

Thursday, April 03, 2025

Ms. Melanie Humphrey
Michigan Department of Environment, Great Lakes, and Energy
1504 W. Washington St.
Marquette, Michigan 49855

**Subject: Revisions to the Annual Mining and Reclamation Report, Eagle Mine, LLC
Nonferrous Metallic Mineral Mining Permit (MP 01 2007), Eagle Mine**

Dear Ms. Humphrey:

Per your request on March 21, 2025, the 2024 Eagle Mine annual report is being resubmitted in full with the following revisions:

1. Section 3.0, p. 2, Table 3.2 – Non-Routine Submittals and Approvals under Part 632 – The Eagle Mine Paste Backfill Request for Amendment/EIA was not approved on 1/10/2025 but was determined to be a significant amendment on that date and final approval is pending. The modification to the COSA does not require an amendment to the mining permit and therefore was approved on 1/10/2025.
 - **Modified the last line item in the table to say, ‘Eagle Mine Paste Backfill Project, Request for Amendment – Paste Backfill Environmental Impact Assessment’ and updated the approval date to N/A.**
2. Appendix K: The tables in this appendix reference CDRM004 as a compliance location for monitoring. It is my understanding that CDRM004 was intended to be a control location for surface water and aquatics monitoring that is outside of the watersheds where mining activities are taking place. It is listed as a “reference” point for water quality on the map in Appendix J, which I think is a more applicable designation.
 - **Appendix K was updated to say ‘reference’ instead of ‘compliance’ in the attachment.**

Should you have any questions about this report, please do not hesitate to contact me at 906-204-5859.

Sincerely,



Alexxa Young
Environmental Advisor

enclosure

Eagle Mine

a subsidiary of **lundin mining**

2024 Annual Mining and Reclamation Report Mine Permit MP 01 2007

March 13, 2025



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Acronyms and Abbreviations

AEM	Advanced Ecological Management
ALS	Advanced Life Support
ASB	Aggregate Storage Building
CMT	Crisis Management Team
COSA	Coarse Ore Storage Area
CRF	Cemented Rock Fill
CWB	Contact Water Basin
DO	Dissolved Oxygen
Eagle	Eagle Mine LLC
EGLE	Michigan Department of Environment, Great Lakes & Energy
ft	Feet
gal	Gallon
gpd	Gallons Per Day
gpm	Gallons Per Minute
GWDP	Groundwater Discharge Permit
in	Inches
KME	King and MacGregor Environmental
LLSI	Leak Location Services, Inc.
m	Meter
m ³	Cubic Meters
MG	Million Gallons
MDNR	Michigan Department of Natural Resources
µg/L	Micrograms Per Liter
µS/cm	Micro-Siemens Per Centimeter
mg/L	Milligrams Per Liter
MPBX	Multi-Point Borehole Extensometer
MRR	Mining and Reclamation Report
MSHA	Mine Safety and Health Administration
NCWIB	Non-Contact Water Infiltration Basin
NJC	North Jackson Company
NLG	Narrow-Leaved Gentian
NREPA	Natural Resources & Environmental Protection Act
ORP	Oxidation Reduction Potential
QAPP	Quality Assurance Project Plan
Q1	Quarter One
SESC	Soil Erosion and Sedimentation Control
SOP	Standard Operating Procedure
SU	Standard Units
t	Tonne (Metric Ton)
TDRSA	Temporary Development Rock Storage Area

Trimedia	Trimedia Environmental & Engineering Services, LLC
TWIS	Treated Water Infiltration System
VOC	Volatile Organic Compound
WSP	WSP Global, Inc.
WTP	Water Treatment Plant

1. Document Preparers and Qualifications

This Mining and Reclamation Report (MRR) was prepared by the Eagle Mine LLC (Eagle) Environmental Department and incorporates information prepared by other qualified professionals. Table 1.1 lists the individuals and organizations responsible for preparing this MRR and those who contributed information for inclusion in the report.

Table 1.1 – Document Preparation – List of Contributors

Organization	Name	Title
Individuals Responsible for the Preparation of the Report		
Eagle Mine LLC	Rob Beranek	Environmental & Water Services Manager
Eagle Mine LLC	Jennifer Nutini, PE	Environmental Superintendent
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Eagle Mine LLC	Alexxa Young	Environmental Advisor
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Eagle Mine LLC	Lisa Tincknell	Controller
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North Jackson Company	Dan Wiitala	Professional Geologist

2. Introduction

Eagle Mine is an underground nickel and copper mine in Michigamme Township that was constructed in 2010 and began underground development in September 2011. Accordingly, Eagle Mine is required to submit the annual MRR under Mining Permit MP 01 2007. Background information regarding the Eagle Mine site is found in Appendix A and a copy of the current site map is provided in Appendix B.

3. Site Modifications, Amendments, and Submittals

Tables 3.1 and 3.2 below list the routine and non-routine notifications and required submittals and approvals that were provided to the Department in 2024 as required under Part 632 Mining Permit (Part 632). Table 3.3 lists other submittals under Eagle’s other permits, Table 3.4 includes submittals for the new groundwater discharge permit (GWDP) and Table 3.5 includes submittals for the air

permit. Table 3.6 lists any spills reported under Part 5 Rules of Part 31 (Spillage of Oil and Polluting Materials). In addition, site modifications and projects completed in 2024 are described below.

Table 3.1 – Routine Submittals and Approvals Required Under Part 632

Date	Description	Approval
01/04/24	Q4 2023 Groundwater and Surface Water Monitoring Data	N/A
03/14/24	2023 Annual Mining and Reclamation Report	N/A
03/28/24	2023 Annual Mining and Reclamation Report – Revised Appendix O	N/A
05/02/24	Q1 2024 Groundwater and Surface Water Monitoring Data	N/A
07/23/24	Q2 2024 Groundwater and Surface Water Monitoring Data	07/24/24
10/21/24	Q3 2024 Groundwater and Surface Water Monitoring Data	N/A

Table 3.2 – Non-Routine Submittals and Approvals Under Part 632

Date	Description	Approval
01/25/24	Empty Liquid Storage Totes Underground Notification	02/08/24
02/26/24	Email Notification Tote Management Plan Implemented	N/A
03/21/24	Empty Liquid Storage Totes Underground Follow Up Notification	N/A
04/04/24	MPBX R2 Anchor 1 Movement Notification	05/08/24
04/10/24	pH Action Level Source Investigation	05/20/24
07/23/24	MPBX R2 Anchor 1 Movement 90-Day Update	N/A
09/12/24	WTP Propane Tank Installation	09/16/24
09/23/24	Abandonment of Well QAL066D	N/A
12/11/24	Eagle Mine Paste Backfill Project, Request for Amendment – Modification to COSA	01/10/25
12/11/24	Eagle Mine Paste Backfill Project, Request for Amendment – Paste Backfill Environmental Impact Assessment	N/A

Table 3.3 – Submittals and Approvals Under Other Permits

Date	Description	Approval
03/25/24	Q1 2024 – QAL051D & QAL075A Vanadium Notification	N/A
06/06/24	Q2 2024 – QAL051D & QAL075A Vanadium Notification	N/A
09/12/24	Q3 2024 – QAL075A Vanadium Notification 7-Day Report	N/A
09/23/24	Q3 2024 – QAL008A pH & QAL051D Arsenic Notification 7-Day Report	N/A
09/24/24	Eagle Mine Paste Backfill – UIC Inventory Form	N/A
10/29/24	Q3 2024 – QAL075A Vanadium Notification 60-Day Report	N/A
11/14/24	Q3 2024 – QAL008A pH & QAL051D Arsenic Notification 60-Day Report	N/A
12/11/24	Q4 2024 – QAL008A pH, QAL051D Arsenic & QAL075A Vanadium Notification 7-Day Report	N/A
12/23/24	Notification of Change in Facility Operations – 3rd Water Treatment Plant Boiler	N/A
01/28/25	Q4 2024 – QAL008A pH, QAL051D Arsenic & QAL075A Vanadium Notification 60-Day Report	N/A

Table 3.4 – Submittals and Approvals Required by GWDP No. GW1810162

Date	Description	Approval
09/13/24	Monitoring Well Installation Work Plan – QAL099A	09/23/24
09/18/24	AOR Notification	N/A
10/02/24	Monitoring Well Abandonment Plan QAL029A and QAL029D	10/07/24

10/30/24	Discharge Management Plan	10/31/24
10/30/24	Operations and Maintenance (O&M) Manual	N/A
12/23/24	Monitoring Well Installation Report – QAL099A	N/A
01/06/25	Confirmation of Monitoring Well Abandonment QAL029A and QAL029D	N/A

Table 3.5 – Air Permitting Submittals and Approvals

Date	Description	Approval
03/18/24	Permit to Install (PTI) Application Covering the Proposed Paste Backfill Operation	Application Replaced by a Revised Application
07/30/24	Revised PTI Application Submitted	Draft Permit Out for Public Comment on January 23, 2025
08/14/24	Submit Updated Emissions Inventory Supporting the Application	
08/30/24	Submit Modeling Files Supporting the Application	
10/08/24	Submit Updated Emissions/Modeling Information Supporting the Application	
10/10/24	Submit Redline Edits to Draft Permit	

Table 3.6 – Report of Incident – Part 5 Rules Release Submittals

Date	Description	Approval
N/A	N/A	N/A

3.1 Site Project Work

Proposed Paste Backfill Project

In March of 2024, geotechnical drilling was completed to gather data on the thickness of alluvium on the northeast edge of the coarse ore storage area (COSA) building and along the south edge of site within the fence line. The information gathered on this project was used to support the newly proposed paste backfill project permit amendment to add an enclosed tailings storage area, a paste backfill plant, and a paste borehole to convey the paste from the surface to the underground mine.



Figure 1 – Drilling Near the Proposed Paste Backfill Project

Abandonment of QAL029A/D and Installation of Well QAL077A/D for Future Paste Backfill Plant

The proposed paste backfill project would include an addition to the north side of the COSA building where an existing monitoring well nest, QAL029A and QAL029D, were located. Michigan Department of Environment, Great Lakes & Energy (EGLE) permitted abandonment of the two monitoring wells. To conform with Rule 425.406, a new nested well set to monitor the COSA, QAL077A and QAL077D, were installed to the northeast of the proposed building addition.



Figure 2 – Abandonment of QAL029A/D

Installation of Monitoring Well QAL099A On October 25th, 2024, a new monitoring well, QAL099A, was installed downgradient of treated water infiltration system (TWIS) monitoring wells QAL051D and QAL075A as required by the renewed GWDP issued on August 1st, 2024.



Figure 3 – New Monitoring Well QAL099A

Multi-Point Borehole Extensometer (MPBX) Installation

In 2024, there was measured displacement in a surface MPBX installed above the ore body. Additional monitoring was implemented in accordance with the *Subsidence Monitoring Plan*. MPBX instruments are valuable monitoring tools, but they have known limitations. For instance, they only measure the displacement of the rock in which they are installed, therefore, the movement measured in the MPBX may or may not be representative of what is happening in the surrounding rock mass as an isolated block or wedge of rock may move independent of the surrounding rock.

