields

Figure C-6

Haile Gold Mine Water Management Systems



14 June 2019

INNOVATION PERFORMANCE GROWTH

OCEANAGOLD

OCEANAGOLD
HAILE OPERATION

Monitoring and Management Plan

10 June 2019

HGM-200-PRO-011

Department:	Environmental
Location/Site:	Haile Operation

	Name	Position/Title	Date	Signature
Authored by				
Approved by				
Approved by				

Document Issuance and Revision History

Revision No.	Revision Date	Description of Revision	Effective Date

Table of Contents

1 PURPOSE

The purpose of this Monitoring and Management Plan (MMP) is to summarize the monitoring and management activities that Haile has committed to perform as part of the Haile Gold Mine Project (Project).

2 OBJECTIVES

The objectives of this MMP are to:

- Identify the environmental sites that Haile will monitor during the Project and provide a summary of this monitoring;
- Provide an overview of major operations and environmental media at the Project site;
- Provide an overview of the major Project facilities to enhance understanding of how Haile's environmental monitoring and management activities will address any potential environmental impacts of those facilities; and
- Summarize information relative to monitoring and management at the Project site.

3 MONITORING PLANS AND PERMITS

Monitoring programs play a key role in release prevention and identification, as well as providing a basis for effective worker training. Monitoring is used to assure compliance with permit terms and regulatory requirements. As explained more fully within this MMP, Haile has committed to monitoring at intervals adequate to characterize the medium being monitored, as well as to provide information in a timely manner to notify authorities and take any necessary corrective actions.

3.1 Existing Operations Plans

To minimize duplication of information and rationale for specific monitoring and sampling requirements, this MMP relies upon and incorporates information from the following documents:

Reclamation Plan
Wetland and Stream Monitoring Plan
Avoidance and Minimization Plan
Surface and Groundwater Monitoring Plan
Wetlands and Streams Mitigation Plans
Cultural Resources Management Plan
Unanticipated Discovery Plan
Fugitive Dust Control Plan
Solid and Hazardous Waste Management Plan
Storm Water Pollution Prevention Plan
Spill Prevention, Control and Countermeasure Plan
Duckwood Tailing Storage Facility Operations, Inspection and Maintenance Plan
Duckwood Tailing Storage Facility Emergency Action Plan
Wildlife Monitoring Plan
International Cyanide Code (2012)
Pre-Blast Survey Plans
PAG Overburden Storage Area Operation, Maintenance, and Inspection Plan

3.2 Permits

Final provisions regarding monitoring are included in State permits. In some cases, these permit terms are available for reference in this MMP. The following permits are referenced in this MMP:

Mine Permit No. I-000601

NPDES Individual Discharge Permit No. SC0040479, Outfalls 002 and 003

NPDES General Stormwater Permit for Industrial Activity Permit No. SCR000000

NPDES General Permit for Stormwater Discharges Associated with Construction Activities Permit No. SCR100000

Air Construction Permit No. 1460-0070-CA

Dam Safety Permit No. 29-0007

3.3 Permit Categories and Monitoring Requirements

The following table contains a list of the State permits that apply to Haile Gold Mine.

Table 1. State Permits & Monitoring Requirements

Permit	Monitoring Requirements
Air Permit (Construction)	See Permit No. 1460-0070-CA (October 6, 2013)
Dam Safety Permit	See Permit No. 29-0007 (October 7, 2013)
Mining Permit (includes Reclamation Plan)	See Permit No. I-000601 (November 6, 2014)
NPDES Individual Permit	See Permit No. SC0040479 (October 7, 2013)
NPDES Industrial General Permit	See Permit No. SCR000000
NPDES Construction General Permit	See Permit No. SCR100000
CWTP Construction Permit	See Permit No. 19830-IW (October 30, 2014)
Surface Water Withdrawal Permit	See Permit No. R.61-119 (June 22, 2012)

4 MANAGEMENT PLANNING

This MMP focuses largely on Haile's commitments for monitoring. Management for environmental protection goes beyond monitoring and includes both operational steps to remain in compliance and procedures for addressing emergencies or other significant events. Haile has developed procedures to remain in compliance with permit terms; those procedures are part of the operational plans that implement the permits and provides for training for employees.

In general, management of emergencies or significant events are addressed in permits and requires notification to the appropriate authorities. Upon notification, the authorities can evaluate the situation, determine what information is needed, and work with Haile to develop and assure implementation of the appropriate response. Because there may be many different circumstances that are treated as "emergencies or significant events" under the permits, it is not feasible to describe the reporting requirements or management planning for response in much detail in this MMP.

Where appropriate, this MMP describes some of the measures that are intended to protect against adverse impact to environmental media. These include, but are not limited to, double High-Density Polyethylene (HDPE) lined ponds, double contained pipelines, lined storage facilities, closed-loop system for process water, concurrent reclamation, cyanide destruct, and buffers for otherwise non-impacted wetlands and streams.

5 GROUNDWATER MONITORING

5.1 Monitoring Plans and Permits

Haile's Operational Water Quality Monitoring Plan includes up-gradient and down-gradient monitoring of the primary facilities at site. Groundwater monitoring associated with reclamation, closure and post-closure is addressed in Section 11.

5.1.1 Monitoring Program

Haile monitors groundwater to comply with the requirements of its Mining Permit. The groundwater monitoring is also planned to assemble data pertinent to evaluating potential indirect impacts of Project activities. Haile's groundwater monitoring program enables verification that the extent of predicted drawdown is occurring, and adequate data is available to update future impact predictions. The groundwater monitoring program rational is outlined in Table 2

Table 2. Groundwater Rationale

Purpose	**Monitor ground water quality and water levels.**			
Location Criteria	**Close to the pits with spatial coverage along prominent flow path and in each aquifer type.**			
Type of Monitoring	**Reporting**	**Monitor**	**Sample Collection**	**Rationale**
Depressurization Wells	Quarterly	Water Levels and Chemistry	Quarterly	Monitoring locations are established around the pits to evaluate decrease in the hydraulic pressure at the dig faces and minimization of water in flux to the active mine pits or openings.
Drawdown Extent	Quarterly	Water Levels	Quarterly	Monitoring locations are established in a phased approach along predicted groundwater elevation contours and provide validation data to the groundwater model. These are predominately located in shallow CPS aquafers and monitor changes in wetlands and stream flows.
TSF, Pit Areas, and Overburden	Quarterly	Water Levels and Chemistry	Quarterly	Monitoring locations are established around mine components to ensure constituent migration is not occurring.
Compliance Wells	Annual	Water Levels and Chemistry	Annual	Monitoring locations are established around mine facilities to ensure constituent migration is not occurring.

5.1.2 Sampling Locations

Monitoring wells are placed, based on modelled predictions of groundwater flow, direction and timing, to provide adequate data to evaluate potential impacts of mine activities on groundwater.

Haile's monitoring site location map is presented in Figure 1, below. The actual number of sampling locations and monitoring specifics are specified in Haile's Mining Permit.

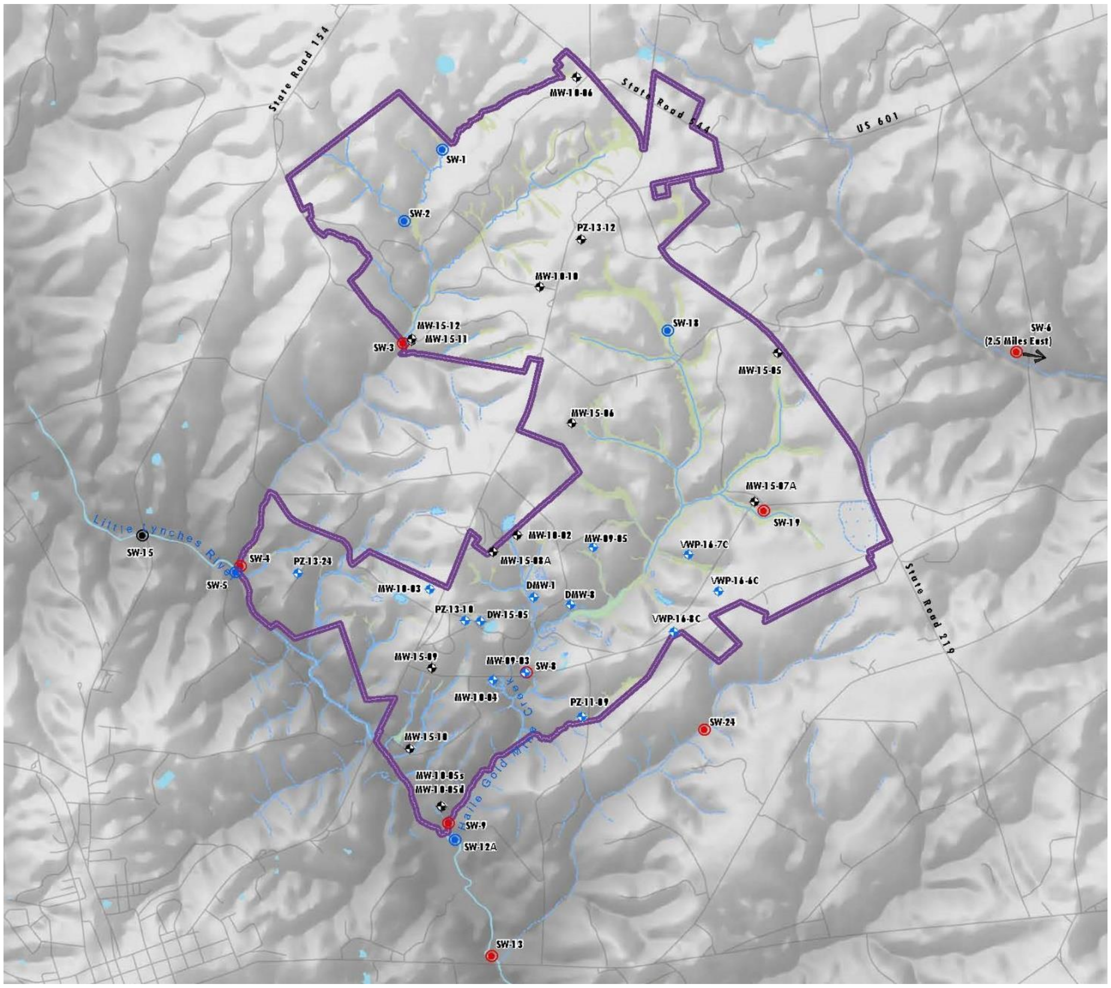


Figure 1. Groundwater Quality Sampling Locations (PZ and MW)

5.2 Water Quality Chemical Analyte Monitoring List During Operations

The analytes identified in the following Tables were provided by Haile to the USACE. These analytes, for which Haile will sample unless DHEC modifies the list, were developed based on geochemical studies performed at the site.

Table 3 identifies analytes for groundwater sampling near the TSF. Table 4 identifies analytes for sampling in other wells. Haile developed different analyte lists in compliance with standards required by DHEC. Haile monitors for indicator analytes near potential sources, and for a fuller suite of analytes at the compliance points (See Table 5).

Table 3. Groundwater Wells Near TSF

(Water Quality Chemical Analyte Monitoring List During Operations)

Analyte Group	List A
Field Parameters	pH EC Temperature
Indicator Parameters	Alkalinity Acidity Sulfate
Cation/ Anion Balance	Calcium Chloride Magnesium Sodium Potassium Bicarbonate/ Carbonate
Other Parameters	Cyanide (WAD) TDS

Table 4. All Other Groundwater Monitoring Wells

Analyte Group	List B
Field Parameters	pH EC Temperature
Indicator Parameters	Alkalinity Acidity Sulfate
Cation/ Anion Balance	Calcium Chloride Magnesium Sodium Potassium Bicarbonate/ Carbonate
Other Parameters	TDS TSS
Total & Dissolved Metals	Aluminum Arsenic Copper Iron Manganese Mercury Nickel Silica Zinc

Table 5. Groundwater DHEC Compliance Wells

Analyte Group	List C
Field Parameters	pH
	EC
	Temperature
Indicator Parameters	Alkalinity
	Acidity
	Sulfate
Cation/ Anion Balance	Calcium
	Chloride
	Magnesium
	Sodium
	Potassium
	Bicarbonate/ Carbonate
Nutrients	Phosphorus (ortho)
	Ammonia
	Total N
	Nitrate
Other Parameters	WAD Cyanide
	Oil & Grease
	Fecal Coliform
Other Parameters	TDS
	TSS
Total & Dissolved Metals	Aluminum
	Antimony
	Arsenic
	Boron
	Chromium III, VI, total
	Copper
	Iron
	Lead
	Manganese
	Mercury
	Nickel
	Selenium
	Silica
	Thallium
	Zinc

5.2.1 Frequency of Sampling

Groundwater wells are sampled for water quality parameters quarterly. Groundwater compliance points are sampled for water quality parameters annually.

