Minto Mine
QML-0001

Underground Mine Development and Operations Plan Amendment
Minto South
March 2022

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Minto South Portal Underground Mine Development and Operations Plan (UMDOP) V2022-01

UMDOP Versions

UMDOP Version	Issue Date	Description of Version
April 2014 UMDOP	April 2014	Area 118, Area 2, and M-zone UG
June 2014 UMDOP	June 2014	M-zone UG, Area 2, Area 118, Minto East zones
2016 UMDOP	March 2016	Replaced June 2014 - M-zone UG, Area 2, Area 118, Minto East zones
2017-01 UMDOP	April 2017	Area 2UG and Minto East
Copper Keel Ramp UMDOP	March 2018	Area 2 UG, Minto East, and Copper Keel Ramp
Copper Keel UMDOP	February 2020	Minto East and Copper Keel zones
Minto South Portal UMDOP	March 2022	Updating the Copper Keel UMDOP to include details on Area 2 UG, Minto East, Copper Keel and updated mine plan. Previously submitted construction drawings for Minto East exploration drift in November 2021 are included.

2022 Revisions

Section	Section Name	Description
1	Introduction	Clarified that this UMDOP replaces all previous Minto South Portal UMDOPs
2	Operations Overview	Updates the current operations and future plans for Minto South Portal lens, provides a table of zones and what permitting phase each zone is associated with, updates the current reserves
Figure 3-1	Plan view	Updated to February 2022 including future plans
3	Deposits and Ore Reserves	Updated to include all lens within Minto South. Minor changes to reflect updated mine development processes and design such as new escapeways
4	Mine Schedule	Updated mine schedule
5	Mine Operations	Minor changes to mine equipment
6.1	Orebody Geometry	Geometry section from the Area 2 UMDOP 2017-01 combined with the Copper Keel information from the Copper Keel UMDOP.
6.2	Excavation Dimensions	Updated to current mine design
6.3-6.5	Rock Mass Characterization, Stability Analysis, Ground Support Requirements	Rock mass characterization, intact strength and ground support requirements updated to match the 2021 GCMP.
6.7	Hydrogeological Assessment	Section 6.7 updated for current dewatering information
7	Ventilation	Ventilation information updated to February 2022 including new figures.
8	Ancillary Infrastructure	Auxiliary information updated to February 2022.
9	Mine safety	Mine safety information updated to February 2022.

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1 Introduction

This document amends the Underground Mine Development and Operations Plan (UMDOP) for the Minto South Underground to include the Copper Keel, Area 2, and Minto East ore zones. For greater clarity, this plan replaces the following UMDOPs:

- April 2014 UMDOP covering Area 118, Area 2, and M-zone UG
- June 2014 UMDOP covering M-zone UG, Area 2, Area 118, Minto East zones
- March 2016 UMDOP (that replaced the June 2014 version)
- April 2017-01 UMDOP covering Area 2UG and Minto East
- March 2018 Copper Keel Ramp UMDOP covering Area 2 UG, Minto East, and Copper Keel Ramp
- February 2020 Copper Keel UMDOP covering Minto East and Copper Keel zones

2 Operations Overview

As of January 2022, mining is currently underway in Copper Keel. The intention is to mine ore lenses within Area 2, Copper Keel, and Minto East over the next few years. Please refer to Section 4 of this report for a mining schedule.

The following table summarizes the nomenclature associated with Minto's ore zones and lists the permitting phase under which each has been assessed.

Table 2-1: Nomenclature for Underground Complexes, Portals, and Zones.

Underground Complex	Zones	Permitting Phase
Minto South Portal	Area 118	Phase IV
	Area 2	Phase IV
	Minto East	Phase V/VI
	Copper Keel	Phase V/VI
	M-zone	Phase IV
	Wildfire	Phase V/VI
	Minto East 2	Phase VII
Minto North Portal	Minto North	Phase VII

A separate, underground complex, known as the Wildfire Underground, was presented during the environmental assessment process for Phase V/VI. This included relatively shallow ore zones from a separate portal with its own dedicated infrastructure. Originally planned to be mined after completing the Minto South Underground, it is now part of the Copper Keel zone.