To be responsive to the MPBX displacement, Eagle hired WSP Global, Inc. (WSP) to complete further investigation. Through revised data collection and modelling, WSP determined that the movement of the MPBX was due to movement of a local structure that was isolated and is not expected to propagate to the surface. As a proactive measure, Eagle installed two additional MPBXs above the ore body from surface directly into bedrock. Additional information on this project is discussed in further detail in Section 4.



Figure 4 – Installation of two MPBXs above the crown pillar into bedrock

Water Treatment Plant Propane Tank Installation

Eagle placed new concrete as the foundation for additional 1,000-gallon (gal) propane tanks. The new tanks are located north of the existing water treatment plant (WTP) propane tanks and will provide additional propane storage capacity for the WTP and a 3rd boiler that was installed in February 2025.



Figure 5 – New Propane Tanks at the WTP

Surface Exploration

On August 25th, 2024, a surface exploration drill rig operated by National Drilling was positioned approximately one mile east of the Mine. The surface exploration component is part of a larger program executed from primarily underground drill stations over the last three years. These drill holes

focused on investigating a geophysical anomaly detected during a magnetotelluric survey completed in late 2023.



Figure 6 – Drill Rig and Core from Surface Exploration

4. Mining Activities and Data Report

4.1 Underground Operations

Subsidence Monitoring

Special condition E-8 of the mining permit requires Eagle to certify that the rock stability modeling provided in the permit application is still valid. This rock stability modeling was most recently updated to support the *Phase 4 Crown Pillar Engineering Assessment*, which was approved by EGLE on September 25, 2019. While geologic, geotechnical, and hydrogeologic conditions observed during mining in 2024 were consistent with inputs and assumptions utilized in the *Phase 4 3D Physical Model*, measured displacement in surface MPBX instrument R2 exceeded the displacements predicted by the simulated models. The displacements also exceeded the established monthly and cumulative thresholds outlined in Eagle's *Subsidence Monitoring Plan*. Eagle immediately paused mining and notified EGLE of the recorded movement in a letter dated April 04, 2024. Eagle also implemented a 90-day monitoring plan, during which mining gradually resumed with increased monitoring density and frequency.

To confirm that the MPBX displacements noted in Section 3.1 were caused by localized structural conditions and to ensure that ongoing mining would not compromise the stability of the crown pillar, Eagle hired WSP to perform back-analysis using the model developed for the Phase 4 assessment. The life-of-mine stope sequence was analyzed to forecast the impact of continued mining. The results indicated that no measurable subsidence is projected at the bedrock/overburden or at the surface.

Eagle decided to extend the 90-day monitoring period as communicated to EGLE on July 23, 2024. In November 2024, additional 24-meter (m) long MPBX instruments were installed both underground, and, on surface to increase monitoring confidence.

Monitoring of survey monuments on the crown pillar are also ongoing, with both the original monuments and those installed in 2023 being monitored. Eagle plans to continue monitoring both sets of monuments. Two additional prisms were installed in 2024 on the steel casings of the new MPBX installations. These steel casings are grouted into the bedrock and are expected to provide more accuracy in detecting any subsidence.

Per special condition E-8 of the mining permit, an annual review of the rock stability was completed to ensure that the modeling is valid. The Operations Manager signed a letter certifying the rock stability (Appendix C).

4.1.1 Underground Development Progress

In May 2024, the Mine Safety and Health Administration (MSHA) implemented a 103 (K) order due to an underground rock fall behind utilities in Eagle East. Eagle completed rehabilitation in the required areas, however, Eagle made the decision to further rehab the main ramp below muck bay 18 to prioritize safety. The ground control rehabilitation project is scheduled to be completed in the first half of 2025. The rehab project affected production and development between May and November 2024 as reflected in the tables below. Table 4.1.1a through Table 4.1.1d breaks out underground development progress and exploration drilling information for Eagle, Eagle East, and ramp development to Upper Eagle East.

Maps showing the 2024 development and progress can be found in Appendix D.

Table 4.1.1a – 2024 Eagle Underground Meters of Development

Eagle Mine Development	Meters
Sills	778
Vertical	0
General/Horizontal	68
Total	846

Source: Mine Engineering Department

Table 4.1.1b – 2024 Eagle East Decline Meters of Development

Eagle East Decline Development	Meters
Sills	927
Vertical	0
General/Horizontal	130
Total	1,057

Source: Mine Engineering Department

Table 4.1.1c – 2024 Upper Eagle East Decline Meters of Development

Upper Eagle East Decline Development	Meters
Sills	0
Vertical	0
General/Horizontal	516
Total	516

Source: Mine Engineering Department

Table 4.1.1d – 2024 Drilling Program

Location	Drill Holes	Meters
Eagle	0	0
Eagle East	13	1,862
Upper Eagle East	32	6,049
Exploration	11	3,947
Total	56	11,858

Source: Mine Geology Department

4.1.2 Geochemistry Program

The geochemistry program is comprised of two parts; the water quality of the underground as it is representative of ore, and sampling of development rock from either Eagle, Eagle East and Upper Eagle East decline development.

Upper Eagle East development sampling began in May of 2023 and continued throughout 2024. The development rock sampling program includes geochemical characterization (i.e., static testing program). Samples are logged and visually characterized, with the percentage of sulfides noted in a comprehensive spreadsheet. Rock types identified in the Upper Eagle East decline have been consistent with those observed in Eagle with siltstone being the most prevalent. On average, 1-2% sulfides have been visually observed along the bedding in siltstone similar to observations reported in the Eagle decline. After observations are recorded, the samples are sent to SGS Laboratories for analysis. As sample results are received from the laboratory, they are reviewed to determine if they are consistent with baseline values.

Additional discussion about the geochemistry of underground water quality is included in Section 4.1.5 of the MRR below.

4.1.3 Underground Ore Production – Stopping & Backfilling

Primary stopes are backfilled using cemented rock fill (CRF) produced at the onsite batch plant. In 2024, 258,060 tonnes (t) of CRF were produced. Table 4.1.3a through Table 4.1.3c details the number stopes mined, amount of CRF used for backfilling and tonnage of ore mined in 2024. For additional information about Eagle’s production methods, reference Appendix A.

Table 4.1.3a – Number of Stopes Fully Mined & Backfilled in 2024

Stope Type	Total (Number)
Primary Stopes	8
Secondary Stopes	16

Source: Mine Engineering Department; 4 of the 16 stopes were backfilled with development rock; the remaining 12 secondary stopes were filled with CRF.

Table 4.1.3b – Tonnage of Cemented Rock Fill

Backfill	Tonnage of CRF
CRF	166,311 (64%)

Jamming	91,749 (36%)
Total	258,060

Source: Mine Engineering Department

Table 4.1.3c – Tonnage of Ore Mined in 2024

Ore Mined	Tonnage of Ore Mined (tonnes)
Eagle Sills	57,565
Eagle East Sills	83,160
Upper Eagle East Sills	0
Eagle Stopes	219,071
Eagle East Stopes	105,313
Upper Eagle East Stopes	0
Survey Actual Adjustment	14,447
Total	479,556

Source: Mine Engineering Department

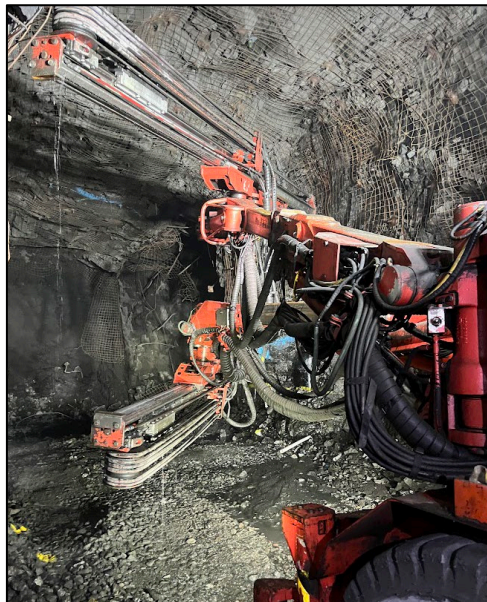


Figure 7 – Underground Drill Rig

4.1.4 Mining Forecast

The 2025 mining forecast is included in Table 4.1.4.

Table 4.1.4 – 2025 Mining Forecast

Production Area	Lateral Advance (m)*	Ore Production (t)*	
		Sills	Stopes
Eagle	237	8,763	105,624
Eagle East	3,722	213,198	391,002
Upper Eagle East	1,553	5,695	8,760
Total	5,512	732,954	

Source: Mine Engineering Department

*All estimates are subject to change

4.1.5 Underground Dewatering Volume and Quality

Underground Dewatering Volume

Water is required underground to complete drilling, bolting, dust suppression activities, and to knock down loose material after a stope blast. There was a shift from previous years in dewatering volume since there was lower than typical water consumption with less mining activities underground. The ground water consumption decreased from 87,613 gallons per month in 2023 to 82,897 gallons per month in 2024. Inspections of the underground found only a few areas in which groundwater infiltration is visible and is significantly less than was predicted during the permit application process. Some small but isolated pockets of water were periodically encountered during the drilling and blasting operations which temporarily resulted in a slight increase in water flow. Table 4.1.5 summarizes water consumption and dewatering in 2024.

Table 4.1.5 – Average Monthly Water Volume Provided to Underground and Dewatering Volume

Month	Average Water Supplied Underground (gpd)	Average Water Pumped from Underground (gpd)	Average Dewatering Volume*(gpd)	Average Dewatering Volume* (gpm)
January	124,418	115,954	-8,463	-5.9
February	112,035	92,764	-19,271	-13.4
March	118,768	93,986	-24,782	-17.2
April	118,539	116,502	-2,037	-1.4
May	90,679	117,177	26,498	18.4
June	52,132	57,794	2,662	1.8
July	48,489	108,871	60,382	41.9
August	45,789	56,422	10,633	7.0
September	49,149	103,538	69,944	49.0
October	62,663	93,717	31,054	22.0
November	72,143	113,003	40,860	28.0
December	99,954	111,378	11,424	8.0

* Dewatering volume is calculated by subtracting the volume of water provided to the mine from the volume of water removed from the mine. Dewatering volume is broadly indicative of the amount of groundwater infiltration occurring. gpm = gallons per minute and gpd = gallons per day.

Underground Water Quality

Underground water quality samples were collected quarterly in February, May, July, and November 2024 from Jump Tank 1 located in the main decline underground. Water from the lower levels of the mine is pumped to Jump Tank 1 which then pumps the water to the contact water basins (CWBs). Samples were analyzed for the annual parameter list in the second quarter and the full parameter list in Q1, Q3, and Q4. A summary table and graph of the results are available in Appendix E.

5.1 Temporary Development Rock Storage Area (TDRSA)

Development rock was not crushed in 2024.

4.1.6 Development Rock Storage Volume

In 2024, the total amount of development rock mined was 78,656 t (28,091 m³)^A. The amount of development rock placed on the TDRSA from underground was 50,226 t (27,903 m³)^B. The remaining 28,430 t (15,794 m³)^B of development rock was utilized as uncemented backfill in secondary stopes.

Once development rock is mined, the density factor decreases to account for swell, or void space of the blasted rock. The table below shows the swell factors used to calculate tonnes/m³ of material of development rock, mined development rock, and crushed development rock. There was no development rock removed from the TDRSA for use in uncemented rock fill.