5.3 Groundwater Level Monitoring

5.3.1 Monitoring of Groundwater Levels Surrounding Pit Activity

The drawdown of groundwater will evolve as mining operations proceed. Due to the changing nature of the groundwater drawdown over time, a phased groundwater monitoring program are implemented, whereby monitoring wells are determined at optimum locations corresponding to expected groundwater conditions between years 1 and 5. As operations continue beyond this timeframe, new monitoring wells may be placed corresponding to the next five or more years of groundwater monitoring; to determine optimum locations for years >5, the groundwater monitoring data are used to verify or update the groundwater contour conditions that were predicted originally. Determination of additional groundwater wells is based on data analysis and conditions at the time.

Groundwater quality monitoring at the Project site is identified in Haile's Mining Permit and operational aspects more fully described in Haile's Operational Water Quality Monitoring Plan.

5.4 Water Supply Monitoring

The objective of the MMP regarding private wells and water supply is to identify potential impacts to the availability of water in private wells near the mine site because of depressurization activities at the Haile Gold Mine. The goal of monitoring potential impacts to water supply is to provide timely response to impacts for which Haile is responsible.

5.4.1 Monitoring Private Wells Water Supply

Haile has installed a series of groundwater monitoring wells within the Project Boundary for purposes, among others, of tracking the lateral and longitudinal movement of the groundwater as it responds to Haile's pumping of groundwater for pit depressurization purposes.

The monitoring system is intended to provide information on the impact of depressurization activities on groundwater and surface water levels in wells, ponds, springs and streams. This monitoring system is used to anticipate adverse impacts on water sources and to direct the remedial actions that are taken because of data obtained.

5.4.2 Management of Private Wells Water Supply

Management of private wells water supply impacted by mine-related activities is a condition of Haile's Mining Permit. The Mining Permit includes requirements to:

- Provide for independent, third party evaluation of potential impacts to private wells and water supply, using the Water Resources Inventory (2013) of all participating landowners;
- Establish a third-party independent investigation and review of complaints to determine if a private party is adversely impacted by Haile's pumping; and
- Provide for appropriate remedial action and/or payment if adverse impacts are discovered to have resulted from Haile's pumping.

Haile investigates all complaints and works cooperatively with DHEC and the private party to resolve any such complaints.

5.5 Reporting and Management Planning

5.5.1 State and Federal Permit Reporting Requirements

Groundwater Monitoring Report issued quarterly to DHEC, Army Corp of Engineers (ACOE) and US EPA. In the event of non-conformances or deviations, notifications will be reviewed with the recipients and corrective actions coordinated through DHEC and ACOE regarding further actions.

6 SURFACE WATER MONITORING

The objective of surface water monitoring is to ensure that the Project is in compliance with permit requirements, including the Mining Permit. Secondarily, the monitoring will provide early warning of water impacts and a means of identifying contaminant sources to assist in identifying contingency actions to be employed. Surface water monitoring associated with reclamation, closure and post closure is addressed in Section 8. In addition to other surface waters, this MMP addresses monitoring of the existing pit lakes at Champion; these pit lakes are currently governed by the on-going reclamation at the Project site. The location and other details of surface water monitoring remain under development pending results of hydrology analysis as well as the State permitting process.

Monitoring and other provisions of NPDES permits, including Haile's NPDES Individual Permit, the NPDES Industrial General Permit, and the NPDES Construction General Permit, are not addressed in this section. Haile's NPDES Individual Permit is addressed in Section 10.3.4, Contact Water Treatment Plant. The NPDES Industrial General Permit and NPDES Construction General Permit are addressed in Section 10.3.5, Stormwater Facilities.

6.1 Monitoring Plans and Permits

Surface water monitoring is identified in Haile's Mining Permit and operational aspects in Haile's Operational Water Quality Monitoring Plan, which will include both surface and groundwater.

6.1.1 Monitoring Program

Haile monitors surface water to comply with the requirements of its DHEC Mining Permit. The surface water monitoring data is used to evaluate potential indirect impacts. The rationale is presented in Table 6.

Table 6. Surface Water Rationale

<table>
<tr><th>Purpose</th><th colspan="4">Monitor surface water and stream channel changes to verify extent and magnitude of predicted impacts, including stream flow water quality and physical characteristics. Monitor existing pit lake at Champion and receiving streams at Camp Branch, Lower Haile Gold Mine Creek and Little Lynches Creek.</th></tr>
<tr><th>Location Criteria</th><th colspan="4">Close to the mine workings with spatial coverage along prominent flow paths; all existing stream locations; and existing mine pit lake (Champion).</th></tr>
<tr><th>Type of Monitoring</th><th>Reporting</th><th>Monitor</th><th>Sample Collection</th><th>Rationale</th></tr>
<tr><td rowspan="3">Geomorphology</td><td>Annual</td><td>Channel Cross-sections</td><td>Annual</td><td>Changes in channel width can be a sign of stream aggradation, degradation, vegetation encroachment and / or bed or bank stability alteration.</td></tr>
<tr><td>Annual</td><td>Channel Profile</td><td>Annual</td><td>Change in channel profile can provide evidence of channel evolution that could occur in response to flow alteration or land use changes.</td></tr>
<tr><td>Annual</td><td>Substrate Sediment Distribution</td><td>Annual</td><td>Changes in sediment size may indicate stream response to flow alteration or land-use changes.</td></tr>
<tr><td rowspan="2">Surface Water Flow and Water Levels</td><td>Quarterly</td><td>Stream Channels</td><td>Hourly</td><td>Mine operations may result in changes to flow.</td></tr>
<tr><td>Quarterly</td><td>Champion Pit Lake</td><td>Quarterly</td><td>Mine operations will eventually result in pit lake dewatering.</td></tr>
<tr><td rowspan="3">Surface Water Quality</td><td>Quarterly</td><td>Streams</td><td>Quarterly</td><td>Chemical Analyte List D</td></tr>
<tr><td>Annual</td><td>Compliance Points</td><td>Annual</td><td>Chemical Analyte List F</td></tr>
<tr><td>Annual</td><td>Champion Pit Lake</td><td>Quarterly</td><td>Chemical Analyte List E</td></tr>
</table>

6.1.2 Sampling Locations

Monitoring locations are located within drainages on the Project site and surrounding areas and have been selected based upon location, physical stream characteristics, site access, as well as those areas potentially influenced by the Project.

Monitoring locations are presented in Figure 2, below.

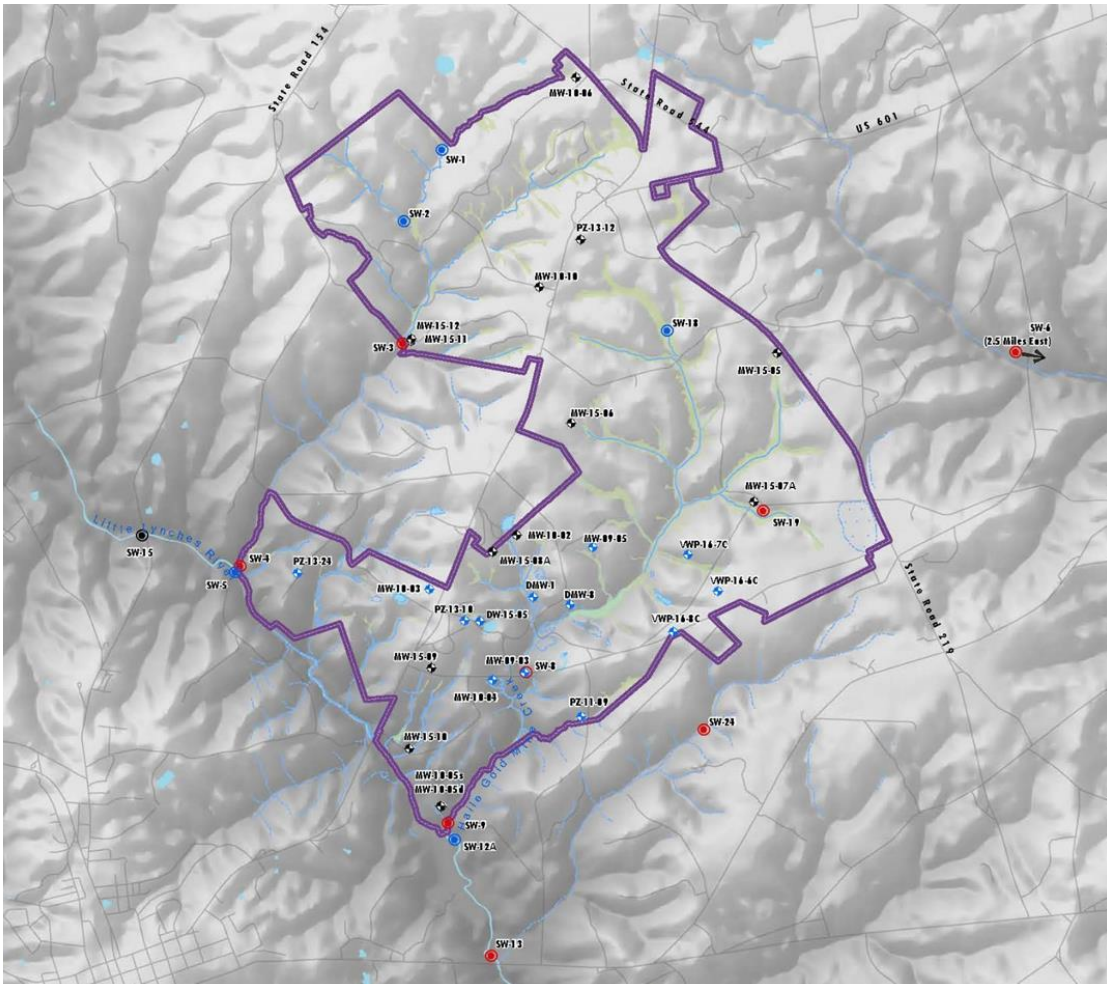


Figure 2. Surface Water Quality Sampling Locations During Operations (SW Locations)

6.1.3 Water Quality Chemical Analyte Monitoring List During Operations

The analytes identified in the following Tables were provided by Haile to the USACE in Haile's Draft MMP (October 30, 2012). These analytes were developed based on geochemical studies performed at the site and professional knowledge of water quality monitoring.

Table 7 identifies analytes for surface water. Table 8 identifies analytes for sampling in existing pit lakes. Table 9 identifies analytes for sampling at "compliance points".