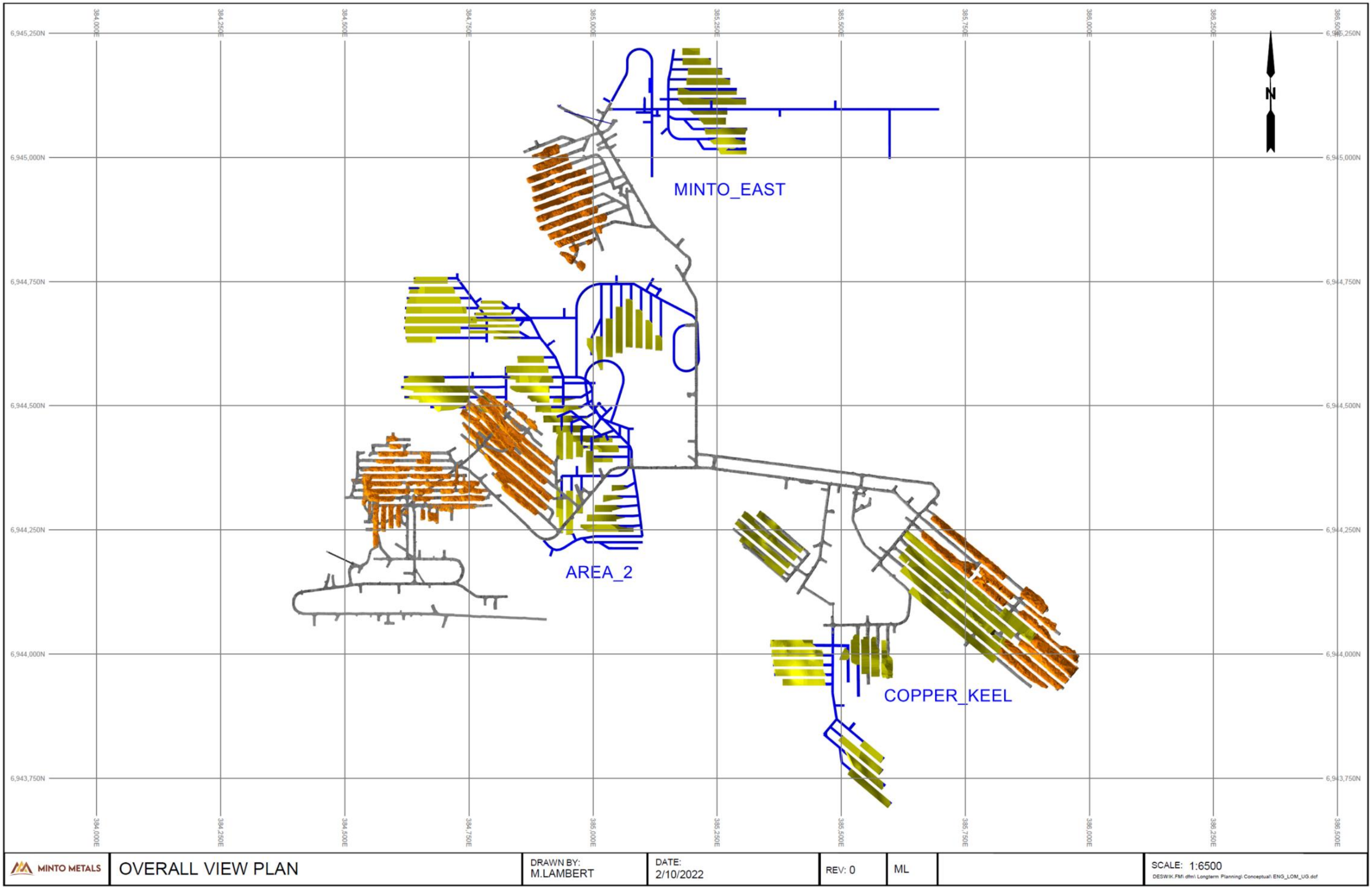
Mineral resources for all underground zones are provided in the following table from the Preliminary Economic Assessment (PEA), 2021:

Table 2-2: Underground Minto South Resource Classification from Minto PEA (2021).