Table 4.2.1a – Swell Factor

Reference	Density (tonnes/m ³)
A	2.8
B	1.8

Table 4.2.1b summarizes the surveyed volume of material stored in the TDRSA as well as the volumes of development rock and limestone added and/or removed for use in backfill in 2024.

Table 4.2.1b – 2024 TDRSA Volume Totals

Month	Volume of Waste Rock Added to TDRSA (m ³)	Development Rock Removed from TDRSA for Backfill (m ³)	End of Year TDRSA Survey Volume (m ³)
2024 Total	27,903	0	124,558

Note: Development rock volume added to the TDRSA was based on the difference between the amount of development rock mined and the amount of development rock remaining underground as GOB fill.



Figure 8 – Temporary Development Rock Storage Area

4.1.7 TDRSA Sump Dewatering Volume and Quality

Primary Contact Sump Volume Monitoring

WTP operators conducted weekly inspections of the TDRSA primary sump water volume, and the Environmental Department conducted an additional weekly inspection. The water level was recorded in a compliance logbook that is retained onsite. Sump water levels were maintained within the ranges specified by the Part 632 permit or returned to those ranges within seven days following a significant wet weather event (rain and/or snowmelt). In 2024, approximately 6.4 million gallons (MG) of water was pumped from the TDRSA contact water sump to the CWBs.

Primary Contact Sump Water Quality

Quarterly water quality monitoring of the contact water sump was conducted in February, May, July, and November 2024. The chemistry of the TDRSA contact water sump fluctuated between sampling quarters which was expected because the material from both Eagle and Eagle East were added during the year and precipitation/snowmelt events contributed fresh water to the system. The concentration-based results for several parameters decreased from 2023 to 2024.

Table 4.2.2a – TDRSA Primary Contact Sump Results for 2024

Parameter	02/19/24	05/06/24	07/29/24	11/11/24
Magnesium (mg/L)	195	147	248	249
Sodium (mg/L)	284	215	288	285
Chloride (mg/L)	235	183	214	217
Nitrate (mg/L)	112	99.7	159	141
Nickel (µg/L)	4,880	3,220	5,480	6,480
Selenium (µg/L)	11.1	10.4	13.4	13.2
pH (SU)	6.2	6.4	6.5	6.8
Specific Conductivity (µS/cm)	4,244	3,480	4,681	4,632

mg/L = milligrams per liter, µg/L = micrograms per liter and µS/cm = micro-siemens per centimeter

Leak Detection Sump Volume Monitoring

Permit conditions require that the leak detection sump be purged and sampled as accumulation occurs. "Accumulation" is defined as a volume of water that is purged for at a minimum of three minutes before sample collection. The volume pumped from the sump is used to calculate the average daily rate of accumulation into the sump. The daily rate of accumulation was estimated throughout the year at approximately 0.02 gal/acre/day which is well below the 25 gal/acre/day threshold indicated in the permit.

In 2024, a total of approximately 65 gallons of water were pumped from the leak detection sump from precipitation that was retained within the liner system during construction. See Appendix A for further information.

Leak Detection Sump Water Quality

Quarterly water quality monitoring of the leak detection sump was conducted in February, May, July, and November 2024. Upon sample collection, the pH and specific conductance of the sample was immediately measured, and the remaining sample aliquot was sent to an offsite laboratory for analysis for the required pH and sulfate analysis.

Table 4.2.2b summarizes the TDRSA leak detection sump analytical results for 2024. The pH results ranged from a low of 6.2 SU to a high of 8.0 SU. Sulfate results fluctuated throughout the year, with levels ranging from a minimum of 704 mg/L in May to a maximum of 1,300 mg/L in November. Though sulfate is the most prominent constituent, no trend was observed.

Table 4.2.2b – TDRSA Secondary Leak Detection Sump Results for 2024

Parameter	02/19/24	05/06/24	07/29/24	11/11/24
Sulfate (mg/L)	844	704	1,120	1,300
Average Daily Flow Rate (gal/acre/day)*	0.02	0.02	0.03	0.02
Purged Volume (gal)*	5.0	5.0	10.0	5.0
pH (SU)	6.2	8.0	6.5	7.2
Specific Conductivity (uS/cm)	3,689	3,794	3,791	3,844

Comparison of Sump Water Quality Results

In addition to the water level, results from the leak detection sump are compared to the contact water sump to determine if a relationship exists. The water from the contact water sump is indicative of the water quality found in Eagle East while the concentrations in the leak sump are significantly lower and do not share the same signatures. Notably, there are clear differences in the concentrations of magnesium sodium and chloride between the two sumps. The source of sulfate was likely introduced during the construction of the lining system.

A summary of the 2024 monitoring results and graphs comparing results from the TDRSA leak detection and contact water sump can be found in Appendix E. For more information about the construction of the TDRSA containment and leak detection monitoring systems, reference Appendix A.

6.1 Site Water Usage, Control, Treatment, and Discharge

Site-wide water consumption includes three features: supply water to domestic users, supply to underground mining activities and process users, and the management of process water in the CWBs for future treatment and discharge. This is accomplished by the domestic (QALPSW001) and the utility (QAL011D) supply wells.

4.1.8 Supply Water Sources and Usage

The domestic well (QALPSW001) was used to supply potable water to the surface facilities and fire water tank if necessary. The mine services well (QAL011D) supplies water to:

- The truck wash building and automatic tire wash,
- Underground operations and dust suppression, and;
- The fire water tank and hydrant network.

The third water source is recycled treated utility water supplied and used by the WTP. Utility water is produced by the treatment of water collected in the CWBs.



Figure 9 – Domestic Well at the Mine Site

4.1.9 Storm Water Control

The mine site storm water is either defined as non-contact storm water or contact storm water. The non-contact storm water is collected in four non-contact water infiltration basins (NCWIBs) where it then infiltrates into the ground. This water does not require treatment because it is from areas of the site that have no contact with operations. Contact stormwater is defined as water in contact with mine material and collected in two lined basins where it is held before treatment through the water treatment facility.

4.1.10 Contact Water Basins

CWB Monitoring

Three primary sources of site water were discharged to the CWBs before treatment in the WTP. These included dewatering from the underground mine, the TDRSA, and storm water that falls on the paved contact area. Additional intermittent sources include dewatering from the sumps located in the COSA, truck wash, fuel area, batch plant, boot wash, and truck shop.



Figure 10 – Layout of the CWB's

CWB levels are continuously recorded and saved to a database maintained by WTP operators. This log with daily readings is in Appendix E. All rainfall and snowmelt that occurred in 2024 was collected and

managed within the capacity of the CWBs. Basin dredging and leak testing to monitor CWB liner integrity is detailed below in Section 5.5.4.

CWB Water Quality

As a best practice, samples were collected from CWB #2 in February, May, July and November 2024 to provide the WTP operators with process control data and provides information to identify trending water quality parameters. Additionally, results can be compared to downgradient water quality to confirm the liners are intact and functioning as designed. A summary of the results can be found in Appendix E.

Like previous years, the CWB monitoring results fluctuate from quarter to quarter and are dependent on the areas being mined underground, TDRSA sump inputs, and the amount of dilution from precipitation. pH results ranged from 8.8 SU in Q3 to 9.7 SU in Q4. Water quality in CWB #2 is influenced by water being recirculated back to the basins from the WTP. Water in CWB #1 can be transferred into CWB #2 and vice versa, to optimize WTP operations.



Figure 11 – View looking southeast at CWB #1

4.1.11 Non-Contact Water Infiltration Basins

NCWIB Monitoring

Inspections of the NCWIBs located near the surface facilities and ventilation air raise occur after wet weather events. The inspections indicate the basins are operating as expected to readily infiltrate storm water with the exception of brief ponding after spring melt or excessive rain events. The basins are monitored for excess silt that would prevent infiltration and ideal operation. No excessive silt was observed in 2024.

NCWIB Water Quality

Per the mining permit, monitoring wells are required to be located downgradient of each NCWIB and must be sampled in the event of a surface discharge from the basin. Eagle Mine has chosen to sample these wells at least annually as surface discharge is not expected to occur. Monitoring wells QAL070A and QAL073A, located downgradient of NCWIBs #2 and #3, are monitored annually while QAL071A and QAL024A located downgradient of NCWIB #1 and #4 and are monitored quarterly.

The analytical results from QAL070A and QAL073A were compared to the established benchmarks calculated for each. Sampling results from QAL070A detected mainly cations and anions including bicarbonate alkalinity, chloride, nitrate, sulfate, calcium, magnesium, sodium, and hardness, that were outside of calculated benchmarks. This well is located adjacent to the site’s main access road which is graded to direct run-off from the roadway toward the monitoring well location. Several elevated analytes at location QAL070A are likely due to a sand/salt mixture applied to the roadway during winter. Results at QAL073A were outside of benchmarks for pH, iron, bicarbonate alkalinity, nitrate, calcium, magnesium, sodium, and hardness. Groundwater monitoring results from QAL071A and QAL073A are further discussed in Section 5.1 and all results are summarized in Appendix G.



Figure 12 – NCWIB #1 Near the WTP

4.1.12 Water Treatment Plant Discharge

The WTP discharged over 55 MG of water in 2024.

Table 4.3.5 – Volume of Water Discharged in 2024

Month	Volume of Water Discharged (gallons)
January	4,189,204
February	4,616,027
March	4,954,743
April	5,944,176
May	4,928,226
June	5,096,071
July	4,858,628
August	3,809,948
September	2,756,219
October	3,554,388
November	4,314,808
December	6,209,254
Total	55,231,690

Source: Eagle Mine WTP

5. Monitoring Activities

7.1 Water Quality Monitoring

5.1.1 Quarterly Groundwater Quality Monitoring

Groundwater quality is monitored through a network of monitoring wells located both inside and outside the mine site perimeter fence. A map of the well locations can be found in Appendix F.

Four quarterly sampling events were completed in February, May, August, and November 2024. The permit prescribes a parameter list for the Q2 annual monitoring events and an abbreviated list to be used in Q1, Q3, and Q4. In addition to the permit-required sampling lists, locations QAL061A, QAL062A, and QAL067A are analyzed for volatile organic compounds (VOCs) annually. VOC samples were collected in Q2 2024 at these three locations and all results were found to be non-detect (i.e., below the laboratory reporting limit). Samples are collected following the Eagle Project Quality Assurance Project Plan (QAPP) and Standard Operating Procedures (SOP) (North Jackson, 2004a and 2004b) and the results are summarized and compared to benchmarks, where applicable, in the tables found in Appendix G.

Two sets of benchmarks were calculated for all mine permit groundwater monitoring locations based on the guidance provided by the Mine Permit and Part 632, with the lower of the two being used for comparison. In late 2015, the results were reviewed and statistically analyzed. The consultant calculated an updated benchmark value for those results that were not trending, and the updated benchmarks were used for comparison since 2016.

Monitoring Results

Twenty-three groundwater samples were collected during each of the four quarterly sampling events. Samples collected from two additional monitoring wells were collected once in 2024 and the results are summarized below. Samples were collected using low-flow sampling techniques, and the field parameters dissolved oxygen (DO), oxidation reduction potential (ORP), pH, specific conductivity, temperature, and turbidity using a flow-through cell and YSI probe.