Table 7. Surface Water Quality Chemical Analyte Monitoring List During Operations

Analyte Group	List D
Field Parameters	pH
	EC
	Temperature
	Dissolved Oxygen
Indicator Parameters	Alkalinity
	Acidity
	Sulfate
Cation/ Anion Balance	Calcium
	Chloride
	Magnesium
	Sodium
	Potassium
	Bicarbonate/ Carbonate
Nutrients	Phosphorus (ortho)
	Ammonia
	Total N
	Nitrate
Other Parameters	WAD Cyanide
	Oil & Grease
	Fecal Coliform
Other Parameters	TDS
	TSS
Total & Dissolved Metals	Aluminum
	Antimony
	Arsenic
	Boron
	Chromium III, VI, total
	Copper
	Iron
	Lead
	Manganese
	Mercury
	Nickel
	Selenium
	Silica
	Thallium
	Zinc

Table 8. Pit Lake Water Quality Chemical Analyte

Analyte Group	List E
Field Parameters	pH
	EC
	Temperature
	Dissolved Oxygen
Indicator Parameters	Alkalinity
	Acidity
	Sulfate
Cation/ Anion Balance	Calcium
	Chloride
	Magnesium
	Sodium
	Potassium
	Bicarbonate/ Carbonate
Nutrients	Phosphorus (Ortho)
	Ammonia
	Total N
	Nitrate
Other Parameters	Turbidity
	TDS

Table 9. Surface Water Chemical Analyte at Compliance Points

Analyte Group	List F
Field Parameters	pH EC Temperature Dissolved Oxygen
Indicator Parameters	Alkalinity Acidity Sulfate
Cation/ Anion Balance	Calcium Chloride Magnesium Sodium Potassium Bicarbonate/ Carbonate
Nutrients	Phosphorus (ortho) Ammonia Total N Nitrate
Other Parameters	WAD Cyanide Turbidity Oil & Grease Fecal Coliform TDS TSS
Total & Dissolved Metals	Aluminum Antimony Arsenic Boron Chromium III, VI, Total Copper Iron Lead Manganese Mercury Nickel Selenium Silica Thallium Zinc

6.1.4 Frequency of Sampling

Streams are sampled for water quality parameters quarterly. Streams are sampled for water flow hourly or quarterly, depending on the stream/sampling location and methodology.

Champion Pit Lake is sampled for water quality parameters quarterly. Surface Water Compliance Points are sampled for water quality parameters annually.

6.2 Reporting and Management Planning

6.2.1 Federal and State Permit Reporting Requirements

Surface Water Monitoring Report is issued quarterly to DHEC, Army Corp of Engineers (ACOE) and US EPA. In the event of non-conformances or deviations, notifications will be reviewed with the recipients and corrective actions coordinated through DHEC and ACOE regarding further actions.

7 AQUATICS MONITORING

Haile has a surface water quality monitoring plan as part of its Monitoring Management Plan. The monitoring includes surface water quality, geomorphology, and surface water flow and water level monitoring. These parameters will provide early warning of water impacts and a means of identifying contaminant sources to assist in identifying contingency actions that are employed. These measures should provide adequate monitoring and assessment of any potential impacts to the aquatic community.

Haile also performs a late spring survey of fish populations, using gill nets and fyke nets (both with 3.25-inch stretch mesh), at two locations below the confluence of Haile Gold Mine Creek and the Little Lynches River: LL4 and LL6, as reflected on Figure 3 below. Frequency of monitoring is a step-down approach, with annual monitoring during the 2017 through 2019, then every two years until the monitoring frequency can be reduced or eliminated based upon review of the data and discussion with SCDHEC and SCDNR.

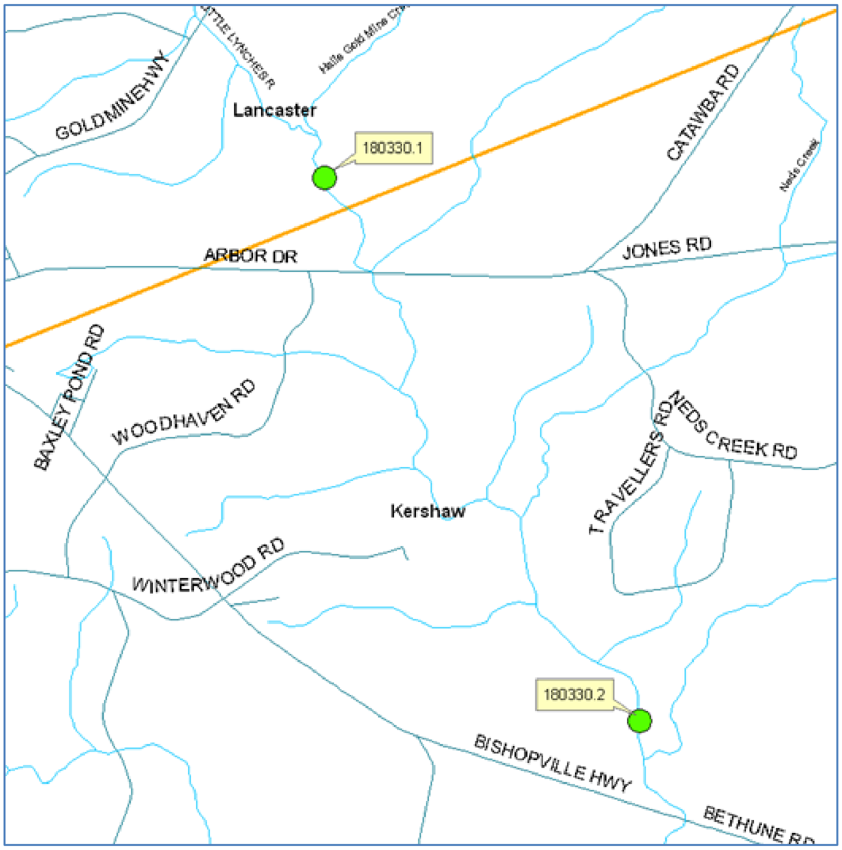


Figure 3. Fish Survey Locations

8 WETLANDS MONITORING

Information regarding the wetlands monitoring to be done at the Haile site can be found in the *Haile Gold Mine Wetland and Stream Monitoring Plan.*

9 WILDLIFE MONITORING

The objective of Haile's Wildlife Monitoring Program is to ensure compliance with federal laws protecting avian species, and to keep records of mortalities to help pinpoint the locations of mortalities and the extent to which they are occurring.

9.1 Monitoring Plans and Permits

Wildlife monitoring is described in Haile's standard operating procedures for the site.

9.2 Reporting and Management Planning

9.2.1 State and Federal Permit Reporting Requirements

In the event of non-conformances or deviations, notifications will be reviewed, and corrective actions coordinated through State Department of Natural Resources and US Fish and Wildlife.

9.2.2 Management Planning

The following management measures are planned for avian and terrestrial wildlife during all phases of the mine life:

9.2.2.1 General Management Practices for Birds

Following Migratory Bird Treaty Act (MBTA) terms described in 16 U.S.C. 703 (a), Haile cannot pursue, hunt, capture, collect, kill or sell/barter any bird or bird part, or any nest, egg or any product of bird covered under the MBTA. Haile will adhere to these terms.

If injured or trapped bird protected under MBTA is observed, Haile will notify the U.S. Fish and Wildlife Service (USFWS) and the South Carolina Department of Natural Resources (SCDNR). Contact information is:

US Fish and Wildlife Office: (843) 727-4707
SCDNR, Nuisance Wildlife Division, Region 2
295 S. Evander Drive, Florence, SC 29506
Wildlife 843-661-4766
Fisheries 843-661-4767
Law Enforcement 843-661-4766

If bird mortalities occur at the site, Haile will keep records of the mortalities to help pinpoint the locations of mortalities and the extent to which they are occurring.

9.2.2.2 General Management Practices for Raptors

The Bald and Golden Eagle Protection Act is a federal law that protects bald and golden eagles from harmful impacts and actions. In 2007, the USFWS developed The National Bald Eagle Management Guidelines to advise landowners and land managers who share land with bald eagles when and under what circumstances the protective provisions of the Eagle Act may apply to their activities (USFWS 2007). These management guidelines are followed by the SCDNR for bald and golden eagles year round. Permits can be obtained under this law, but Haile will adhere to The National Bald Eagle Management Guidelines provided by the USFWS in May of 2007 (USFWS 2007) which obviates the need for a permit. No bald or golden eagles or their nests were identified during wildlife surveys at and near the Haile Project location. If such species or their nests are identified, Haile will work with the SCDNR and USFWS to determine the appropriate actions. Depending upon the circumstances (e.g., whether bald or golden eagles commence nesting activities at or near the Project during mining activities rather than in advance of Project activities), the response may differ.

If other active raptor nests are identified during the breeding season (generally April through August), Haile will work with the SCDNR and USFWS to determine the appropriate actions. Depending upon the circumstances (e.g., whether the raptors commence nesting activities at or near the Project during mining activities rather than in advance of Project activities), the response may differ.

Haile will not intentionally feed any raptors.

If other active raptor nests are identified during the breeding season (generally April through August), Haile will keep a distance between the activity and active nest (i.e., establish a ‘buffer’). An active nest is defined as any nest that is frequented or occupied by a raptor (nestling, fledgling or adult) during the breeding season. The buffer areas serve to minimize visual and auditory impacts associated with human activities near nest sites. Buffers and activities for other raptors are established in consultation with the USFWS and SCDNR.

9.2.2.3 General Management Practices for Terrestrial Mammals

Haile has fenced all HDPE-lined ponds and TSF perimeter with an eight-foot tall fence and the Project boundary are fenced where practicable, which will help deter terrestrial mammal entry.

All fencing around HDPE-lined ponds and TSF perimeter are inspected regularly by Haile personnel performing their job functions.

Transportation corridors on site are periodically visually surveyed for signs of wildlife.

Haile will use skirting to enclose open spaces as necessary beneath raised structures, such as buildings, to deter wildlife from denning, resting or hiding.

Wildlife will not intentionally be fed, harassed or approached.

Vehicle traffic will follow posted speed limits to prevent accidents with wildlife.

9.2.2.4 Management Practices for Open Solution Ponds, including the TSF

As noted above, fencing has been installed around HDPE-lined ponds and the TSF to restrict entry and the property is fenced, where practicable, for security, which will deter some wildlife entry. Note also that TSF management are consistent with the principles and safe practices as described in the International Cyanide Management Code (ICMC 2012) for protection of birds and other wildlife from adverse effects of cyanide process solution. This includes the following measures:

- Where birds or other wildlife have access to water impounded in the TSF, operations will implement measures to limit the concentration of WAD cyanide in the TSF to a maximum of 50 ppm.
- For managed pond systems, as often as possible, uneven water margins and dam floors that may form islands, are avoided because these can attract birds.
- Contact and process water ponds are designed and operated in such a way as to restrict access where necessary and to provide a means of escape for trapped animals (textured exit ramps, etc.). It may be possible in some cases to safely rescue wildlife if discovered quickly enough.

- Vegetation surrounding the perimeter of ponds are cleared, and infrastructure around open solution ponds and the TSF are minimized where practicable.

As part of the closure of all operations, the steps necessary to decommission mine facilities are determined so that the facility can be closed in a manner that prevents adverse impacts to people, wildlife or the environment. The perimeter fence around HDPE-lined ponds and the TSF will remain in place for safety (and wildlife deterrence) during reclamation. Reclamation management is addressed further in Section 11.

Wildlife monitoring are implemented at all open retention structures that are HDPE-lined. For these structures, Haile staff will visually inspect each structure and, if wildlife is observed, they will try to deter the wildlife away from the structures. Measures to deter wildlife will include, but not be limited to the following: clapping, honking vehicle horn, air horn, more aggressive mechanical noises or pyrotechnics (bangers/screamers/lighting), or other types of non-threatening noise making devices.

9.2.2.5 Management Practices for Transmission Lines

The design of substations and distribution and transmission lines for Haile Gold Mine will follow the guidelines established in the Rural Utilities Service (RUS) Substation Design and Transmission Line Design Handbooks. Haile will design and construct its transmission lines to meet these requirements and will follow the guidelines in the Suggested Practices for Avian Protection on Power Lines - The State of the Art in 2006 (APLIC 2006) for the protection of federally and state protected avian species from electrocution and line strikes. Below are the best management practices and avian protection plan that Haile will implement specific to transmission lines on the property owned or managed by Haile.

9.2.3 Best Management Practices

Isolation is provided when possible. Isolation refers to a minimum separation of 150 cm (60 in) between phase conductors or a phase conductor and grounded hardware/conductor.

Insulation, which refers to cover phases or grounds where adequate separation is not feasible, is considered when attempting to make a structure safe for avian habitat. Examples of coverings are: phase covers, bushing covers, arrester covers, cutout covers, jumper wire hoses, and covered conductors.

Perch discouragers are used to deter birds from landing on hazardous (to birds) pole locations where isolation, covers, or other insulating techniques cannot be used.