Resource	Ore tonnes	Cu %	Au gpt	Cu (000lbs)	Au (oz)
Indicated	**3,448,629**	1.47	0.59	111,964	64,928
Inferred	**3,693,799**	1.28	0.53	103,942	63,058

Figure 2-1 below demonstrates preliminary development and stoping designs for the portion of those resources addressed in this document.

Figure 2-1: Plan View of Underground Development and Ore Zones.



3 Mine Development and Design

3.1 Ramp Development

The ramp is 5.0 m wide and 5.5 m high, consistent with the existing ramp in Area 2, Copper Keel, and Minto East zones. It will be used for all ore and waste haulage, personnel/equipment access, and services running to the Copper Keel zone. The back height is increased to 6.5 m at remuck intersections to provide the size necessary for the load, haul, dump (LHD) units to load trucks.

Remuck bays are developed every 150 m to improve the efficiency of the development cycle; they are designed to hold two rounds of development muck. The remuck bays have the same dimensions as the decline and are 20 m long. Additional cut-outs for drill bays and sumps (etc.) are developed as required. Safety bays are developed every 30 m.

3.2 Minto South Mine Design

Sill drifts are driven along the footwall contact of the ore zone. Sill drifts are spaced every 20 m. The drifts will follow the footwall contact of the ore and will vary between positive and negative grades.

3.2.1 Stope Width and Sill Drift Spacing

The stope design is nominally based on 12 m wide stopes and 8 m pillars, but geotechnical analysis indicates that the pillar width must vary as a function of stope height to maintain stability and maximize recovery. Pillar thickness increases when the stope is tall and decreases when the stope is short.

3.3 Truck Loadouts

Truck loadouts are used at Minto to reduce the LHD tram distance. Each loadout consists of a truck bay, a scoop bay/remuck, and a connection between the two. The scoop bay is elevated relative to the truck bay so that the LHD can dump material into the truck box from above.

3.4 Water Management

Sumps are planned at low points of the main accesses. Sumps are typically 15 m long and dip at -15%. Water collected in the sumps will be pumped to the Minto East Pump Station, where it is pumped directly to the surface through a sub-vertical pipe using multi-stage electric pumps. In addition to the Minto East Pump Station, water is pumped through a chain of sumps up the main ramp to the surface and deposited via UG1.