Figure 13 – Groundwater Monitoring Location QAL008A

Most of the analyzed parameters had non-detectable concentrations. The greatest number of detections were reported for anion and cation parameters. In certain wells, the measured value for bicarbonate alkalinity has increased over the previous several quarters to years. Bicarbonate levels in background A-zone wells are typically from 20-60 mg/L, but in some wells the bicarbonate concentrations are over 100 mg/L. There is a potential for there to be a relationship between higher chloride concentrations and bicarbonate concentrations in that the bicarbonate formation could be enhanced by increased chloride in the water. A summary of quarterly data of the groundwater wells can be found in Appendix G.

Per Part 632, R425.406 (6) when a result was greater than a benchmark for two consecutive sampling events at a compliance monitoring location, Eagle notified EGLE in the quarterly benchmark report. The results can also be summarized as follows:

- **Location:** QAL024A – Vent Raise Area
 - **Quarterly Parameters Above Benchmark:** bicarbonate alkalinity, chloride, sodium, nitrate
 - **Summary:** Elevated levels of sodium and chloride were first reported at this location in 2013 due to the use of a sand/salt mixture to minimize ice build-up and subsequent storage of stockpiled snow near the monitoring location. Results for chloride and sodium have both decreased overall since their peak concentration in Q2 2013. A pattern was observed in 2016, 2019 and 2021 where nitrate results trended up, followed by periods of downward trending back toward baseline values. Results in 2024 followed this pattern but didn't reach previous peak levels. Alkalinity results remained elevated from baseline but were consistent with results reported since 2016.
- **Locations:** QAL060A and QAL061A – North of the TDRSA and CWBs
 - **Quarterly Parameters Above Benchmark:** bicarbonate alkalinity, nitrate
 - **Annual Parameters Above Benchmark:** calcium, magnesium, hardness
 - **Summary:** Nitrate concentration fluctuated slightly from 2023 to 2024 with an overall gradual increase to a possible equilibrium of around 0.30 mg/L at QAL060A. However, nitrate at QAL061A was only above benchmark in Q1 2024 after consistently decreasing since Q2 2019.

The fluctuation may be a function of the historic use of salt at the mine site as road salts have the potential to affect nutrient cycling (such as for nitrogen/ammonia) and cation exchange reactions within the affected soil profiles. Changes in these parameters in groundwater are characteristic of the sand/salt applications due to the ion exchange processes occurring in shallow groundwater. In addition, bicarbonate alkalinity, calcium, magnesium, and hardness were greater than benchmarks at QAL061A and QAL060A. Cyclical increases and decreases have occurred in these wells for years.

Results from QAL060A and QAL061A were compared to the TDRSA contact water sump and CWB results to determine if they were a potential source of the elevated values. Elevated levels of sulfate and metals were reported in the TDRSA sump and CWB but were below benchmark or non-detect in the monitoring wells indicating that the elevated results are likely not related to the immediately upgradient facilities.

- **Location:** QAL062A & QAL063A – East berm of the TDRSA
 - **Quarterly Parameters Above Benchmark:** pH, bicarbonate alkalinity, chloride, nitrate, sodium
 - **Annual Parameters Above Benchmark:** calcium, magnesium, potassium, hardness
 - **Summary:** Bicarbonate alkalinity, chloride, nitrate, and sodium above benchmark levels at QAL062A and QAL063A are likely due to the historic use of salt at the mine site. There is no relationship between the concentrations at these wells when compared to the TDRSA contact water sump and the CWBs.

The pH results at QAL062A and QAL063A continue to be below the calculated benchmark range by at least 0.5 SU for more than two consecutive sampling quarters. pH ranges at surrounding locations downgradient of QAL062A (i.e., QAL060A and QAL061A) are within benchmark values. pH has consistently been below benchmark indicating a period of stabilization and equilibrium. A source investigation was conducted in 2024 to assess pH variability. pH changes were determined to not be due to mining facilities or activities as discussed in a letter to EGLE dated April 10th, 2024. pH has not decreased below 7.0 for two or more consecutive sampling events at these locations.

- **Location:** QAL064D – South of the Yellow Dog River
 - **Annual Parameters Above Benchmark:** magnesium, hardness
 - **Summary:** Magnesium and hardness both decreased from 2023 into 2024.
- **Location:** QAL065D – North of the Yellow Dog River
 - **Annual Parameters Above Benchmark:** calcium, magnesium and hardness
 - **Summary:** Calcium and hardness remained the same and magnesium slightly increased.
- **Location:** QAL066D – Above the Ore Body
 - **Quarterly Parameters Above Benchmark:** pH, iron, mercury, vanadium, alkalinity bicarbonate, sodium
 - **Summary:** This well has historically had groundwater results for metals including arsenic, mercury and iron which were attributed to fine-grained sediment present in the well from improper grouting during well installation. Mercury concentrations were in the 7.5 to 12.0 ng/L range in 2012, the year following well construction, and is an example of the improper construction. The well screen is placed in a horizon where clay material known to contain vanadium is present.

In 2022, the well was purged to remove sediment and iron decreased initially but increased in Q1 2024 and then fell again to previous levels. The elevated iron is likely the result of iron oxides or iron hydroxides in the clay soils within the formation in which this well is located. Vanadium increased above 4.0 µg/L in early 2024 but has since been below benchmark range. Sodium concentrations decreased during the year. Purging is planned for 2025 to remove sediment present in the well.

- **Location:** QAL067A – Southeast Corner of the TDRSA
 - **Quarterly Parameters Above Benchmark:** alkalinity bicarbonate, chloride, nitrate, sulfate, sodium
 - **Annual Parameters Above Benchmark:** calcium, magnesium, hardness
 - **Summary:** The elevated quarterly and annual results at this location are also suspected to be associated with the historic use of salt on the contact area as no additional changes have occurred in the area. However, sodium, chloride, nitrate and sulfate decreased throughout 2024 with bicarbonate alkalinity slightly increasing again. Jersey barriers were placed at this location in December 2020 to prevent snow from being pushed into the vicinity of well QAL067A and asphalt curbing was enhanced along the berm in 2021. Chloride and sodium continue to decrease in 2024 and are expected to continue to trend toward baseline levels.



Figure 14 – Curbing Located Near QAL067A

- **Location:** QAL071A – Northwest Corner of the Septic Drain Field
 - **Quarterly Parameters Above Benchmark:** pH, alkalinity bicarbonate, chloride, nitrate, sulfate, sodium
 - **Annual Parameters Above Benchmark:** calcium, magnesium, hardness
 - **Summary:** Alkalinity, chloride, nitrate, and sodium at QAL071A continue to decrease, while sulfate increased in 2024. Sulfate has fluctuated in previous years, with 2024 below previous year elevated results. pH, calcium, hardness, and magnesium were

consistent with last year's results. In Q3 2014, the action level for nitrate was met. See additional discussion below.

- **Location:** QAL074A – Downgradient of the Septic System
 - **Quarterly Parameters Above Benchmark:** iron, bicarbonate alkalinity, chloride, nitrate, sodium
 - **Annual Parameters Above Benchmark:** chromium
 - **Summary:** This location has been sampled quarterly since 2014 when the action level for nitrate was met at QAL071A. Bicarbonate alkalinity, chloride, nitrate and sodium have decreased since 2022 except for a slight increase in Q4 2024. Iron was above the benchmark for Q1 and Q2 but fell below benchmark in the remaining quarters. Chromium was above benchmark in the two consecutive annual sampling events. Chromium was elevated in 2020 as well and returned below the benchmark range the following year.

- **Location:** QAL071A and QAL074A – Nitrate Source Investigation
 - At the time of installation, QAL071A and QAL074A were installed to monitor groundwater flowing northeasterly from CWBs and TDRSA. However, the groundwater flow direction in this area is currently to the east, therefore the wells are instead downgradient of the septic system. The monitoring locations do not have obvious sources of nitrates further upgradient, so the septic tank effluent cannot be excluded as a source of the nitrate. Additional information from the source investigation is as follows:
 - Snow storage activities that are occurring near NCWIB #1 began after the elevated nitrate results were initially reported, thus eliminating them as the potential source.
 - Chloride, sodium, and nitrates are all present in human wastes and are good indicators of septic system waters. All three constituents are present in the groundwater at QAL071A and QAL074A.
 - A review of monitoring results from locations downgradient of QAL071A and QAL074A near the TWIS (e.g., QAL056A) do not show any signs of elevated nitrate levels. Currently there is no threat of elevated nitrate levels migrating offsite.

The septic system upgrades completed and documented in the 2022 MRR were expected to improve nitrate conditions in the groundwater over time. Nitrate results have fluctuated since the upgrades were completed and are expected to stabilize at the current level and return to baseline when the septic is reclaimed.

Overall Trend Analysis

As required by MP 01 2007 special condition N2, a statistical trend analysis has been conducted for all monitoring locations/parameters and is summarized in Appendix H. Possible trends were identified for one or more parameters at fifteen compliance locations and eight background monitoring locations using data collected from baseline sampling events (2011) through October 2024.

Bicarbonate alkalinity, magnesium, nitrate and sodium were the most frequently noted as possibly trending. Changes in these parameters indicate the overall change in site storm water infiltration changes and ion exchange processes occurring from de-icing products.

Piper diagrams were created for select monitoring locations that have exhibited possible trends in one or more chemical parameters. Monitoring locations QAL025A, QAL026A, QAL044B, QAL060A, QAL061A, QAL064D, QAL068A, QAL071A, and QAL073A are all classified as having a calcium bicarbonate water chemistry and have shown no signs of a change in water chemistry.

The following monitoring locations exhibited a change in water chemistry evidenced by plotting data between the years 2012 and 2024:

- QAL024A – The water type was originally classified as calcium bicarbonate in 2012 but changed to a sodium chloride classification in 2013. From 2014 through 2024, the water chemistry moved from mixed-cation chloride to the classification of calcium bicarbonate, and back to sodium chloride classification in 2024. The change in chemistry from 2013 to the present may have been associated with the previous construction of the vent raise as well as salt use and snow storage practices near monitoring well QAL024A.
- QAL029A & QAL029D – Water chemistry data from these locations were originally classified as calcium bicarbonate from 2008 to 2012 but shifted to sodium chloride. Both QAL029A and QAL029D appear to be trending toward calcium bicarbonate. These background monitoring wells for the GWDP were abandoned in October of 2024. Abandonment was completed following plugging procedures as specified in the GWDP requirements.
- QAL062A & QAL063A – Water chemistry data from these locations were originally classified as calcium bicarbonate in 2011, shifted towards sodium chloride and continue to be in 2024 but are moving back towards calcium bicarbonate. This shift indicates historic road salt use on the contact area and the corresponding chloride plume moving across the site.
- QAL066D – Samples before 2016 were classified as calcium bicarbonate and then alternated between sodium and calcium bicarbonate several times between 2016 into 2024. This is attributed to fine-grained sediment present in the well resulting from improper grouting during installation. This well requires aggressive purging on a routine basis to remove the accumulating sediment. The 2024 results continue to trend back towards calcium bicarbonate.
- QAL067A – All samples before May 2014 were classified as having a water type of calcium bicarbonate. In 2014, the water chemistry began to change and was classified as mixed-cation chloride and then continued to shift to the classification of sodium chloride waters from 2015 through 2024. This change in water chemistry indicates an external source of contamination and is likely due to deicers.
- QAL069A – Water chemistry from this location was classified as calcium bicarbonate until 2018 when it shifted towards a mixed-cation chloride classification. Water chemistry then shifted back towards the historical classification of calcium bicarbonate in 2019 where it remained in 2024. This well is located near the security building and site access road where salt is used as a deicer.