Priority is given to poles preferred by raptors or other birds that have a high electrocution risk.

9.3 Avian Protection Plan for Transmission Lines

The following Avian Protection Plans (APP) are implemented at the Haile Mine site for transmission lines.

9.3.1 Training

Haile provides avian issues training to all appropriate personnel. The training will encompass: the reasons, needs, and methods for reporting avian mortalities; following nest management protocols; disposing of carcasses; complying with applicable regulations; and, understanding the potential consequences of non-compliance.

Supplemental training is provided when there are changes in regulations, permit conditions, or internal policies.

9.3.2 Construction Design Standards

Haile includes, at a minimum, the accepted standards for both new construction and retrofitting techniques as recommended in APLIC (2006) to limit avian interactions when designing and siting new facilities and operating and maintaining existing facilities.

9.3.3 Nest Management

Haile developed, in consultation with the SCDNR and USFWS, specific procedures for managing nests of protected species on utility structures, including a process for problem nests that need to be relocated or removed. These procedures are discussed during training to ensure consistent treatment of avian nest issues and compliance with regulations or permits related to nest management.

9.3.4 Mortality Reduction Measures

Haile has implemented the general management practices for birds described above. Haile has implemented the avian mortality reporting system as described in above.

9.3.5 Quality Control

Haile will review existing APP practices and ensure their efficiency and effectiveness, and update procedures and standards as needed for Facilities Monitoring

9.4 Major Facilities Monitored During Operations

This part of the MMP has been included so that the reviewer can understand how the monitoring described above relates to the major site facilities during operations, including the following:

Tailing Storage Facility.
TSF Impoundment.
TSF Underdrain Collection Pond.
Green OSAs (Ramona, South, Hayworth, Hilltop, James and 601).
JPAG / West PAG, including the 465 and 470 Collection Ponds.
East PAG, including 500 Pond

Other Facilities

Contact Water Treatment Plant, including the 19 Pond.
Mill Site, including the Process Event Pond.
Pipelines
Stormwater management facilities, including roadside ditches.

9.5 Tailing Storage Facility (TSF)

Initial, normal, and emergency operating procedures for the TSF are described in the TSF Operation, Maintenance and Inspection Manual. A contingency plan for emergency conditions and a discussion of safety measures and techniques for periodic monitoring are also provided therein.

As part of the requirements for Haile's Dam Safety Permit No. 29-0007, a comprehensive Emergency Action Plan has also been developed. The goal of an emergency preparedness plan is a written procedure for reacting to emergency situations caused by a threat of the TSF embankment failure.

The TSF is designed to receive and store tailing from the Mill processing plant, arriving in a slurry. The TSF is operated to separate the liquid and the solids so that the liquid can be recycled for use in the Mill, and the solids can settle and eventually dewater, starting during operations and completing the process after closure. Tailing will retain residual Sodium Cyanide solutions at projected concentrations of less than 50 ppm Weak Acid Dissociable (WAD) Cyanide. The ultimate TSF would be constructed in five stages with storage to contain the current life-of-mine total tons of tailing. All five stages allow for the storage of an operating Reclaim Pond and the Probable Maximum Precipitation (PMP) event while retaining four (4) feet of freeboard above the maximum water elevation.

The TSF is monitored for structural integrity and for possible releases of pollutants into the environment, in accordance with its Dam Safety Permit No. 29-0007 and/or Mining Permit, as summarized herein. Final permit terms and conditions of Haile's Mining Permit have been established by DHEC.

9.5.1 TSF Structural Monitoring

9.5.1.1 TSF Geotechnical Measurements and Structural Integrity

Structural Integrity of the TSF is monitored in accordance with the terms of Haile's Dam Safety Permit No. 29-0007. Monitoring for TSF stability will include visual monitoring as well as geotechnical instrumentation that are installed in and around the TSF. Monitoring instruments include vibrating wire piezometers (VWPs), monuments to measure embankment settlement and movement, and monitoring of groundwater for possible leaks from the TSF. Groundwater quality monitoring is addressed more fully in Section 2, Groundwater.

9.5.1.2 TSF Monitoring

The TSF and the Mill processing facilities provide for a "closed loop" system in which there is no discharge of TSF fluids or materials into surface waters. In accordance with Haile's Mining Permit, surface water and groundwater near the TSF are monitored to detect and respond to a release from the tailing and solution stored within the TSF.

Shallow groundwater is routed under the TSF in collection pipes installed below the HDPE and low-permeability soil liner to route groundwater from beneath the facility (to avoid contact with the tailing material). Initially, per DHEC's request, this shallow groundwater is sampled at a manhole access point and may be pumped to the TSF Underdrain Collection Pond where it would be pumped back into the TSF Reclaim Pond for return to the Mill for reuse as process water.

The earth fill material used for the TSF embankment is site material classified as "Green" (see Section 9.6.5, Overburden Monitoring and Management Plan) or other clean material. The TSF will have a stormwater management and collection system for non-process water, meaning runoff that does not come into contact with the tailing or tailing pond. Stormwater at the Haile Gold Mine is managed in accordance with the Industrial General Stormwater Permit No. SCR000000. Consequently, water is released to receiving waters without chemical treatment after suspended solids have been removed in sediment ponds. Stormwater management and monitoring is described in Section 10.3.4.

9.5.1.3 Surface Water Monitoring

In accordance with Haile's Mining Permit, surface water above and below the TSF are monitored. See Section 3 for more details on Surface Water Monitoring at the Haile site. This monitoring will serve to detect releases from the tailing and solution stored within the facility. In the event of sampling data indicative (based on protocols and procedures to be established in consultation with DHEC) of a release from the tailing or solution material, the Management Procedures identified in Section 6 (surface water) and any applicable Reporting Procedures in Haile's State permit(s) are followed.

9.5.1.4 Groundwater Quality Monitoring

In accordance with Haile's Mining Permit, Haile will conduct monitoring of groundwater. Groundwater monitoring is described in Section 5. This monitoring will serve to detect releases from the tailing and solution stored within the facility. In the event of sampling data indicative (based on protocols and procedures to be established in consultation with DHEC) of a release from the tailing or solution material, the Management Procedures identified in Section 5 (groundwater) and any applicable Reporting Procedures in Haile's State permit(s) are followed.

At the TSF, groundwater wells are installed at the locations identified in Section 5.1.1, including "upstream" of the TSF and "downstream" of the TSF. Sampling and characterization of samples from groundwater quality monitoring wells and groundwater manhole sumps are conducted in accordance with DHEC permit requirements.

9.5.1.5 Tailing Materials and Process Water

Cyanide is present only in the "closed-loop" process water used at the Mill and circulated through the TSF. Under normal operating conditions, flow from the Mill is pumped to the TSF. The pipelines from the Mill to the TSF are double-contained (a pipe in a lined ditch). See Section 10.3.7.1, for further details on pipeline management. If the cyanide level is greater than or equal to 50 ppm WAD cyanide, the flow would be directed to the cyanide destruction tanks, where cyanide levels would be reduced using a sulfur dioxide and air process. In the TSF, UV sunlight and air would naturally decompose cyanide and cyanide complexes to further decrease cyanide levels.

Haile will operate the gold extraction process at the Mill consistent with the International Cyanide Management Code so that the cyanide level (measured as weak acid dissociable cyanide, $CN_{(wad)}$ in the TSF is less than 50 ppm $CN_{(wad)}$. In accordance with its Mining Permit, $CN_{(wad)}$ levels are tested at the Reclaim Pond in the TSF.

9.5.1.6 TSF Underdrain Collection Pond

The TSF is designed with an underdrain collection system placed below the tailing (but above the HDPE liner) that collects seepage of fluids and places them in the double HDPE-lined Underdrain Collection Pond. Fluids from this Underdrain Collection Pond are pumped back into the TSF Reclaim Pond and used during operations as process water in the closed-loop recycling system between the Mill and the TSF.

In accordance with the TSF Operation, Maintenance and Inspection Manual, Haile will undertake periodic visual monitoring and management actions related to the Underdrain Collection Pond, including the Leakage Collection and Recovery Systems (LCRS) and underdrain collection sump pumps, for purposes of prevention, identification, and appropriate response in the event leakage should develop through the primary HDPE liner in the Underdrain Collection Pond.

9.5.1.7 Leak Collection and Recovery System

Double-HDPE lined ponds at the Project site will have a similar Leak Collection and Recovery System (LCRS). It is described more fully here but see also Sections 10.2.3 (465, 470, and 500 Collection Ponds) and 10.3.3 (19 / 29 Pond).

The LCRS are constructed as part of the Underdrain Collection Pond. The purpose of the LCRS is to provide a method to collect fluids in the event of a leak in the primary HDPE liner. Leakage are collected and removed from a low point located above the secondary HDPE liner.

9.5.1.8 LCRS – Monitoring and Response

Leakage through the primary HDPE liner of the Underdrain Collection Pond are indicated by the presence of process water in an LCRS sump. Level probes in the sump will start and stop the LCRS sump pump automatically. A totalizing flow meter on the discharge of the pump provides local indication of total flow.

Upon detection of leakage, pond levels are reduced, and an investigation conducted to determine the cause and location of the leakage.

9.5.2 Emergency Operating Procedures

Potential consequences of emergency situations and unforeseen natural disasters are addressed in Section 9.5. of the TSF Operation, Maintenance and Inspection Manual (August 31, 2013) and the Duckwood Tailing Storage Facility Emergency Action Plan (June 2013). Contingency procedures are described to reduce the effects of possible loss of tailing material and process water from the containment facilities.

9.5.3 Reporting and Management Planning

9.5.3.1 Federal and State Permit Reporting Requirements

Haile will comply with the reporting requirements in its Mining Permit. For further information on Haile’s reporting with respect to surface and groundwater sampling data, see Section 6 and 5, respectively.

The Mining Permit requires regular reporting of the results of monitoring at the TSF. It also requires notification and reporting to DHEC if monitoring indicates a serious matter of structural integrity of the TSF or an actual or potential release of tailing or solution into the environment.

9.6 Overburden Monitoring and Management Plan

The purpose of the Overburden Management Plan is to describe the methods that are used to classify, characterize, segregate and manage overburden at Haile. The plan identifies materials that pose acid drainage (AD) or metal leaching (ML) risk so that they can be segregated and managed in a way that decreases environmental risks during and after mining.

The Overburden Management Plan is based on the Haile geochemical characterization program. The purpose of geochemical characterization is to identify, manage, and mitigate geochemical risks from the Project.

The purpose of the Overburden Management Plan is to assure that overburden presenting greater risk of release of pollutants or contaminants into the environment is managed commensurate with the risk and to provide for safe and stable management and storage of overburden material.

9.6.1 Overburden Classification

Haile has identified significant differences in the AD and ML risk of different overburden and rock units at the Project site, based on extensive analysis of cores from drilling done at the mine. Overburden is tested and classified during ore control sampling (with a sample of the drill cuttings from each blast hole assayed for sulfur and gold) into the following categories based on its potential to generate acid (PAG) characteristics:

- PAG (Red Class) – Net Neutralization Potential (NNP) < -31.25 kg/t as $CaCO_3$
- Moderate PAG (Yellow Class) – Total S greater than 0.2 % or NNP < 0 and NNP $\geq$ -31.25 kg/t as $CaCO_3$

- Non-PAG (Green Class) – Total S less than 0.2 % and NNP > 0 kg/t as $CaCO_3$

9.6.2 Growth Media

During mining, runoff from the Growth Media Storage Areas are monitored in accordance with the NPDES Industrial General Permit No. SCR000000. Water meeting growth media is released to receiving water without chemical treatment after suspended solids have been removed in sediment ponds.

9.6.3 Green Overburden

During mining, runoff from Green overburden are monitored in accordance with the NPDES Industrial General Permit No. SCR000000 for waste rock and overburden piles. Runoff from Green overburden is released to receiving water without chemical treatment after suspended solids have been removed in sediment ponds.