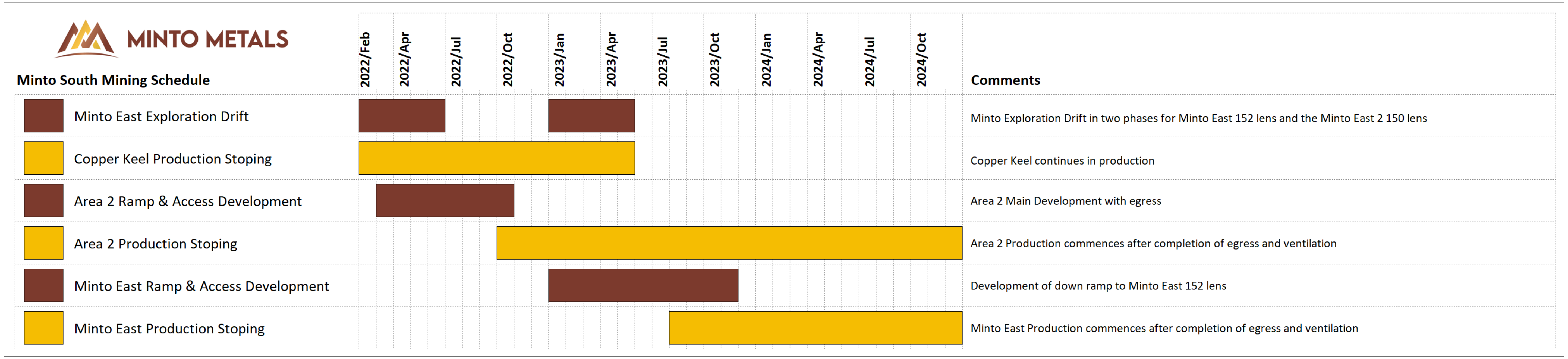
3.5 Escapeway

An escapeway from the lowest workings of the mine was completed in the Minto East area in April 2018 and will remain active throughout all Minto South mining. A second drift was developed between the Copper Keel mining area and the Minto East ramp to act as a secondary egress for mining in Copper Keel. Expansion mining in Area 2 will access the main ramp at two locations to allow egress and ventilation. Expansion mining in Minto East to the 152 zone will haven an escapeway to the exploration drift above to allow egress and ventilation.

4 Scheduling

The Minto East Exploration Drift and a ramp accessing the Area 2 expansion will be the primary development priority. The actual production will be limited to the volumes assessed and licenced. The following are significant milestones in the schedule for Minto South development and production activities (as depicted in the Gantt chart):

Figure 4-1: Minto South Schedule.



5 Mine Operation

5.1 Material Handling

Material is mucked from stopes and development headings by a combination of CAT1700G and CAT1700K LHD units. Stope mucking operations are carried out via remote control from a stand set up at the open stope brow or via tele-remote from surface. With both these methods the operator is not exposed to the unsupported ground in the open stope.

A fleet of seven CAT AD45 and one Atlas Copco MT42 haul trucks are currently used for haulage. Typically, only 4 – 5 trucks are operational at one time. All haulage is through the Minto South ramp and portal. Ore from both development and stoping is hauled to a surface stockpile adjacent to the portal, from which it is picked up by a separate fleet of surface haul trucks and loaders and taken to the crushing plant.

Waste rock from development headings is hauled to a surface stockpile adjacent to the portal. Development rounds are assayed, and the waste is moved to the appropriate waste dump as outlined in the *Waste Rock and Overburden Management Plan* (WROMP). The protocols for the segregation and placement of waste materials are consistent with the protocols for surface mining.

6 Geotechnical

Geotechnical characterization and design work, summarized in the following sections, were carried out by Golder Associates Ltd. and Minto's Mine Technical Department for Area 2, Area 118, Minto East underground, and Copper Keel areas. A ground control management plan was developed and implemented in 2013 and has been used for all underground development to date. The plan is updated annually; the most recent update was in 2021.

6.1 Orebody Geometry

The following points (italicized excerpts from the SRK Phase V Prefeasibility Study) summarize the general ore body conditions:

> *The (mineralized) zones bifurcate, which means that a mineralized zone can contain a significant amount of waste, or that thinner ore zones can merge with larger zones. A bifurcating geometry complicates geological modelling and may expect to increase internal dilution.*
>
> *The width and dip of mineralized zones are locally variable. The zones therefore appear to pinch-and-swell. The change in thickness might be as much as an order of magnitude over less than 30 m in horizontal distance.*
>
> *At least some of the irregularity in the geometry and thickness of the mineralized zones is due to small-scale and large-scale structural displacements. No detailed structural model has been completed for either deposit, but at least two faults appear to be present in Area 2, and three possible faults displace the modelled zones in Area 118. Similar structures may be present throughout the deposit, each with displacements of a few metres or less.*

Table 6-1: Summary of Main Orebody Lens Geometry.

Zone	Depth(m)	Area (m)	Dip (degrees)	Vertical Thickness (m)
M-zone	25-110	120x100	10-15	8-23
Area 118	150-200	235x190	18-45	5-35
Area 2	90-225	220x115	10-30	5-31
Minto East	270-330	220x150	10-30	5-26
Copper Keel	220-285	500x190	10-30	5-25

6.2 Excavation Dimensions

The following is a summary of the planned excavation and pillar dimensions:

Table 6-2: Summary of Excavation Dimensions.