- QAL070A – Samples collected before May 2015 were classified as having a water type of calcium bicarbonate indicating shallow fresh groundwater. From May 2015 through 2024, a shift in water chemistry occurred in which the water was classified as a mixed type, however, the water does not display a dominant cation type though it does correspond with a chloride type chemistry. This monitoring location is also found near the site access road where salt is used as a deicer and drainage from the roadway is routed near this well.

Piper diagrams for each monitoring location referenced above are in Appendix I.

5.1.2 Quarterly Surface Water Quality Monitoring

Surface water sampling was conducted quarterly in 2024 at 11 locations: nine on the Salmon-Trout River and one each on the Yellow Dog River and Cedar Creek as shown on the map in Appendix J. The samples represent winter base flow, spring snowmelt/run-off, summer base flow, and the fall rainy season. Samples are collected following the Eagle Project QAPP and SOP and the results are summarized and compared to benchmarks in Appendix K. In 2015, all surface water benchmarks were reviewed and updated using results that were not determined to be trending based on statistical analysis. These updated benchmarks were used for comparison since 2016.

Monitoring Results

Grab samples were collected from each location during the quarterly sampling events completed in March, June, August, and October 2024. The Eagle Mine Permit prescribes a parameter list for the Q2 annual monitoring events and a shorter list to be used in Q1, Q3, and Q4. In addition to the grab samples, field measurements including DO, pH, specific conductivity, and temperature were collected and determined using a YSI instrument. The stream stage and flow measurements were obtained using a wading rod and current meter. The following is a summary of the 2024 events that occurred.

- The pH at STRM001 was above benchmark for two consecutive Q1 and Q3 sampling events.
- Compliance location STRM004 was above benchmark for two second quarter sampling events for bicarbonate alkalinity, at 52.0 mg/L both quarters.
- At compliance monitoring location STRM005, bicarbonate alkalinity, calcium, and hardness were over the benchmark for two consecutive Q2 sampling events. This location is near a county highway crossing of the river and these parameters are expected to be influenced from spring snowmelt and runoff in Q2. pH was above the benchmark for two consecutive third quarter sampling events. pH results in Q1 and Q4 2024 were within benchmarks indicating the change may have been the result of seasonal variation.
- Compliance location STRE005 results for alkalinity bicarbonate, calcium, magnesium, and hardness that were just above the established benchmark for two consecutive annual Q2 sampling events.
- STRE009 was above the benchmark for two consecutive second quarter sampling events for bicarbonate alkalinity, calcium, magnesium and hardness in Q2.
- Bicarbonate alkalinity, calcium, magnesium, and hardness were above the Q2 seasonal benchmark representing spring snowmelt and runoff conditions at STRE010. Iron was also above the Q4 benchmark at location STRE010 for two consecutive quarters. The Q4 sampling

event is conducted for fall precipitation and iron is likely from impacts from precipitation related runoff.

Overall Trend Analysis

A trend analysis was also conducted for the surface water monitoring locations. The same statistical analysis as groundwater was utilized with the exception that each parameter was also analyzed for each quarter, rather than just parameter and location, to consider seasonal variations.

Trends were identified for one or more parameters at all the eleven monitoring locations using data collected from baseline sampling events (2011) through October 2024. Calcium and sodium were most frequently noted as possibly trending. The largest number of the trends identified occurred in Q2. The elevated results and associated trends return to baseline levels in subsequent quarters, indicating that the results are likely due to seasonal variation.

A table summarizing the potential surface water trends can be found in Appendix L. For compliance monitoring locations in which results were outside of established benchmarks for at least two consecutive seasonal quarters and a potential trend was identified, the trend charts are also provided in Appendix L.

8.1 Regional Hydrologic Monitoring

5.1.3 Continuous, Daily and Monthly Groundwater Elevations

Water levels are monitored in two distinct hydrologic zones near the mine site: in the shallow, unconfined unit (QAL024A, and wetland locations WLD022, WLD023, WLD025, WLD026, WLD027, WLD028), and a clay layer-confined aquifer located beneath the A-zone (QAL023B, QAL044B, QAL064D, QAL065D, QAL066D). The B- and D-zone wells are in the same confining unit as Eagle's industrial supply well and are affected by limited recharge that occurs seasonally during spring melt or significant precipitation. All the locations are instrumented with continuous water level meters. Water level meters were connected to a telemetry network in 2020 which allows for real-time data review and analysis rather than monthly downloads as was previously the practice. A map of these locations can be found in Appendix M.

Water levels in the background reference location QAL007A are reflective of regional groundwater trends where the Eagle Mine is located. QAL007A water level was four feet (ft) lower than the 2023 peak levels, as shown in Figure 15. Though regional precipitation rates were above average in 2024, there was lower snowfall and lower snowpack leading into 2024 leading to moderate drought conditions for the year according to the Palmer Hydrological Drought Index. As historically observed, precipitation rates influence the shallower zone wells.

In addition, some of the short-lived fluctuations in deeper D-zone groundwater levels below the confining layer may be attributed to blasting events. In a confined aquifer, the impacts of blasting may be observed as an instantaneous pulse in groundwater levels due to increased pressure or changes in pressure. Water levels return to pre-blast levels typically within the hour after the blasting cycle is complete.

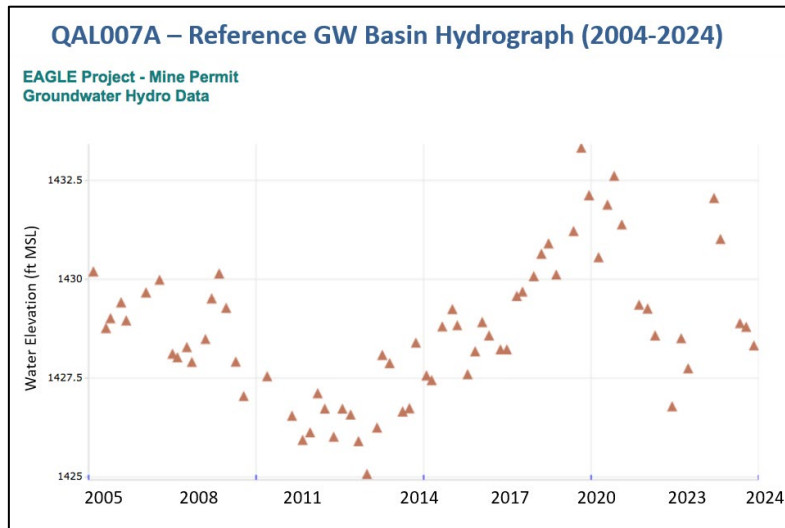


Figure 15 – QAL007A – Regional Decrease in Water Levels 2024

Continuous groundwater monitoring locations are reported by water year (October 1 – September 30). Calculated background water levels and monthly water level results are based on mean daily values and summarized in Appendix O. The following is a summary of the findings:

- QAL023B – The mean water level readings were less than the minimum background baseline levels October 2023 – September 2024. The lowest reading was recorded at 5.6 ft below the minimum baseline level in September 2024.
- QAL024A – The mean water level readings for October 2023 were greater than the maximum background baseline level.
- QAL044B – The mean water level reading from January – September 2024 was a maximum of 1.4 ft below the minimum baseline level calculated for this location. The lowest reading was recorded in September 2024.
- QAL064D – The mean water level reading for March 2024 was 0.1 ft below the minimum baseline level calculated for this location.
- QAL065D – The mean water level readings were below the minimum baseline water levels from October 2023 – September 2024. The lowest mean water elevation was 1.2 ft below minimum baseline in September 2024.
- QAL066D – The mean water level readings were less than minimum background baseline levels from October 2023 – September 2024. The lowest water level was recorded in September 2024, 2.5 ft below the minimum baseline level calculated for this location.



Figure 16 – Piezometer with a Level Troll Located at QAL008A

In addition to continuous monitoring, Eagle Mine implemented a regional hydrologic monitoring program to assess potential groundwater elevation changes due to mine dewatering. The regional monitoring wells cover about 14 square miles. Discrete water elevations are measured every quarter at 120 locations. Several wetland locations were unable to be monitored due to frozen or unsafe conditions throughout the quarters.

A map of the hydrologic monitoring locations can be found in Appendix M and a map of the A- and D-zone groundwater contour maps for each sampling quarter can be found in Appendix N, and summarized as follows:

- No significant changes or shifts in calculated groundwater contours were reported for calendar year 2024.
- Regionally, the overall water levels were higher in Q1 and Q2 2024 than in corresponding quarters of 2023 and lower in the second half of the year. The exception is in the D-zone water levels in monitoring wells located above the ore body near the mine services well.
- QAL004D water levels fluctuate based on the use of the mine services well because it is located within the direct influence of the well. As stated in section 4.3.1, the mine services well (QAL011D) is used to supply water for underground operations, dust suppression, fire water, etc. Previous studies indicate that the drawdown in QAL004D occurs when the mine services well is operating but then rebounds when the well is not in use. The hydrographs indicate the mine service well influences water levels in the confined aquifer (B- and D-zones) extending to the area above the orebody. The change in water levels is not reflected in either the A-zone water table aquifer hydrographs or the wetland hydrographs. In addition, wetlands lying above the deeper aquifer and orebody have not shown any hydrological response to the mine service well or potable water supply well pumping.
- Changes in water level in the monitoring wells located within the vicinity of the orebody (i.e., QAL023B, QAL044B, QAL064D, QAL065D, and QAL066D), are most likely attributed to precipitation rates, water withdrawal from the mine services well and/or infiltration of water encountered during mining activities.

Wetland Water Levels

Wetland water levels above the orebody (e.g., wetland wells WLD025-4.5, WLD027-4.5, and WLD028-4.5) remained above the permit threshold in 2024. In some instances, in 2024, the water levels fell below the minimum baseline levels because the wetlands are heavily influenced by precipitation levels. There were lower precipitation rates in 2024, so water levels generally decreased in wetland piezometers in 2024.

- WLD022-4.5 had a mean water level below the baseline minimum between December 2023 and September 2024. The lowest reading was 0.4 ft below the baseline minimum.
- Mean water levels at WLD025-4.5 were 0.1 ft above the baseline maximum in September 2024.
- Mean water levels at WLD026-9.5 were 0.3 ft above the baseline maximum between July and September 2024, attributed to precipitation.

Hydrographs of each groundwater and wetland monitoring location can be found in Appendix P. A summary of discrete water elevation results from Q1 to Q4 2024 is included in Appendix Q.

Groundwater Infiltration

A wireless radio telemetry network provided continuous, real-time monitoring of water levels from bedrock piezometers, quaternary wells, and wetland piezometers. Additionally, the Crown Pillar Management Plan establishes actions to initiate if discrete inflows that occur in the Eagle ore body are greater than five gpm. No discrete inflows of greater than five gpm were identified in 2024.