9.6.4 Yellow Overburden

Yellow PAG material placed in backfilled mine pits are restricted to elevations well below the ultimate water table that is expected to develop (based on historic groundwater levels and model predictions) in the backfilled pits after closure. Pit backfill is placed in lifts not more than 50 feet thick and material is amended with process lime or an equivalent amount of other alternative suitable alkaline material (which could include limestone or various by-products such as lime kiln dust or carbide from acetylene production). (The current anticipated rate of lime amendment is 2 pounds of lime per ton of yellow PAG, subject to DHEC review and final determination.) To add the lime, haul trucks loaded with yellow PAG material will drive beneath a bin containing lime. Lime is dropped onto the yellow PAG material as the truck passes beneath the bin. The truck would end-dump the material into the pit; this end-dumping over a 50-foot height causes the PAG material to mix with the lime. Yellow PAG material not used as pit backfill is permanently stored at PAG Facilities. See Section 11.4.1 below.

9.6.5 Red Overburden

Red overburden is permanently stored at PAG Facilities. See Section 11.4.3 below, for details regarding PAG Facilities.

10 REPORTING AND MANAGEMENT PLANNING

10.1 Federal and State Permit Reporting Requirements

Haile will comply with the reporting requirements in the Industrial General Stormwater Permit No. SCR000000 and its Mining Permit.

10.1.1 Management Planning

Haile has developed operational and management plans to ensure compliance with permit terms, including any emergency reporting and responses.

10.2 Potentially Acid Generating OSA's

PAG facilities – (JPAG / West PAG and East PAG), will contain Red (and some Yellow) PAG, as well as a temporary low-grade ore stockpile, are constructed with an 80-mil thick, HDPE geomembrane liner underlain with low permeability soils to contain and route seepage and runoff waters to the 465, 470 and 500 Collection Ponds for water treatment or use in the Mill. Red PAG are placed in lifts not more than 50-feet in height. The top of each bench will be compacted, and the outside perimeter of each bench will be constructed with a minimum 20-foot wedge of saprolite. These measures will help minimize oxygen and meteoric water entry/infiltration into the PAG during operations. A minimum of 5 feet of saprolite will be placed on top of each PAG facility at closure.

10.2.1 Site Monitoring

Surface water and groundwater near the PAG facilities are monitored for purposes of leak detection in accordance with Haile's Mining Permit, as described in Sections 5 and 6 of this MMP. This monitoring will serve to detect any release of the PAG material stored within the facility through the HDPE liner and low permeability soils. In the event of sampling data indicative (based on protocols and procedures to be established in consultation with DHEC) of a release from PAG Facility, the Management Procedures identified in Sections 5 (groundwater) and 6 (surface water) and any applicable Reporting Procedures in Haile's Mining Permit are followed.

10.2.2 Water Quality Monitoring

10.2.2.1 Surface Water

Any water in contact with the material on PAG Facilities (including the low-grade ore stockpile) are managed as contact water. Collection channels are built within the HDPE-lined facility and surround PAG Facilities to divert untreated surface runoff to HDPE-lined collection ponds that are sized to capture the 100-year, 24-hour storm (a model storm of a 24-hour duration with an intensity that is only likely to occur once every 100 years). This "contact" stormwater runoff is used in the closed-loop process at the Mill or treated at the on-site Contact Water Treatment Plant and released to Outfall 004 or returned to the Mill as a make-up water source.

10.2.2.2 Shallow Groundwater

Shallow groundwater is routed under PAG Facilities (to avoid contact with the PAG materials) via collection pipes that are installed below the low-permeability soil liner to route shallow groundwater from beneath the facility. Shallow groundwater is routed and discharged to a tributary of Haile Gold Mine Creek (HGMC) in accordance with Haile's Mining Permit.

10.2.3 465, 470 and 500 Collection Ponds

A summary of the Collection Pond is shown in Table 8. The Collection Ponds are double HDPE-lined with a leak collection and recovery system (LCRS). See Section 9.5.1.7 for details regarding LCRS. Fluids in these ponds are pumped to the 19 Pond / 29 Pond as the ponds are designed to be maintained empty, rather than as holding ponds.

Table 10. Contact Water Collection Ponds

Contact Water Collection Pond	Source of Water	Volume of Water
465 Pond	JPAG / West PAG	19 Million Gallons
470 Pond	West PAG	70 Million Gallons
500 Pond	East PAG	50 Million Gallons

Collection Ponds are sized such that each can contain the entire 100-year, 24-hr storm volume plus 10 percent excess storage capacity. Each is also designed so that the 100-year runoff volume can be emptied in 72 hours, with water pumped to the 19 Pond for treatment at the CWTP and discharge or use as make-up water at the Mill.

10.2.3.1 Monitoring Plans & Permits

Since the Contact Water Collection Ponds are a source of water that will need to be treated and are managed in accordance with both the CWTP Construction Permit and the Mining Permit.

10.2.4 Reporting and Management Planning

Reporting requirements for PAG Facilities and the Collection Ponds are in Haile's CWTP Construction Permit and Mining Permit. Haile has developed operational and management plans to ensure compliance with permit terms, including any emergency reporting and responses.

10.3 Other Facilities

10.3.1 Contact Water Treatment Plant

Haile's Contact Water Treatment Plant (CWTP) will treat contact water in accordance with Haile's Individual NPDES Permit No. SC0040479. The CWTP is designed to treat 1,200 gpm and to handle variable low flows efficiently. The treatment approach is a two-stage clarification system to address the estimated influent metals loading from contact water generated on site during operational activities. The water treatment process approach was selected to provide flexibility and reliability in meeting discharge permit standards for the variable flow rates and water quality from the contact water generated on site (the inflow to the CWTP will vary, over time, in both quantity and quality). Redundancy has been provided for critical process areas and unit process equipment to ensure NPDES compliance and to better handle the variable water quality and loading.

The CWTP is a self-contained facility within the Mill Site. Contact water is collected in the double HDPE-lined 19 Pond, which can be a makeup source for the Mill or can be sent to the CWTP, where it is treated and released or returned to the Mill as a make-up water source. The treatment process is two reaction tanks, two clarifiers, and a multi-media filtration process that is designed to precipitate the metal hydroxides into flocculated solids. The solids that settle in the containment compartments ultimately are disposed in the TSF.

The Contact Water Treatment Plant (CWTP) will be expanded to 2,200 gpm in approximately 2025.

10.3.2 Sources of Contact Water

Contact water is water that meets PAG material. Contact water originates from the following sources:

- Dewatering of the surface water within active and inactive pits (not reclaimed) that have intercepted PAG material, including seepage, stormwater runoff, and pit wall runoff;
- Runoff from PAG Facilities;
- Seepage from PAG Facilities; and
- Runoff and seepage from ore stockpile(s) – including the low-grade ore stockpile at PAG Facilities, the primary crusher, and the ore stockpile at the Mill.

10.3.3 19 Pond / 29 Pond

The 19 Pond is designed to store approximately 19 million gallons of water (2.54 million cubic feet) with an additional 2 feet of freeboard. The 19 Pond is designed to be used as a buffer between the various sources of contact water and the CWTP. The 19 Pond is sized to ensure the a Contact Water Collection Ponds can be evacuated of runoff from the 100-year event within 72 hours in coordination with running the CWTP. The water reporting to the 19 Pond will either be treated in the CWTP or be sent to the Mill for make-up water.

The 19 Pond is double HDPE-lined with a leak collection and recovery system (LCRS). See Section 9.5.1.7 for details on the LCRS.

A third cell will be added to 19 Pond which will increase its capacity from 19 million to 29 million gallons (3.88 million cubic feet) in approximately 2024.

10.3.4 Monitoring Plans & Permits

The CWTP is monitored in accordance with Haile's NPDES Individual Permit No. SC0040479 and is operated in accordance with Haile's Operations and Maintenance Manual for the CWTP. Water quality at the CWTP is monitored in accordance with Haile's NPDES Individual Permit No. SC0040479.

10.3.5 Reporting and Management Planning

10.3.5.1 Federal and State Permit Reporting Requirements

Specific reporting procedures are in NPDES Individual Permit No. SC0040479, Part II, Section L, Reporting Requirements.

10.3.5.2 Management Planning

In the event of any non-compliance, including that which may endanger health or the environment (as these terms are defined in Haile's NPDES Individual Permit No. SC0040479), Haile will follow the reporting procedures in Part II, Section L, Reporting Requirements. This includes notification of the DHEC local office within 24 hours, and a written submission within 5 days of the time Haile becomes aware of the circumstances. "The written submission shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance."

10.3.6 Mill Site

10.3.6.1 Process Flow

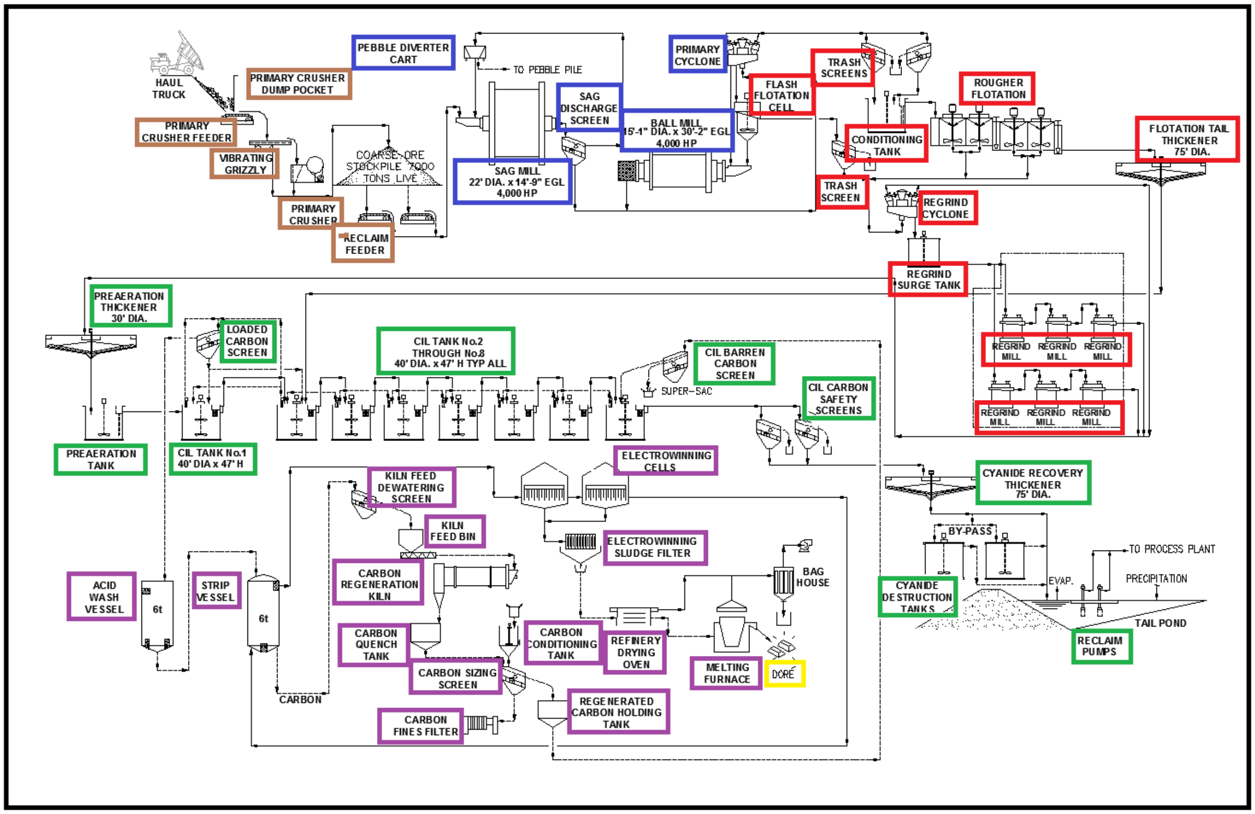
Gold bearing ore is sent to the Mill where it will go through a process of physical size reduction and chemical separation to extract the precious metals. TSF reclaim water is re-used in the Mill process. The reclaim water will cycle between the Mill and the HDPE-lined TSF in a closed loop, which will prevent the Mill process water from being discharged into the environment.