Excavation/Pillar	Minto South deposits
Development drifts, ramps	5.0 m (W) x 5.5 m (H)
Production drifts	6.0 m (W) x 4.3 m (H)
Longhole stope (non-entry)	12 m (W) x 9-20 m (H)
Longhole pillar	8 m (W) x 9-20 m (H)

6.3 Rock Mass Characterization

6.3.1 Rock Mass Classification

Rock mass characterization is based on core logging, and laboratory testing by SRK Consulting and underground mapping carried out by Minto. Summaries of rock mass quality and strength from the Ground Control Management Plan (GCMP) are contained in Table 6-3 below.

Table 6-3: Rock Mass Parameter Summary.

Area	Source	Type	Condition	# of Samples	RMR			Q' Range		
					min	Max	avg	min	max	avg
Area 2 (M-Zone)	Underground mapping	fG	Fresh	92 m	55	92	77	0.8	50.0	9.6
Area 118	Core Logging (SRK)	eG,pG,fG	Fresh	334 runs	22	81	58	-	-	-
			Weathered	59 runs	21	72	51	-	-	-
Area 118	Underground Mapping	fG	Fresh	147 m	59	89	79	1.4	150.0	17.7
		eG	Fresh	204 m	65	92	85	2.6	50.0	17.5
Area 2 UG	Core Logging (Minto)	fG	Fresh	60 runs	70	89	72	33.8	300	45.4
		eG	Fresh	83 runs	65	94	69	11.5	150	23.4
Minto East	Core Logging (Minto)	fG	Fresh	22 runs	61	89	69	10.6	73.8	23.2

Area	Source	Type	Condition	# of Samples	RMR			Q' Range		
					min	Max	avg	min	max	avg
Minto East	Core Logging (Minto)	eG, Peg, pG	Fresh	96 runs	56	89	64	18.2	300	26.4
Copper Keel	Core Logging (Minto)	eG, fG	Fresh	75 runs	-	-	74	0.2	447	50.4
Copper Keel	Underground mapping	fG	Fresh	100 m	-	-	-	0.3	100	29
Copper Keel	Underground mapping	eG	Fresh	120 m	-	-	-	8	60	25

6.3.2 Intact Strength

Intact rock strength properties are based on the results of drilling and testing carried out in 2009 and 2015 by SRK and 2015, 2016, and 2017 by Golder. The following table is from the GCMP.