5.1.4 Continuous Surface Water Monitoring

Locations STRE002, STRM004, STRM005, and YDRM002 have been equipped with continuous monitoring instruments for temperature, conductivity, and flow rate since 2004 are downloaded quarterly by North Jackson Company.

The results for surface water locations are also being reported by water year from October 1st, 2023 to September 30th, 2024 averaged over each month based on mean daily values. Background levels are based on data collected from September 2004 through August 2011. The monthly temperature, flow, and specific conductivity are summarized in Appendix R. The following is a summary of the findings:

- Continuous flow readings were not collected from locations STRM004, STRM005 and YDRM002 from January and February 2024 due to ice conditions. In addition, STRM004 wasn't collected in May 2024 due to water elevations from beaver activity and YDRM002 in December 2024 due to ice buildup.
- The January 2024 mean temperature and September 2024 specific conductivity at Location STRE002 were higher than the background maximum, with the September 2024 flow lower than the background minimum.
- STRM004 water flow from November and December 2023 was lower than the background minimum.

- STRM005 mean specific conductivity was above background maximum in September 2024.
- The mean specific conductivity at Location YDRM002 was below the background minimum level by 2.3 $\mu\text{S}/\text{cm}$ in February 2024. Specific conductance returned to normal in the following months.
- The pattern of flow and hydraulics of the watershed resulted in variable streamflow conditions. The changes in stream discharge rates observed throughout the watershed are from the influence of precipitation and snowmelt events. There was below average snowfall in late 2023 resulting in less snowmelt in early 2024. In the summer months of 2024, there was above average precipitation, followed by below average precipitation in the fall.
- Both temperature and flow affected specific conductivity. The higher temperatures affected conductivity by increasing ionic mobility and the solubility of many salts and minerals, and, higher flow rates during spring snowmelt resulted in lower specific conductivity due to dilution.

Hydrographs for each location are found in Appendix S.

9.1 Biological Monitoring

Biological monitoring events conducted in 2024 included flora and fauna surveys, wetland monitoring, fish and macroinvertebrate surveys, and a Narrow-Leaved Gentian (NLG) survey. Results from each survey completed in 2024 have been compiled into reports attached as Appendices T and U.

10.1 Fish Tissue Survey

The Michigan Department of Natural Resources (DNR) recommended a reduction in fish tissue sampling due to the brook trout population concerns. Experts from EGLE and the DNR determined that adequate information has been collected to support the conclusion that future fish tissue sampling events shall occur only under the following conditions:

- If quarterly surface water monitoring and/or annual aquatic survey results indicate impacts to streams from mining activity.
- During the first fisheries and aquatic survey after cessation of mining.

The correspondence provided to EGLE is attached as Appendix V.

11.1 Miscellaneous Monitoring

5.1.5 Soil Erosion Control Measures

There were no temporary Soil Erosion and Sedimentation Control (SESC) measures in place on site in 2024. If areas are identified that need temporary SESC measures in the future, they will be installed and maintained in compliance with the requirements of Part 91 (NREPA, 1994 PA 451, as amended). Permanent SESC measures are in place and continue to be effective, monitored, and improved, as necessary.

5.1.6 Berms, Embankments and Basins

All containment berms and embankments of the TDRSA, CWB, NCWIBs, and facility perimeter are inspected monthly, or after a 0.5" rain event, to ensure cracking, settlement, or erosion is not affecting the integrity of the berms. Inspections were completed as required in 2024; observations and/or repair recommendations are recorded in the surface inspection log stored in the compliance binder at the mine site. Issues are corrected by onsite staff and a follow-up inspection is completed to ensure that repairs have been made.

In spring 2024, hydroseeding was completed along the TDRSA berms after tree removal was completed in 2023. The project was completed by M.J. Van Damme (MJVD) using a mulch with tackifier to hold seed to the sloped areas. Additional mulch and grass seed was applied on the south berm where the hydro seeder accessed the slope.



Figure 17 – Hydroseeding on the TDRSA Berm and Additional Mulch

5.1.7 Impermeable Surface Inspections

The impermeable surface monitoring plan outlines the requirements of integrity monitoring of surfaces exposed to contact storm water. Areas inspected in 2024 included concrete or asphalt in the WTP, truck wash, truck shop floors, sumps, trench drains, the contact area, and travel ways. Per the monitoring plan, inspections of the contact area and travel ways were suspended during the months when snow covered much of the surface and winter weather prevented effective patching efforts.

All inspection results are recorded on the impermeable surface inspection form and stored in the compliance binder at the Eagle Mine Site. Any issues identified during the inspections are recorded and planned for repairs. The following repairs were made in 2024:

- Concrete seams were re-sealed on the WTP floors as well as the bulk hydrochloric room floor and sumps.
- Asphalt and concrete were removed and replaced on the contact area in June 2024 from multiple locations including near the CWBs, between the portal and CRF plant, east of the aggregate storage building (ASB), the COSA load bays, the TDRSA entrance/exit, and smalls sections near the fuel island and in the north laydown area.



Figure 18 – Paving South of CWB #1



Figure 19 – Paving the COSA Load Bays



Figure 20 – Paving Between Portal and CRF



Figure 21 – Paving East of the ASB

In November 2023, WSP completed an inspection of the CWBs to evaluate the perimeter where the asphalt and liner meet. Recommendations were provided by WSP for asphalt repair and realignment of the metal sheeting along the basin edges. Repairs were postponed due to the underground rehabilitation work adjusting the mining plan, the previously dredged CWB material that was staged along the basin edges could not go underground until later in the year. The repairs are now to be completed in the summer of 2025.

5.1.8 NCWIB & CWB Sediment Accumulation Measurements

Sediment accumulation is monitored and measured at both the non-contact and contact water basins. This requirement is in place as sediment accumulation in the NCWIBs could result in diminished infiltration capacities and decreased water storage capacity in the CWBs.

Non-Contact Water Infiltration Basins

As required by the mining permit, sediment accumulation measurements are conducted annually for the NCWIBs. Each of the four NCWIBs was inspected in 2024. No visible changes were observed. Minimal vegetation was observed and removed and will continue to be monitored.

Contact Water Basins

Sediment thickness measurements were completed in July and October 2024 in CWB #1 and #2 utilizing a boat and sludge judge. The sediment accumulation in CWB #1 was approximately 42 inches (in) at its highest near the south end where the underground water is pumped into the basin. The average sediment accumulation in CWB #1 was approximately 13 inches and CWB #2 was approximately 10 inches. CWB #2 had sediment accumulation approximately 33 inches at its highest at the northwest corner.

A leak location survey was performed by Leak Location Services, Inc. in CWB #1 in July 2024. A towed probe survey method was used, which is completed by personnel systematically pulling a probe back and forth across the bottom of the pond along temporary survey lines. The probe detects an electrical path from the probe inside the basin to an electrode connected to the earth outside of the basin. This process can detect a leak that is 0.001 square inches or greater in size. One signal was detected in CWB #1 during the 2024 survey. Inspections were completed in the past on this location and no leaks were found. The signal location is expected to be interference from the intake pumps and associating piping and ground connections. There is unlikely to be any damage to the liner in this area because there was no previous dredging work in this location and approximately one foot of sediment is left on the liner. Eagle has also reviewed operational activities within and near the CWBs and no activities were completed that could have caused damage to the containment system liner.

The 2025 inspection is tentatively planned to be performed in CWB #2.

6. Reclamation Activities

In July 2024, Barr Engineering provided 500 seedhead weevils for spotted knapweed biocontrol. Weevils eat the knapweed seeds, preventing the plant from re-populating. The use of weevils is a long-term reclamation activity, expected to take approximately 3 years until noticeable reduction in spotted knapweed is observable. A reduction in knapweed will make site revegetation easier post-closure and reduces dependency on herbicides.



Figure 22 – Weevil Release for Natural Knapweed Control

Closure Planning

Closure planning continued in 2024 with the assistance of Ramboll US Consulting of Denver, Colorado. Work in 2024 primarily consisted of revising the closure cost estimate using current U.S. labor rates.

7. Contingency Plan Update

An updated contingency plan can be found in Appendix W. This plan will also be submitted to the Local Emergency Management Coordinator.



Figure 23 – Mine Rescue Exercise – CPR/First Aid Certification

8. Financial Assurance Update

Updated reclamation costs will be submitted to the Department by late March. Eagle Mine understands that if these costs require updating of the current bond for financial assurance EGLE will notify Eagle Mine.

9. Organizational Information

An updated organization report can be found in Appendix X.

Appendix A

Eagle Mine Background Information

Eagle Mine

a subsidiary of **lundin mining**

1. Background Information

The Eagle Mine Site is located in the Upper Peninsula of Michigan, within Michigamme Township, Marquette County. Eagle Mine is an underground nickel and copper mine. Underground activities began in September 2011, with drilling operations in preparation for blasting. On September 22, 2011, blasting at the Eagle Mine constituted the commencement of mining activities and Eagle initiated all monitoring programs per the Part 632 Mining Permit. Beginning in 2014, ore that is mined is brought to the surface via haul truck, and transported offsite for processing at the Humboldt Mill.



Figure 1 – Eagle Mine Location

2. Underground Operations

Two mining methods are being utilized at Eagle Mine; longhole open stoping and cut and fill mining. Longhole open stoping is utilized in the Eagle orebody while Eagle East uses both longhole stoping and cut and fill mining methods. The majority of Upper Eagle East is longhole stoping with a small area of cut and fill mining at the top of the ore body. Only development mining has been completed in Upper Eagle East in 2024.

When utilizing the longhole stoping method, the stopes are mined in an alternating sequence of primary and secondary stopes. Cemented rock fill (CRF) is used in the primary stopes, while uncemented rock fill is used in the secondary stopes below the 327.5 meter (m) above mean sea level (AMSL) levels. Both primary and secondary stopes were mined and backfilled in Eagle and Eagle East in 2024.

Cut and fill mining areas in Eagle East and Upper Eagle East are being mined in lifts from the bottom up and jam filled with CRF as they are completed. Cut and fill is utilized as it is a more efficient mining method for higher-grade irregularly shaped orebodies.

All CRF is made onsite at the batch plant and is transported underground using underground haul trucks. The CRF is currently composed of development rock or offsite aggregate, sand, cement, water, and a concrete admixture.



Figure 2 – Cemented Rock Fill (CRF) Plant

3. Subsidence Monitoring

Deflection of the crown pillar bedrock is monitored via three multi-point borehole extensometers (MPBX) installed from the surface. The MPBX is grouted in a vertical hole and has six points of measurement, or anchors, at incremental depths along the hole. As the anchors move, fiberglass rods separating the anchors produce a change in resistance, which is converted to a voltage used to calculate displacement. Data for the surface MPBXs is downloaded manually monthly using a handheld data logger.

Deflection at the surface is monitored via the monthly surveying of 12 monuments that are installed within the crown pillar footprint. The change in elevation of each monument is measured in reference to a backsight point fixed to exposed bedrock, and the accuracy of the measurements is within one millimeter or less.