Sodium cyanide is used only in tanks and in the following manner within the closed-loop system for the Mill process water. Sodium cyanide is added with activated carbon to the concentrate and flotation tailing treatment stages. (Prior to those stages, the slurry is aerated to oxidize the ore, which reduces the amount of sodium cyanide required to extract the gold.) In addition to sodium cyanide and activated carbon, lead nitrate and lime are added in the concentrate and flotation tailing treatment stages in various amounts to enhance gold recovery and maintain the pH to ensure protective alkalinity. The Carbon-in-Leach (CIL) process will then take place in eight tanks. Slurry will advance from tank to tank by gravity and the discharge from the last tank would report to a carbon screen. Because the particles of activated carbon with the adsorbed gold are larger than the slurry mixture, they would be retained in the tanks by screens while the “waste slurry” will pass through from tank-to-tank and finally out of the circuit.

Tailing slurry is pumped through the Cyanide Destruct Process to the TSF. In the cyanide destruction tanks, WAD cyanide is oxidized to form cyanate (OCN-). The process utilizes sulfur dioxide and air at a slightly alkaline pH in the presence of soluble copper to oxidize the cyanide. Through this process, the cyanate quickly decomposes in water to ammonium (NH4) and bicarbonate (HCO3) ions that are stable. This process was developed in the 1980’s by INCO and is currently in use in over 30 mine sites worldwide. Ammonium bisulfite is the source of sulfur dioxide, and air is the source of oxygen. Copper sulfate is added as a catalyst, as needed, and lime is added to control pH.

Figure 13 presents the general Mill process flow sheet, showing Primary crushing (Brown), Grinding (SAG and Ball Mill) (Blue), Flotation (Red), Regrind (Red), Carbon-in-Leach (CIL) (Green), Carbon stripping and Gold processing (Purple).

Figure 13. General Mill Process Flow Sheet



Source: Project Description (December 2018).

10.3.6.2 Spill Containment & Response

The ore processing facilities and chemical storage areas are designed with the capacity to contain spills or leaks, with the volume to hold a 100-year, 24-hour storm event, assuming it would occur in conjunction with a spill or leak. Each area is built on a concrete floor with cast-in-place concrete walls. The floor area and wall heights are designed to capture any spills, and the floors slope toward a collection sump for clean-up and return of the spill to the process stream for which it is best suited. The floor area and walls are designed to capture 110 percent of the largest vessel (or container) in that process area plus stormwater (for the 100-year, 24-hour storm event) if it is open to the sky.

In the event of a spill that exceeds a facility's containment capacity, the overflow will drain to the adjacent Process Event Pond, which is designed to act as a failsafe in case individual containment systems have insufficient capacity. The Process Event Pond is designed to capture quantities of spilled solution or slurry that may exceed the main process containment facilities, tailing slurry pipeline contents, or reclaim water line contents. It is constructed on the north end of the processing facilities. Table 9 summarizes the containment systems and volumes for each component of the Mill.

Table 9. Containment Systems for the Mill

Containment Area	Indoor / Outdoor	Containment System	Containment Volume	Sump Pumps to
Primary Crusher	Outdoor	Concrete Pad with stem walls	100 year/ 24-hour storm event	Stockpile Collection Pond
Grinding (SAG & Ball Mill) Building	Covered	Concrete Pad with stem walls	110% of largest vessel	Grinding Circuit
Flotation and Regrind	Outdoor	Concrete Pad with stem walls	110% of largest vessel + 100 Year/ 24-hour storm event (utilizing overflow to adjacent containment areas)	Flotation Circuit
Pre-aeration Thickener	Outdoor	Concrete Pad with stem walls	110% of largest vessel + 100 Year/ 24-hour storm event (utilizing overflow to adjacent containment areas)	Pre-aeration Thickener
Flotation Tail Thickener	Outdoor	Concrete Pad with stem walls	110% of largest vessel + 100 Year/ 24-hour storm event (utilizing overflow to adjacent containment areas)	Flotation Tail Thickener
Carbon in Leach (CIL) Area	Outdoor	Concrete Pad with stem walls	110% of largest vessel + 100 Year/ 24-hour storm event (utilizing overflow to adjacent containment areas)	CIL Circuit
Cyanide Recovery Thickener/Cyanide Destruction	Outdoor	Concrete Pad with stem walls	110% of largest vessel + 100 Year/ 24-hour storm event (utilizing overflow to adjacent containment areas)	Cyanide Destruction
Reagent Mixing Area	Covered	Concrete Pad with stem walls	110% of largest vessel in each containment area + 100 Year/ 24-hour storm event	Cyanide Destruction
Reagent Storage Area	Outdoor	Concrete Pad with stem walls	110% of largest vessel in each containment area + 100 Year/ 24-hour storm event	CIL Circuit
Reclaim Water Pad	Outdoor	Concrete Pad with stem walls	110% of largest vessel + 100 Year/ 24-hour storm event	Reclaim Water Tank
Tailing Line	Outdoor	Lined Trench and Pond	110% of the entire pipeline volume + 100-year/ 24- hour storm event	Process Event Pond
Truck Shop Tank Farm	Outdoor	Double Walled Tanks	Tanks are double-walled on concrete foundations.	No sump in this area. Any spills would be remediated at the point of spill
Carbon Acid Wash	Outdoor	Concrete Pad with stem walls	110% of largest vessel + 100 Year/ 24-hour storm event	Carbon Acid Wash
Carbon Strip	Outdoor	Concrete Pad with stem walls	110% of largest vessel + 100 Year/ 24-hour storm event	Carbon Strip
Carbon Regeneration	Outdoor	Concrete Pad with stem walls	110% of largest vessel + 100 Year/ 24-hour storm event	Carbon Regeneration
Refinery	Indoor	Concrete Pad with stem walls	110% of largest vessel	Refinery
Fuel Storage	Outdoor	Double Walled Tanks	Tanks are double-walled on concrete foundations.	No sump in this area. Any spills would be remediated at the point of spill

Source: Haile Draft Project Description (December 2018)

Systems and procedures at the Mill Site are in place to address potential recovery of released solutions, remediation of any contaminated soil, and possible failures of delivery tank trucks, as necessary to protect surface and ground water.

10.3.6.3 Process Event Pond

The Process Event Pond is a 1.5-million-gallon capacity HDPE-lined pond to handle overflow events should multiple spill events occur in the Mill processing area., Process solution or slurry exceeding secondary containment capacity would exit the containment area through a pipeline and would flow by gravity within a pipe to the HDPE-lined Process Event Pond. Should a failure of the tailing or process water pipelines occur, or in the event of a prolonged unplanned power outage, the material from the pipelines would drain to the Process Event Pond.

Once the failures have been repaired, or power restored, the material in the Process Event Pond would be returned to the cyanide recovery thickener or applicable area for processing. Water from a spill or incident that contacts processing reagents would be suitable for use in the closed-loop system, which includes use of process water from the TSF.

10.3.6.4 Monitoring Plans & Permits

The Mill and Process Event Pond are monitored in accordance with Haile’s Mining Permit, and operated in accordance with Haile’s Operating Plans and Procedures for the Mill, which will describe the standard practices necessary for the safe and environmentally sound operation of the facility, and specific measures needed for compliance with applicable regulatory requirements. Haile’s Operating Plans and Procedures for the Mill are consistent with the International Cyanide Management Code.

10.3.6.5 Water Quality Monitoring

Sections 5, Groundwater, and Section 6, Surface Water, provide for up-gradient and down-gradient monitoring of the primary facilities at the mine, to determine whether constituent migration from the Mill is occurring, as well as appropriate reporting and response activities.

10.3.6.6 Cyanide Management

Unloading of liquid cyanide and other chemicals used at the Mill is done on a concrete surface to prevent any leakage from reaching the environment. Cyanide storage and mixing tanks are located on concrete surface to prevent seepage to the subsurface. Secondary containment is employed to contain any releases from the tanks, and for any precipitation that may contact cyanide. Should there be any releases from the tanks, the material/liquid are recovered and returned to the cyanide process and any contaminated materials are disposed of properly.

10.3.6.7 Air Quality Control and Monitoring

Haile’s Air Quality State Construction Permit No. 1460-0070-CA and Operating Permit (not yet issued) from the South Carolina DHEC, Bureau of Air Quality, will contain emissions limitations, work practice standards, recordkeeping requirements, equipment monitoring requirements and reporting obligations. *See* Air Construction Permit No. 1460-0070-CA, Sections C-N.

10.3.6.8 Reporting and Management Planning

Haile will follow the reporting procedures in its Air Construction Permit No. 1460-0070-CA and Air Operating Permit and Mining Permit, as appropriate.

Haile will develop operational and management plans associated with optimization to ensure compliance with permit terms, including any emergency reporting and responses.

10.3.7 Pipelines

10.3.7.1 Spill Prevention, Containment & Response

The tailing slurry (from the Mill to the TSF) and process water pipelines (from the TSF to the Mill) are designed to have double containment – with one pipe placed inside another pipe (the containment pipe) and/or a pipe in an HDPE-lined ditch – to minimize the potential of an accidental spill. Haile will also install pressure-sensing alarms on these pipelines.

Should a failure of the tailing or process water pipelines occur, or in the event of a prolonged unplanned power outage, the material from the pipelines would drain to the Process Event Pond (See Section 10.3.6.3 for details on the Process Event Pond). Once the failures have been repaired, or power restored, the material in the Process Event Pond would be returned to the cyanide recovery thickener or applicable area for processing. Water from a spill or incident that contacts processing reagents would be suitable for use in the closed-loop system, which includes use of process water from the TSF.

The contact water pipelines will carry contact water from its source to the 29 Pond for treatment or use in the Mill. The contact water pipelines and pump systems have not yet been designed; however, Haile expects that these are single-wall pipes that will have differential pressure-sensing alarms and/or an automatic shut-off system to respond to a change in pressure in the pipe (which is a standard indicator of a potential leak).

10.3.7.2 Monitoring Plans & Permits

Tailing slurry and process water pipelines are monitored in accordance with Haile’s Mining Permit. Haile’s contact water pipelines from originating sources to the 29 Pond are expected to be addressed in Haile’s CWTP Construction Permit for mine optimization.

10.3.7.3 Reporting and Management Planning

Haile will comply with the reporting requirements in its Mining Permit and NPDES Individual Permit, as appropriate.

Haile has developed operational and management plans to ensure compliance with permit terms, including any emergency reporting and responses.

10.3.8 Stormwater Facilities, Including Roadside Ditches

Management of non-contact stormwater involves routing runoff from undisturbed areas around mine facilities, collection of stormwater runoff from non-PAG mine facilities, sediment control and release of non-contact waters to the stream system.

10.3.8.1 Monitoring Plans & Permits

Stormwater management actions are more fully described in Haile's Stormwater Pollution Prevention Plans (SWPPP), which were completed in conjunction with the NPDES Industrial General Permit. Methods of managing sediment and erosion control during construction will follow guidelines presented in the South Carolina Stormwater Management Handbook (DHEC 2005) and be in accordance with the NPDES Industrial Permit.

For construction activities at the Mill area, Haile will comply with the NPDES Construction General Permit. Following construction, this area will comply with the NPDES Industrial General Permit.

10.3.8.2 Stormwater Management

Stormwater management at Haile is guided by the regulations and standards set by the DHEC and Haile's current coverage under the NPDES Industrial General Permit. Presently, all covered stormwater discharges are being managed in accordance with the requirements of the NPDES Industrial General Permit. Regulation R61-9.122.26(b)(14) defines "Stormwater discharge associated with industrial activity" to mean "the discharge from any conveyance that is used for collecting and conveying stormwater and that is directly related to manufacturing, processing or raw materials storage areas at an industrial plant. The term does not include discharges from facilities or activities excluded from the NPDES program under this regulation."