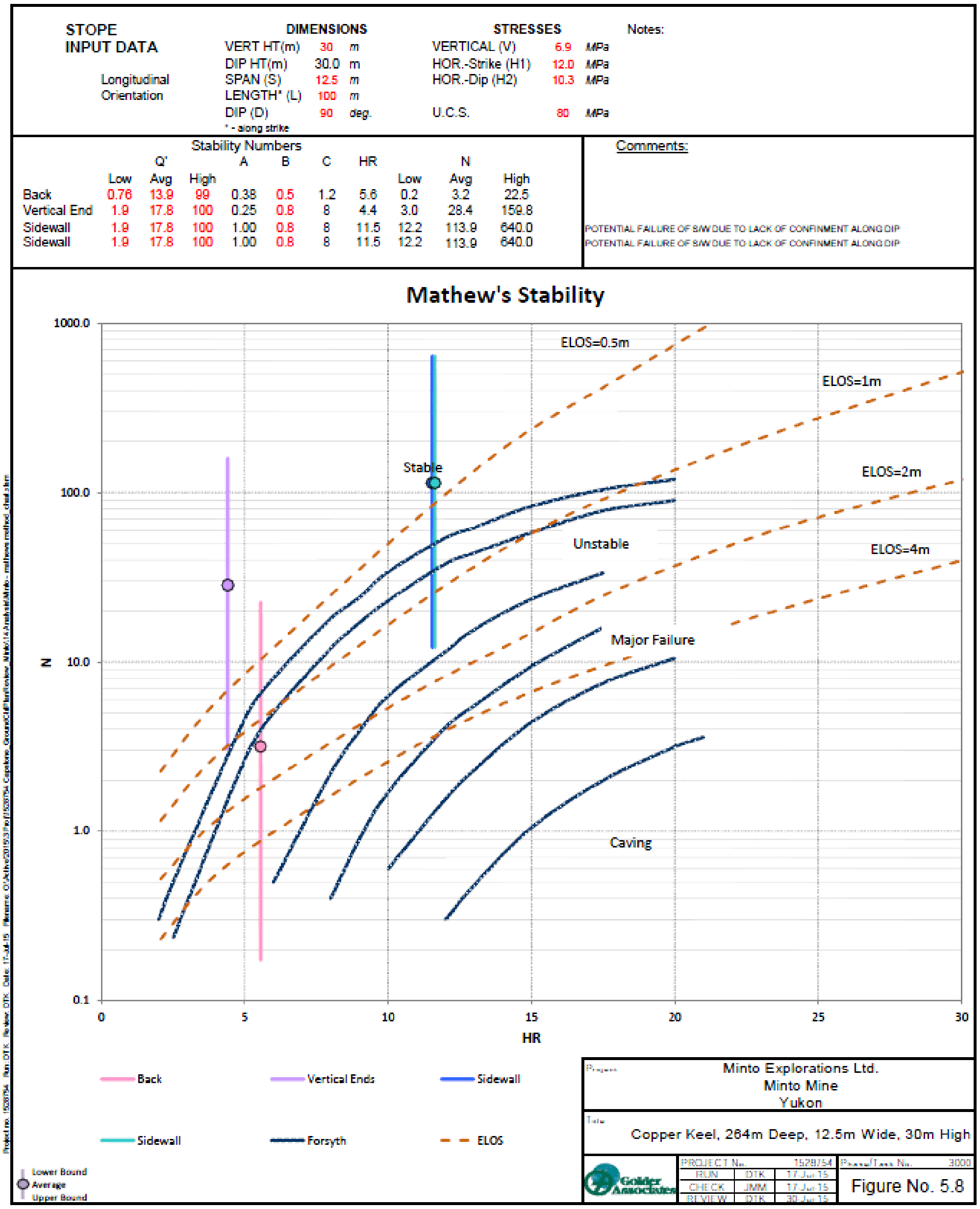
Table 6-4: Summary Testing for Intact Strength Properties.

Area	Lithology	Condition	UCS (MPa) (excluding invalid tests)				Young's Modulus (E) (GPa)	Poisson's Ratio	Brazilian Tensile Strength (MPa)	Density (kN/m³)
			tests	min	max	mean				
Area 2 Pit	Equigranular Granodiorite (eG)	Fresh	1	103	103	103	-	-	-	26.3
	Foliated Granodiorite (fG)	Fresh	4	94	173	122	47	0.23	7.6	26.4
	Porphyroblastic Granodiorite (pG)	Fresh	2	58	150	104	15	0.08	-	26.4
		Weathered	3	21	49	31	-	-	-	25.8
Area 118	Equigranular Granodiorite (eG)	Fresh	1	150	150	150	-	-	-	26.3
	Foliated Granodiorite (fG)	Fresh	8	86	165	125	67	0.30	-	26.6
	Porphyroblastic Granodiorite (pG)	Fresh	6	72	198	141	49	0.21	10.1	26.4
		Weathered	1	88	88	88	51	0.22	-	26.1
Area 2 UG	Equigranular Granodiorite (eG)	Fresh	2	103	111	107	-	-	-	26.5
	Foliated Granodiorite (fG)	Fresh	14	75	138	103	65	0.23	-	28.0
	Porphyroblastic Granodiorite (pG)	Fresh	1	88	88	88	-	-	-	26.6
Minto East	Equigranular Granodiorite (eG)	Fresh	3	89	132	122	-	-	-	26.5
	Foliated Granodiorite (fG)	Fresh	4	65	142	105	-	-	-	28.9
Copper Keel	Equigranular Granodiorite (eG	Fresh	8	-	-	114	85	0.34	-	26.5
Copper Keel	Foliated Granodiorite (fG)	Fresh	4	-	-	109	82	0.24	-	27.0