In addition to the subsidence monitoring required by permit condition L-17, additional extensometers are installed at various locations in Eagle and Eagle East, including in the back of each stope sill in Eagle's two uppermost levels. Data from these instruments are reported in real-time using a Load sensing telemetry system, and the measurements are used to better understand the ground conditions throughout the mine and identify early indicators of potential changing conditions. This information is used to guide mitigation measures to help ensure the safety of Eagle employees and contractors.

4. TDRSA Construction and History

The Temporary Development Rock Storage Area (TDRSA) was created to hold development rock until the material can be placed back underground as backfill. The storage area has multiple protective layers between the surface and the development rock. The TDRSA has two collection sumps; the contact water sump and the leak detection sump. The contact water sump collects drainage from the primary TDRSA liner where the water is in contact with development rock. The purpose of the leak detection sump is to capture water within the secondary liner system in the event of a failure of the primary liner.

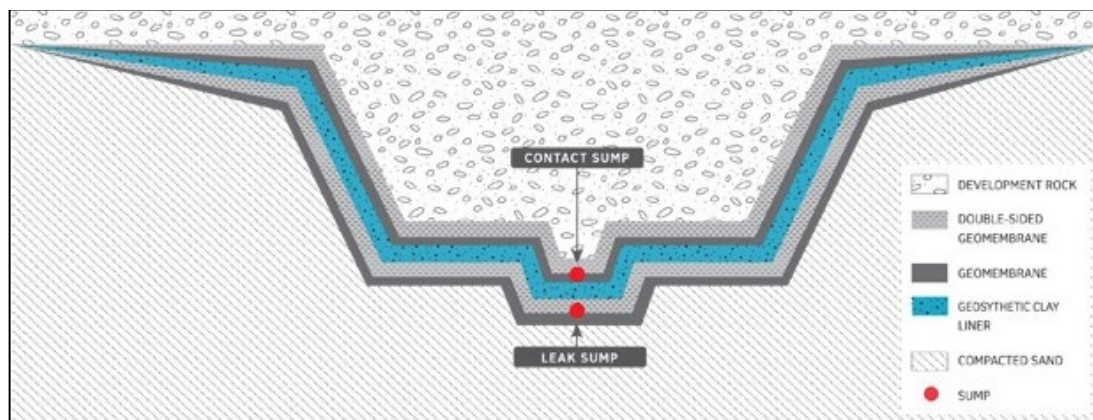


Figure 3 – Eagle Mine Rock Storage Area (TDRSA) Cross Section

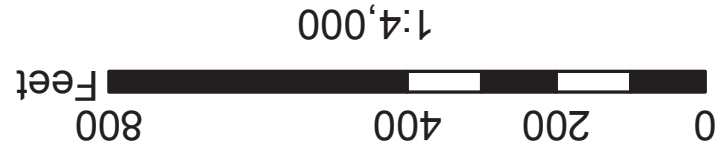
The water currently in the leak detection sump is rainwater that entered the secondary collection system during construction in 2011 via rainfall and has been encapsulated in the secondary lining system since construction (estimated 26,000 gallons). Since that time, water has been pumped from the leak detection monthly.

The contact water pumping system is equipped with an automatic pump start and high-water alarm to indicate when the water level is approaching the one-foot maximum head level. Both sumps are continuously monitored using pressure transducers. The leak detection sump is manually pumped, as necessary. Eagle implemented operational controls including operator training and control panel lockout to ensure the systems operate as designed, and that the required sampling and volume collection occur when the pumps are operated.

Appendix B

Eagle Mine Site Map

Data source: Lundin Mining and North Jackson Company
Basemap: National Agriculture Imagery Program
Satellite image taken August 11, 2020.
Projection & Datum: NAD 1983 UTM Zone 16N

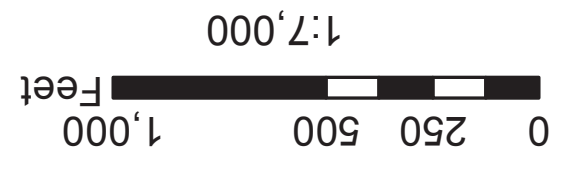


Groundwater Discharge Permit
Wells

Figure 1



Data source: Lundin Mining and North Jackson Company
*Well sampled on an annual rather than quarterly basis.
Basemap: National Agriculture Imagery Program
Satellite image taken August 11, 2020.
Projection & Datum: NAD 1983 UTM Zone 16N

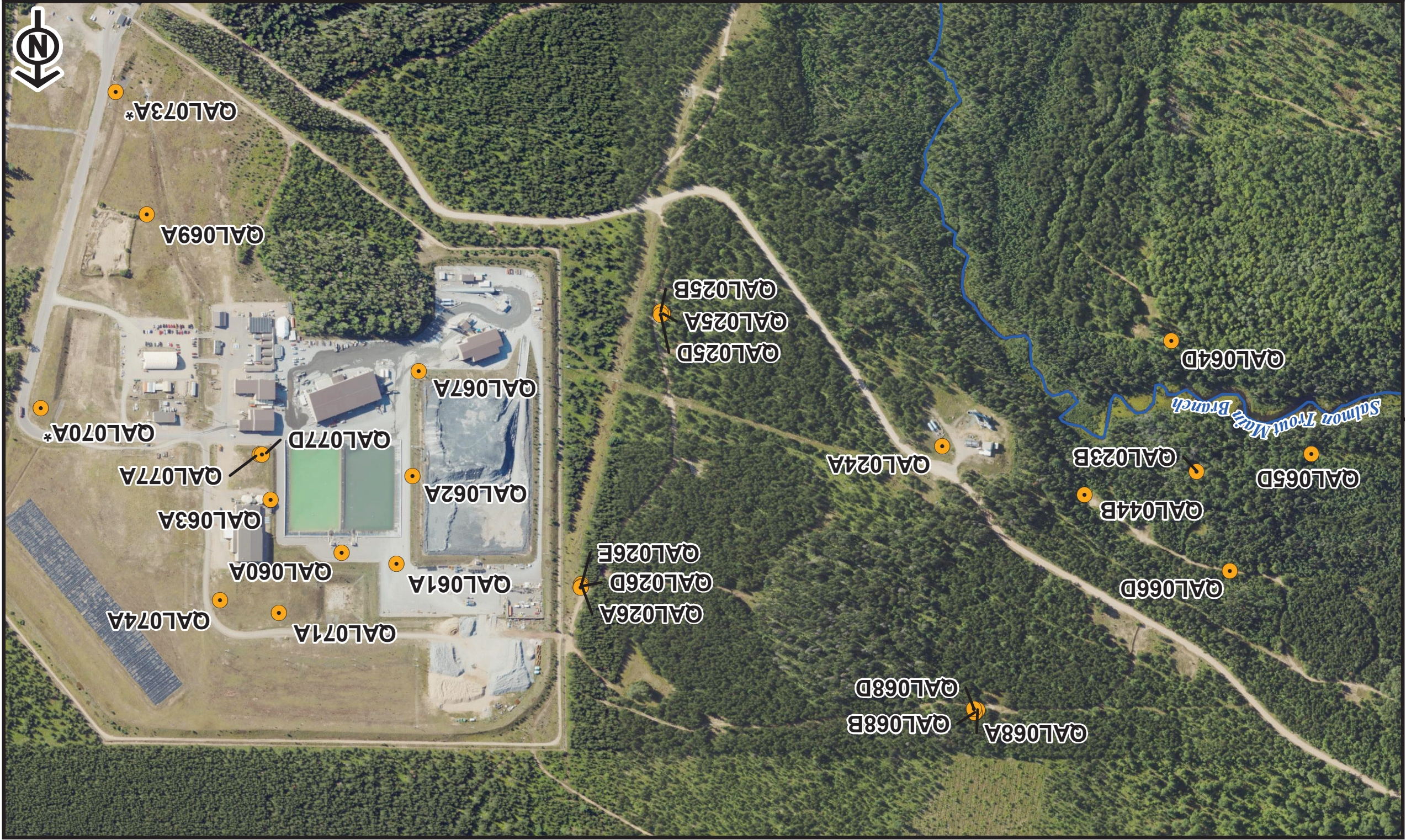


● Mine Permit Groundwater Wells
Figure 2

ENVIRONMENTAL SCIENCE & ENGINEERING
North Jackson Company

Lundin Mining

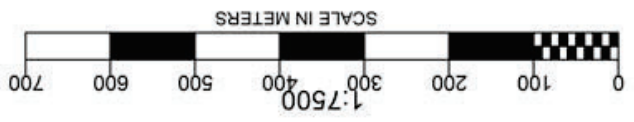
Mine Permit
Groundwater Wells



EAGLE MINE LLC AERIAL MAP



DATE: 1/6/2023



Appendix C

Eagle Mine Rock Stability Certification

Eagle Mine

a subsidiary of **lundin mining**

Eagle Mine
4547 County Road 601
Champion, MI 49814, USA
Phone: (906) 339-7000
Fax: (906) 339-7005
www.eaglemine.com

Thursday, February 27, 2025

Ms. Melanie Humphrey
Michigan Department of Environment, Great Lakes, and Energy
1504 W. Washington Street
Marquette, Michigan 49855

**Subject: Rock Stability Certification – Eagle Mine, Marquette County Michigan
Mining Permit (MP 01 2007)**

In accordance with special condition E-8 of mining permit MP 01 2007, I certify that the rock stability modelling for Eagle Mine is still valid. Numerical modelling was updated in 2024 to include a discrete rock mass domain for the “contact damage zone,” a localized area along the SED/PER contact with higher intensity structure and alteration. Loosening of this zone likely caused the displacement measured in the surface extensometer instrument, MPBX R2. Model inputs for existing rock mass domains (i.e., intrusive, sulphide, and sedimentary) were unchanged based on observed conditions. A life of mine assessment using the updated model shows continued displacement is localized within the contact damage zone and no measurable displacement at the overburden/bedrock contact. Eagle also continues to perform daily visual inspections to verify ground stability and identify any early indicators of changing conditions.