The NPDES Industrial General Permit includes Part 8 (Sector-Specific Requirements for Industrial Activity), Subpart G (Sector G-Metal Mining). The sector-specific requirements apply to those areas of the mine facility where those sector-specific activities occur. These sector-specific requirements are in addition to any requirements specified in the permit. Coverage is required for metal mining facilities that discharge stormwater contaminated by contact with, or that has come into contact with, any overburden, raw material, intermediate product, finished product, byproduct or waste product located on the site of the operation (see Part 8.G.1, Covered Stormwater Discharges). Part 8.G.2, Covered Discharges from Active and Temporarily Inactive Facilities, identifies the stormwater discharges covered under Part 8, Subpart G. In accordance with the NPDES Industrial General Permit, Part 5, Stormwater Pollution Prevention Plan (SWPPP), Haile will update its existing SWPPP to document the selection design, and installation of control measures, and implementation (including inspections, maintenance, monitoring, and corrective action) of the permit requirements.

DHEC has determined that construction of the Mill Site will require coverage under the NPDES Construction General Permit and associated SWPPP for stormwater discharges associated with construction. As a result, Haile submitted its Notice of Intent (NOI) for coverage under the NPDES Construction General Permit to DHEC on June 28, 2013. Upon completion of the construction activities for the Mill Site, stormwater discharges associated with industrial activities at the Mill Site will return to being regulated by the NPDES Industrial General Permit. Other earthmoving activities at the mine are covered by the NPDES Industrial General Permit.

Stormwater control design measures and implementation procedures are in process for several of the planned facilities at the mine site, and Haile is working with DHEC to ensure compliance with all stormwater permitting requirements. Haile will have complete stormwater plans, which will have been reviewed by DHEC, prior to conducting any construction and industrial activities not otherwise covered under the current NPDES Industrial General Permit.

10.3.8.3 Reporting and Management Planning

The reporting requirements are stated in Part 8, Sector G, 8.G.8 of the NPDES Industrial General Permit.

Under the NPDES Industrial General Permit, Haile must report any noncompliance which may endanger health or the environment. Any information must be provided orally to DHEC within 24 hours from the time Haile becomes aware of the circumstances. A written submission to DHEC must also be provided within five days of the time Haile becomes aware of the circumstances.

Under the NPDES Industrial General Permit, if a follow-up monitoring test result (as defined in Section 6.3 of the permit) exceeds a numeric effluent limit, Haile must submit an Exceedance Report to DHEC no later than 30 days after it has received its lab results. Haile's report must include the following:

a. NPDES permit tracking number;
b. Facility name, physical address and location;
c. Name of receiving water;
d. Monitoring data from this and the preceding monitoring event(s);
e. An explanation of the situation; what Haile has done and intends to do (should the Company's corrective actions not yet be complete) to correct the violation; and
f. An appropriate contact name and phone number.

Under the NPDES Construction General Permit, Haile shall report to DHEC any noncompliance which may endanger health or the environment. Any information shall be provided orally within 24 hours from the time Haile becomes aware of the circumstances. A written submission to DHEC shall also be provided within 5 days of the time Haile becomes aware of the circumstances. The written submission shall contain:

a. A description of the noncompliance and its cause;
b. The period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue;
c. And steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

Under the NPDES Construction General Permit, Haile shall report to DHEC all other instances of noncompliance at the time monitoring reports are submitted. The monitoring reports shall contain the above-listed information.

11 RECLAMATION PLAN, POST-MINING RECLAMATION AND CLOSURE MONITORING

The Haile Gold Mine Reclamation Plan has been developed to meet the requirements of Section 48-20-90 of the South Carolina Mining Act. The Reclamation Plan is designed to describe methods used to reclaim land disturbed by mining, ore processing operations, and associated activities to a stabilized condition that will provide for the long-term protection of land and water resources, minimize the adverse impacts of mining, and support the intended post-mining land use.

In addition, the Reclamation Plan serves as a basis for calculating reclamation costs, identifying long-term post-reclamation monitoring and maintenance requirements, and determining financial assurance. As mining activities at the Haile Gold Mine progress, the Reclamation Plan is continuously refined and expanded, while adhering to the concepts outlined therein. Appropriate financial assurance is provided for reclamation and closure activities to ensure that funds for reclamation and closure are available.

Due to its past reclamation successes at the Haile Gold Mine site, Haile has experience and understanding of the reclamation process, including what vegetation can and will grow at the site. During mining operations, Haile will take every opportunity to perform reclamation concurrent with operations. Concurrent reclamation is performed on disturbed areas once all planned mining activities in the area are completed and no future mining activity is expected. Final reclamation is completed as soon as practicable after mining activities cease at the facility. Haile will also conduct post-mining reclamation and closure maintenance and monitoring.

11.1 Site-Wide Reclamation Plan

The Haile Gold Mine Reclamation Plan describes the reclamation of disturbed land from mining and ore processing operations to a stabilized condition that will provide for the long-term protection of land and water resources for post-mining land uses. Additional goals include:

- Reducing the environmental impacts of mining.
- Utilizing concurrent reclamation where appropriate throughout the mining process.
- Minimizing the need for long-term active water management requirements through the conversion to and use of passive treatment technology at the TSF and PAG Facilities.
- Abating the generation of acid rock drainage from the sulfide materials exposed due to mining operations.
- Meeting state and federal regulatory requirements.

During operations, Haile will perform aspects of the final reclamation activities as part of operational activities. This concurrent reclamation is planned for stabilization and vegetation of the outboard slopes of the TSF and OSAs, backfill and reclamation of certain mine pits, and grading and reseeding areas where previously reclaimed facilities were removed. Final reclamation (which is anticipated to include reclamation of the TSF, PAG Facilities, the Mill Site, roads, pit lakes, and the associated revegetation efforts) begin immediately upon cessation of mining and milling operations. Reclamation are completed as expeditiously as practicable and in compliance with SC Mining Regulations 89-80.B: “Reclamation shall be conducted simultaneously with mining whenever feasible and in any event shall be initiated at the earliest practicable time, but no later than within 180 days following termination of mining on any segment of the mine and shall be completed within two years after completion or termination of mining on any segment of the mine.”

11.2 Vegetation Plan

Re-establishing vegetation on impacted lands are essential to preventing erosion, restoring surface stability, providing site productivity, and providing wildlife forage/cover opportunities as well as visual/aesthetic values at the Haile Gold Mine Project site during operations and reclamation. The vegetation procedures planned for the Haile site are based on industry standards, site specific experience in South Carolina, and past reclamation success.

Multiple seed mixes are to be used at Haile depending on soil condition, planting season, weather conditions and available water sources. All seed shall be certified noxious weed-free. Seed mixes are chosen based on species characteristics, varied soil conditions at site, and the planned land use and maintenance of the area. An annual grass is used in the mix and will change dependent on the time of year the planting is made. The primary goal of revegetation is soil stabilization while a secondary goal is to provide a habitat for wildlife and the natural succession of vegetation.

During the mine operating period, Haile will consult with SCDNR and DHEC, establish vegetation test plots and perform other studies to establish, confirm and refine appropriate vegetation species and seeding rates, determine the need for soil amendments, and determine overall vegetation procedures to ensure sustainable vegetation post-mining for the intended land use.

Based on previous experience at the mine site, majority of the disturbed surfaces are suitable to sustain vegetation without the need to supplement the soil. As a precaution, growth media is stockpiled during mine development to fully reclaim the site in accordance with SC Mining Regulation 89-140. Where Haile, in conjunction with the State, determines that growth media is needed to establish vegetation, material are recovered from the storage areas and used during reclamation activities.

11.3 Post-Mining Land Use

Consistent with the individual locations that are reclaimed as described in Sections 11 to 11.6, the goal of Haile's reclamation plan is to return the disturbed areas to a stable condition that can support a productive post-mining land use. After reclamation, assuming such uses are consistent with local zoning laws, most of the site are suitable for other uses (i.e., industrial, commercial, residential, and agriculture & forestry), restored to their natural condition (i.e., wetlands and streams), or reclaimed as pit lakes. Future activities at the TSF and PAG Facilities are limited, consistent with post-closure restrictions.

11.4 Facilities

The facilities at the Haile Gold Mine that are addressed in the Reclamation Plan include:

- Backfilled Mine Pits
- Pit Lakes
- Green OSAs
- PAG Facilities
- Site surface water management facilities
- TSF
- Mill Site and associated infrastructure
- Roads, on-site power lines, and other ancillary facilities

Following is an overview of the reclamation activities planned for the above facilities:

11.4.1 Backfilled Mine Pits

Mill Zone, Snake, Haile, and Red Hill are backfilled with overburden and reclaimed to facilitate post mining land uses. A reclamation approach for each pit has been designed to best suit the location, geometry, and timing of mining within the scope of the current mine plan and reclamation concepts. These pits are backfilled with Yellow and Green overburden as part of overburden placement during operations (i.e., concurrent backfilling).

As Yellow overburden material is placed in the pit backfill, the overburden is amended with lime at a rate of 2 lbs. per ton of overburden. Lime amendment will assist in neutralizing acid rock drainage that forms within the pit backfill material until depressurization activities cease, and the water level in the pit backfill has risen to fully inundate the yellow overburden. Yellow overburden is placed using lift heights no greater than 50 feet.

The final lift of Yellow overburden will be placed well below the anticipated inundation level (based on historic levels and groundwater modeling). Above the Yellow overburden, a minimum of 5 feet of saprolite will be placed to reduce oxygen entry into the backfill. Once water levels in the pit backfill have recovered to the inundation level, the Yellow overburden is permanently Snake, Mill Zone submerged, limiting the oxygen available and thereby reducing the potential to generate acid rock drainage.

The top of pit backfill will be regraded to minimize impoundment of storm waters and flow concentration and seeded using an approved seed mix and appropriate seeding methods, described above in Section 11.2 until inundated with water at the end of active mining with the filling of Ledbetter Reservoir.

11.4.2 Pit Lakes

Ledbetter Reservoir (comprised of the partially backfilled Snake, Haile, Mill Zone and Red Hill Pits and Small Pit) and Champion Pit Lake will fill with water at the cessation of dewatering. A safety berm is constructed around any portions of the Champion Pit Lake and the Ledbetter Reservoir that did not have these during operations. Appropriate signage will be placed at regular intervals on the berm warning of the potential hazards of highwall remaining along the shore and other pit lake hazards.

Pit lake water quality studies have been performed based on pre-mining information. During operations, as additional information is acquired related to acid generating characteristics of the pit walls and refined groundwater modeling, additional pit lake studies will be performed to refine the predictions of the quantity and quality of the Ledbetter Reservoir and Champion Pit Lake.

During pit filling and until water quality stability has been achieved, water quality within the pit lakes will be monitored and managed to ensure water quality meets applicable requirements. Lime will be added, as necessary, to maintain the pit lakes with an appropriate pH levels throughout the post closure period.

11.4.3 PAG Facilities

PAG Facilities are designated to receive all Red overburden and any Yellow overburden not utilized for the pit backfills. Low grade ore will also be stored within the lined area of PAG Facilities; however, the plan is to remove and process the low-grade ore prior to final closure and reclamation of PAG Facilities. Any low-grade ore left within PAG Facilities would be closed and reclaimed with the Red/Yellow overburden. Additionally, spent ore from the existing Chase and South Heap Leach Pads and existing passive cell material are placed in PAG Facilities; Red or Yellow material from existing overburden facilities and backfill material from previously backfilled pits that are within the pit footprints are placed in PAG Facilities.

PAG Facilities are constructed with an 80-mil thick, HDPE geomembrane liner underlain with low permeability soils to contain and route seepage and runoff waters to three collection ponds (the 465, 470 and 500 Collection Ponds) for water treatment. The HDPE liner is overlaid with two (2) feet of sand, to protect the liner during operations and removal of the low-grade ore stockpile for processing at the Mill. Collection channels are built within the HDPE-lined facility and surround PAG Facilities to divert untreated surface runoff and seepage from the PAG to HDPE-lined collection ponds that have been sized to capture the 100-year 24-hour precipitation event. Groundwater is routed under PAG Facilities to avoid contact via collection pipes that would be installed below the low- permeability soil liner to route groundwater from beneath the facility.

Red PAG is placed in lifts not more than 50 feet in height. The outside perimeter of each bench will contain a minimum 20-foot wedge of saprolite. Also, the top of each bench is compacted. These measures will help minimize oxygen and meteoric water entry/infiltration into the pile. As sections are filled to capacity, thetop surface of the regraded PAG will be c capped with a minimum five (5) feet of saprolite cover.

Once the pile is constructed and capped to final configuration, the entire surface of PAG Facilities are covered with a double textured HDPE geomembrane to limit the infiltration of water and restrict oxygen movement. A minimum of two feet of growth media material are placed on top of the liner. The growth media is vegetated. See Section 11.2. Once vegetated, a petition to re-classify stormwater as non-contact will be submitted to DHEC. After DHEC approves, runoff will be treated as stormwater.

After the geomembrane cover is installed and infiltration into the OSA is cut off, seepage from PAG Facilities is anticipated to report to the seepage collection pond at a low flow rate and be of poor quality for an extended duration. However, the quantity of seepage is expected to decrease quickly once the HDPE cover is installed and additional precipitation is prevented from infiltrating the PAG material. The long-term treatment of this flow will be performed using a passive treatment facility. Unless and until the flow is capable of being treated by passive technology, Haile will use the on-site CWTP to treat and discharge the seepage from PAG Facilities.

Passive systems use gravity to move the water. The system is planned to be constructed in the lined Collection Ponds. Due to the passive (no pumping) nature of the system, the maintenance is expected to be minimal. The media in the cells have been assumed to require replacement every 20 years for bonding purposes.

These passive treatment systems will treat the seepage using an anaerobic (no-oxygen) treatment cell filled with organic media containing beneficial bacteria followed by an aerobic (with oxygen) polishing treatment cell and discharge. The Contact Water Collection Ponds for PAG Facilities will contain passive treatment systems capable of addressing the effluent from their portion of PAG Facilities.

Construction and operation of the passive wastewater treatment facility will be regulated by the DHEC

11.4.4 Green OSAs

Five OSAs are designated to receive only Green overburden (601, Ramona, Hayworth / South, and James OSAs). All operational slopes of the OSAs are constructed with alternating benches and angle of repose slopes to have an overall slope no steeper than 3H:1V. Concurrent with placement of the overburden, the angle of repose slopes is pushed down to develop inter-bench slopes of 2.5H:1V slopes with surface water controls to limit erosion. Benches will remain to provide surface water control to limit erosion from the slope face. Any portion of the OSA that can be safely accessed without impacting overburden placement are regraded in this manner and vegetated concurrent with mining activities.

Once final reclamation of a facility has begun, any remaining regrading are performed to achieve the above configuration over the remainder of the OSA slopes. Additionally, access ramps are removed or reduced, the top surface are regraded to promote drainage and minimize erosion, and any additional surface water control features that are needed for reclamation are shaped into the overburden surface. During final grading, occasional large boulders that are uncovered during sloping may be left on the surface to provide topographic diversity, microhabitats for wildlife and vegetation, and to break the linear appearance of the final slope.

11.4.5 Site Surface Water Management

The development and active mining of the Mill Zone, Haile, Red Hill, Snake and Ledbetter Pits will impact stretches of Haile Gold Mine Creek and North Fork Creek. For temporary surface water control, diversion ditches are installed to enable flow around active open pit mining activities. In 2016, a HDPE-lined diversion channel was constructed to divert the Haile Gold Mine Creek flow below the historic Ledbetter Reservoir around the Mill Zone Pit. For permanent water control, a Fresh Water Storage Dam (FWSD), a retention structure, is expected to be constructed in 2019 within the footprints designated for the previously permitted detention structure and the previously permitted “Pit-Related Activities” area south of there. Initially, this will be a retention structure placed in the upper reaches of Haile Gold Mine Creek that can capture some of the stream flow (to a 470’ amsl operating level and then divert the remaining Haile Gold Mine Creek streamflow) once related permitting is completed. There will be a haul road over the top of the FWSD that will be a crossing between West PAG and East PAG. The FWSD will have the capacity to detain up to 100-year precipitation event and will allow for controlled flow into the diversion pipes. Stormwater exceeding the design event would flow through the emergency spillway into Ledbetter Pit. Upon the filling of Ledbetter Reservoir to equilibrium (approximately 95%), the Fresh Water Detention and Diversion Structure / low head dam is expected to be removed and all stream flows in Haile Gold Mine Creek will flow into Ledbetter Reservoir with flows exiting the pit lake through an engineered outlet structure into the re-established downstream channel. An engineered outlet structure will be designed prior to this time in cooperation with DHEC. The plan is to allow the upper Haile Gold Mine Creek to flow through the Ledbetter Reservoir, then out of the reservoir through an engineered outlet structure, into re-established stream channels constructed over the backfilled pits, into the Lower Haile Gold Mine Creek, and into the Little Lynches River.

11.4.6 Tailing Storage Facility

The TSF is constructed using conventional downstream construction methods to raise the embankment in four stages. The site topography is such that to achieve the total storage capacity the embankment is a four-sided ring dike configuration, approximately 5,500 feet by 3,500 feet along the embankment crest centerline for the longest embankment legs.

The facility is underlain by a composite liner consisting of a low permeable soil liner and a 60 mil HDPE liner. An underdrain system over the 60 mil HDPE liner system will collect seepage from the tailing and convey it by gravity to the Underdrain Collection Pond at the toe of the southwest embankment. Groundwater is routed under the TSF in collection pipes installed below the HDPE and low-permeability soil liner to route groundwater from beneath the facility (to avoid contact with the tailing material).

As the outboard slopes of the TSF achieve final configuration, they are vegetated using established procedures. See Section 11.2 for details.

At the cessation of milling, the TSF is reclaimed using a dry closure approach. In order to dewater the tailing facility, the CWTP will be reconfigured to treat the water within the tailing impoundment and Underdrain Collection Pond. Water collected from the Underdrain Collection Pond and any remaining free water in the impoundment will be treated in the reconfigured water treatment plant and discharged though the same outfall used during operations.

As consolidation in an area of the tailing nears completion, that portion of the tailing will be covered with a smooth HDPE geomembrane laid directly on the tailing surface or foundation layer. The geomembrane will limit infiltration and will reduce long term seepage to the TSF underdrains, allowing the eventual use of passive treatment technology. The geomembrane cover will extend over the entire tailing surface to the edge of the TSF impoundment and will be sealed directly to the exposed TSF geomembrane liner at the perimeter of the TSF.

Following placement of the geomembrane cover, a minimum 2-foot thick layer of growth media are placed over the geomembrane to protect it from damage, UV radiation, and freezing and to provide a soil layer for establishing vegetation. The growth media will be placed over any exposed geomembrane liner on the interior TSF embankment and the top of the TSF embankment, extending to the outboard slopes of the TSF embankment. The surface the embankment is graded to allow precipitation on this surface to drain to the outside of the TSF embankment. The final surface is vegetated with an approved seed mix and established seeding methods. See Section 11.2 for details.

Drain down would continue to be collected in the TSF Underdrain Collection Pond and treated as provided for under the NPDES permit until the seepage is determined to be at the point where a passive treatment cell can treat the volume of flow from the seepage collection system. As described for PAG Facilities, see Section 11.4.3, the passive treatment cell will improve the water chemistry of the seepage to acceptable levels for state permitting requirements. As with all passive treatment systems, the nature of the organic strata must be specifically tailored to the effluent stream and permitted by DHEC.

11.4.7 Borrow Areas

Two borrow areas (Holly and Hock) may be used to provide material for construction and expansion of the TSF. Once material from the borrow areas have been exhausted the areas are reclaimed.

If required, slopes on the edges of the borrow areas are maintained at a 3H:1V or shallower. Since material is being removed to lower the elevation without creating pits, slope grading should be minimal during reclamation. Also, during operations, slopes retained within the borrow areas will allow precipitation to flow off the areas and not create pooling. Reclamation of the borrow areas will include scarifying to loosen compacted soils and revegetating with an approved seed mix using approved seeding techniques.

11.4.8 Ancillary Facilities

Other facilities at the mine, including the Mill Site, growth media storage areas, sediment and settling ponds, disturbed land, roads, power lines, pipelines and surface water controls, that are not required for post-mining monitoring or maintenance will be regraded, demolished, salvaged and/or removed as appropriate. Specific areas (such as portions of the Mill Site) will be covered with a layer of growth media. All disturbed areas will be vegetated using established procedures.

11.5 Post-Mining Reclamation and Closure Monitoring

Haile will conduct post-mining reclamation and closure monitoring for purposes of ensuring continued compliance with permit requirements. However, Haile expects that a Post-Closure Water Quality Monitoring and Management Plan will be adapted from the operational water quality plan. In addition, monitoring will be coordinated with requirements of permits in that are affected. Overall objectives are to demonstrate that receiving waters are meeting water quality criteria. Secondarily, the plan will provide early warning of water impacts and a means of identifying contaminant sources. Finally, the plan will identify contingency actions that are employed if monitoring objectives are not satisfied.

Haile will develop a detailed post mining monitoring plan prior to mine closure based on a continuation of the operational monitoring plan. As noted above in Sections 5 and 6, the operational monitoring plan will have sampling sites in surface and groundwater that provide up-gradient and down-gradient monitoring. These sites may also be suitable for post mining monitoring. It will also include required discharge monitoring.

The Post-Mining Reclamation and Closure Water Quality Monitoring and Management Plan will be designed to assure:

- Surface and ground waters are monitored up gradient and down gradient (as appropriate) of permanent post mining features.
- There is monitoring in place between any potential sources of contamination and receiving waters to provide for adequate response time.
- All discharges are monitored in accordance with applicable regulation.
- Any known sources of contamination are appropriately monitored.
- Post mining monitoring for a period specified by regulation or agency requirements.

Groundwater monitoring are used to determine the performance of reclaimed and closed facilities that may have subsurface discharges. Selected wells are used to assess the potential loads contributed to groundwater from various facilities. Actual monitoring locations are designated in plans submitted before final reclamation commences. These points are selected for their ability to provide pertinent information on up gradient and down gradient water quality.

Based on early post-mining monitoring, the parameter list and sampling frequency may be adjusted to reflect the observed conditions. The parameters analyzed are selected based on parameters observed during operations and having the potential to adversely impact water quality downstream.

11.5.1 Post-Mining Care and Maintenance

The reclamation designs for the facilities at the Haile Site were developed to reduce the need for long-term care and maintenance. Staged-level monitoring will occur over the life of the mine, based upon Haile demonstrating that its reclamation and closure designs meet physical and chemical performance standards on a facility-by-facility basis.

The use of passive treatment cells for ongoing treatment of the drainage effluent from the TSF and PAG Facilities are expected to function over the long term but will require periodic replacement of the organic media within the facility. Haile has assumed that the cells will require replacement approximately every 20 years, or as necessary (based on the functionality of the media).

Maintenance of vegetation will also be required on PAG Facilities and the TSF following closure. Maintenance activities would be conducted to prevent woody species from becoming established. Haile will accomplish this via chemical application (i.e., spot spraying) and/or mechanical (i.e., bush hogging) as required.

Additional maintenance activities include the addition of lime to the pit lakes to maintain a neutral pH until the water level inundates any potential acid generating material in the pit walls. Haile anticipates that lime would be added to Ledbetter Reservoir and Champion Pit Lake until both water bodies obtain their design pool.

Post-mining monitoring and maintenance will also consist of surface and groundwater monitoring on a Site-wide basis beginning in Year 15 of the Mine Schedule (surface and groundwater will also be monitored during Years 0-14 as part of operations) and continue for pit lake filling reaches design pool and water quality within the lakes equilibrate. However, it is expected that the intensity and frequency of the surface and groundwater monitoring would be decreased over time as performance standards are achieved, until eliminated.

Importantly, DHEC and Haile will actively work together to determine appropriate post-mining monitoring and management obligations, as well as the appropriate length of time for which these activities should occur, once reclamation activities are underway and more Site-specific information is available.

12 CULTURAL RESOURCE MONITORING

Information regarding the cultural resource management measures that Haile is committed to implementing can be found in the Section 106 Memorandum of Agreement (MOA), Cultural Resources Management Plan (CRMP) and Unanticipated Discovery Plan.

13 REFERENCES

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