Sincerely,

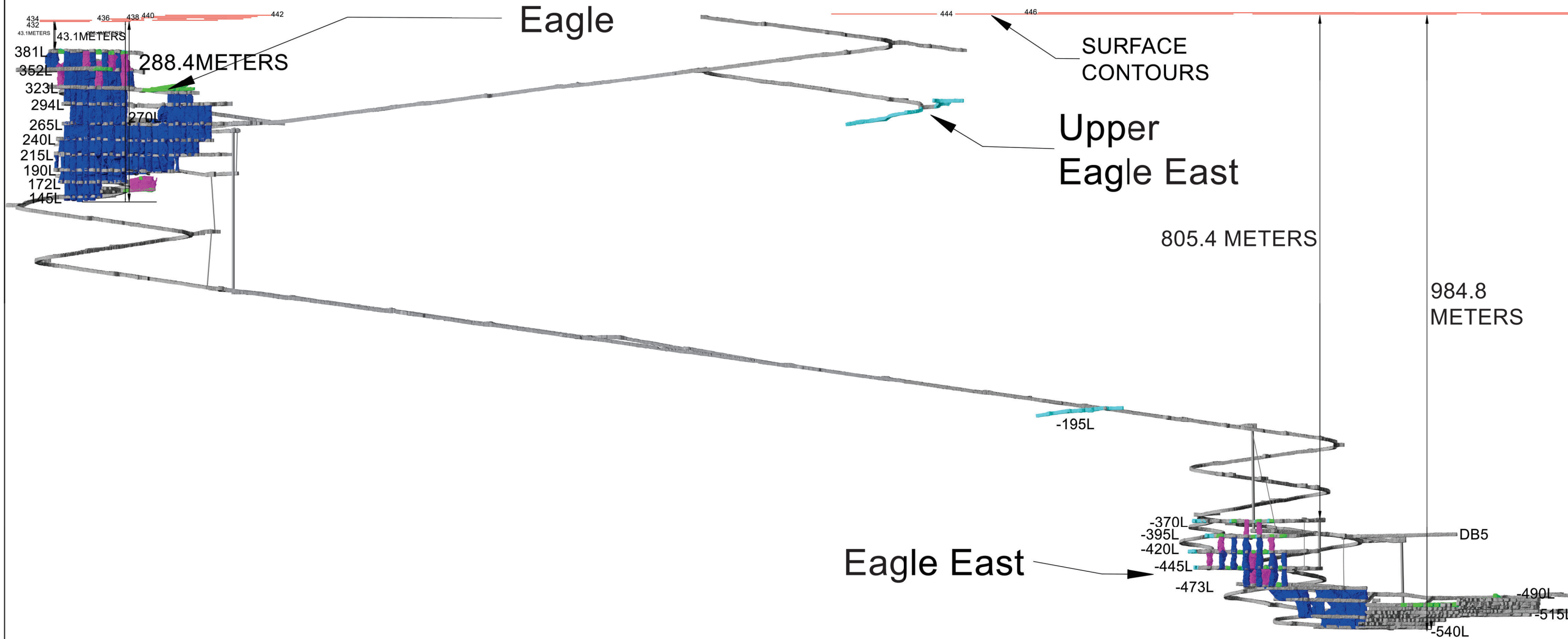


Lars Olausen
Mine Manager
Eagle Mine, LLC.

Appendix D

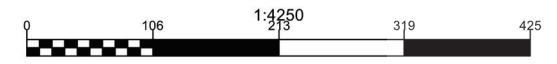
Eagle Mine

Maps of Eagle, Eagle East and Upper
Eagle East Development and Production
Mining Progress



NOTE: ALL ELEVATIONS IN METERS. IN THE LEVEL LABELS THE NUMBER REFERS TO HEIGHT ABOVE/BELOW MEAN SEA LEVEL (-540L HAS A SILL ELEVATION OF 540 METERS BELOW MSL)

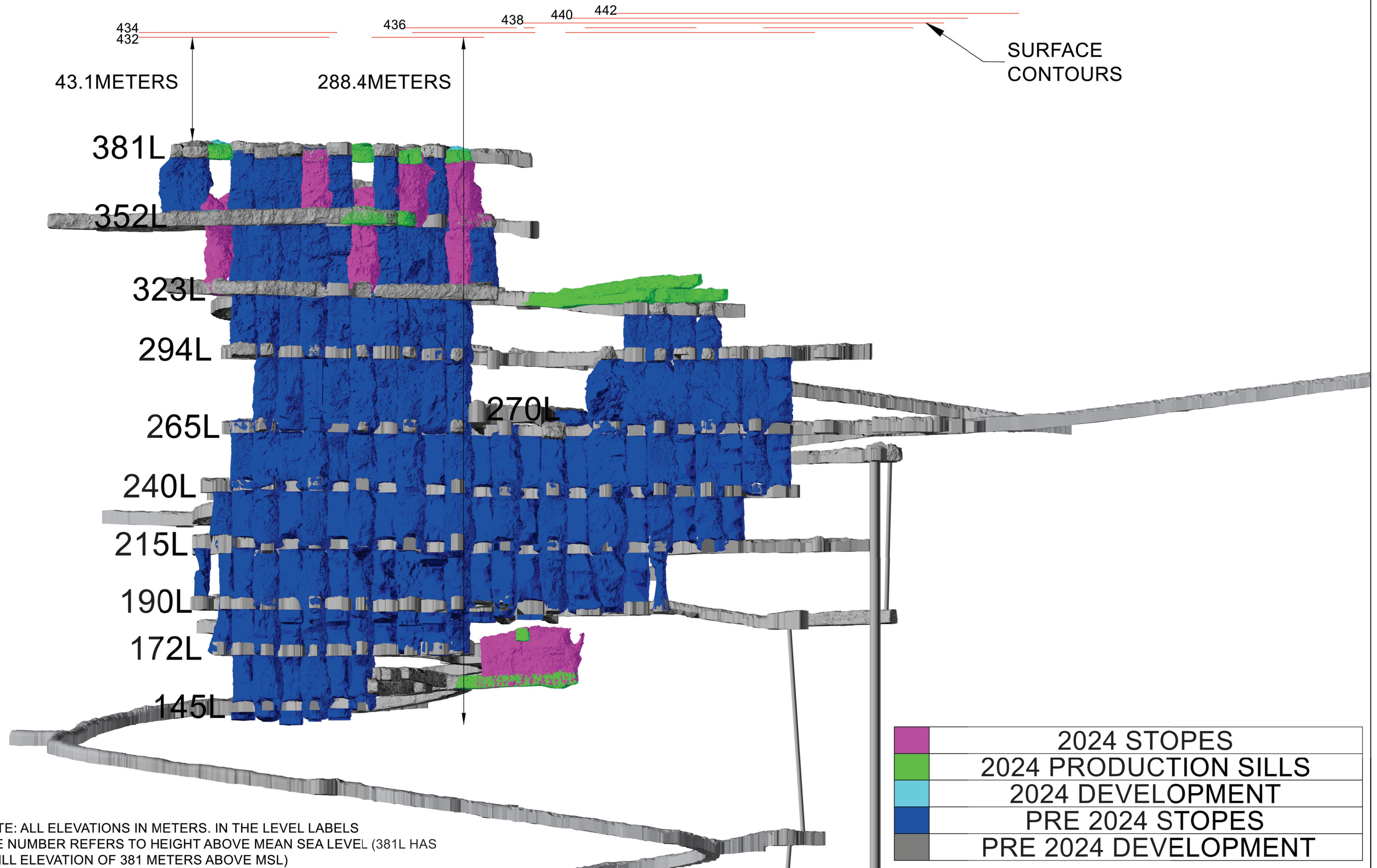
	2024 STOPES
	2024 PRODUCTION SILLS
	2024 DEVELOPMENT
	PRE 2024 STOPES
	PRE 2024 DEVELOPMENT



Drawing Title:
2024 Mining

Author: Cody.Gobbs
Date: 1/13/2025
Scale: 1:4250

Eagle Mine



NOTE: ALL ELEVATIONS IN METERS. IN THE LEVEL LABELS THE NUMBER REFERS TO HEIGHT ABOVE MEAN SEA LEVEL (381L HAS A SILL ELEVATION OF 381 METERS ABOVE MSL)

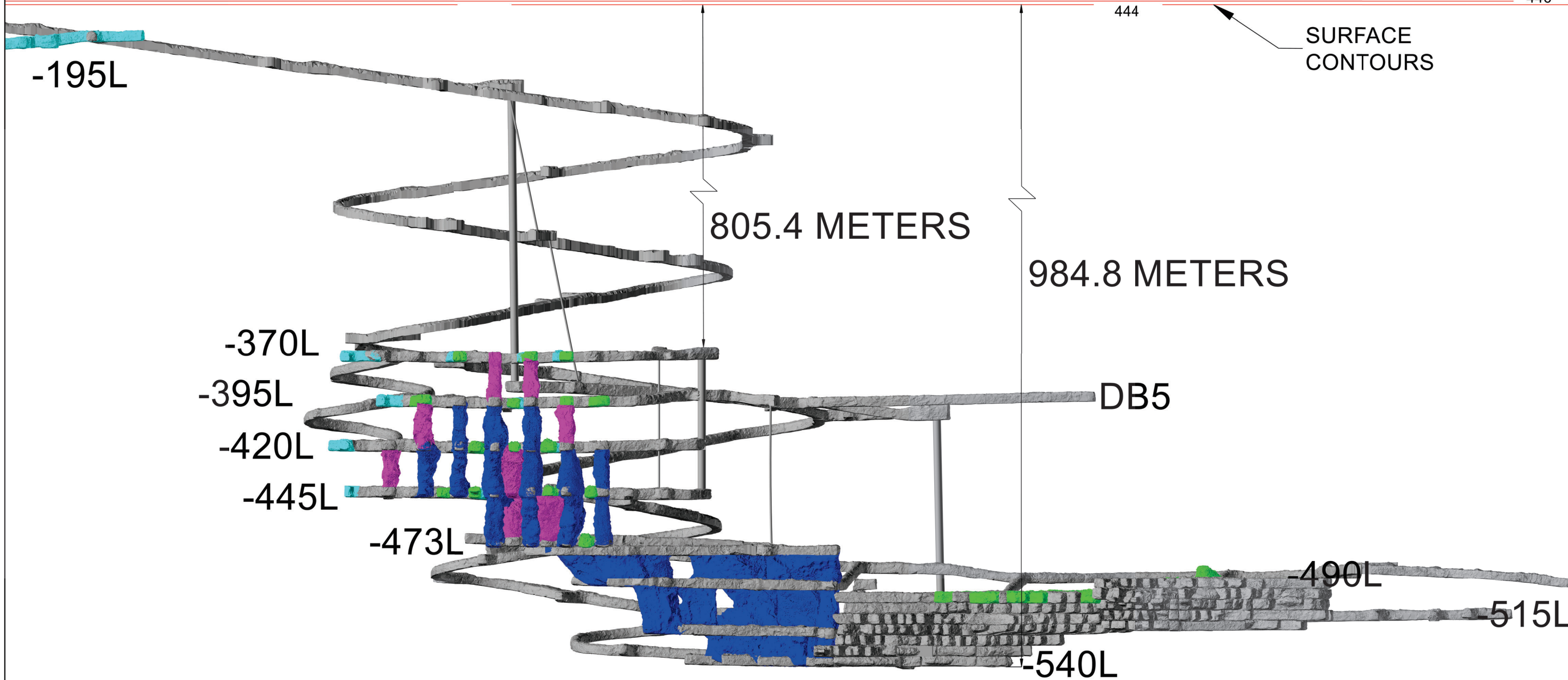
	2024 STOPES
	2024 PRODUCTION SILLS
	2024 DEVELOPMENT
	PRE 2024 STOPES
	PRE 2024 DEVELOPMENT



Drawing Title:
2024 Eagle

Author: Cody.Gobbs
Date: 1/13/2025
Scale: 1:1000

Eagle Mine



	2024 STOPES
	2024 PRODUCTION SILLS
	2024 DEVELOPMENT
	PRE 2024 STOPES
	PRE 2024 DEVELOPMENT

NOTE: ALL ELEVATIONS IN METERS. IN THE LEVEL LABELS THE NUMBER REFERS TO HEIGHT ABOVE/BELOW MEAN SEA LEVEL (-540L HAS A SILL ELEVATION OF 540 METERS BELOW MSL)



Drawing Title:
2024 EE

Author: Cody.Gobbs
Date: 1/13/2025
Scale: 1:1500

Eagle Mine