6.4 Stability Analysis

Stope spans for future mining areas were designed using a combination of empirical analysis, numerical modelling, and experience in the Minto underground to date. Figure 6-1 below shows the stability graph for 12.5 m wide and 30 m high stopes as per planned stope and pillar geometry.

Figure 6-1: Mathew's Method Stability analysis (Golder, 2015).



The following is an excerpt from Golder 2015:

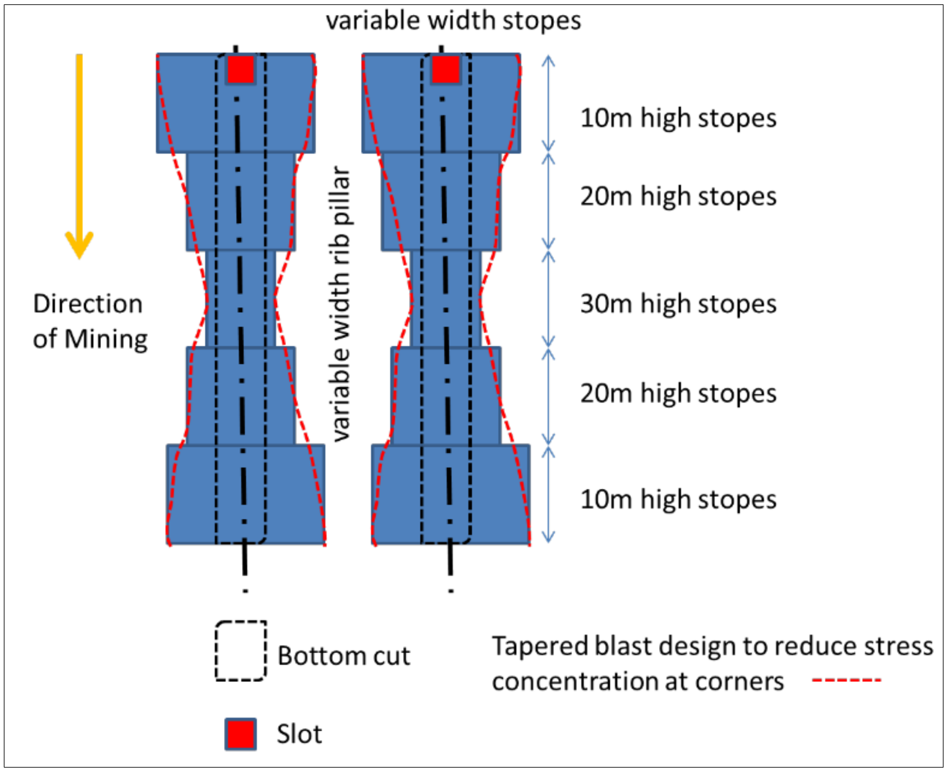
> *The assessment suggests that 10 m wide stopes in typical ground are stable, but localised areas of poorer quality hanging wall waste could result in challenging back conditions and slough. Increases in stope span beyond 10m will result in increasingly challenging conditions and 15 m wide stopes in typical*

ground would expected to exhibit slough that will result in operational challenges. A change in mining approach whereby ground support would be installed in the stope backs would be required to provide confidence in back spans beyond 10 m to 12.5 m.

The proposed mining method is consistent with the mining method employed in Copper Keel, Minto East, and Area 2 UG. The logic behind this mining method is to develop sill drifts that are 20 m apart (consistent drill drift centerline). This allows for adjustment of the pillar size based on the stope height. Figure 6-2 below is presented to explain the mining method better.

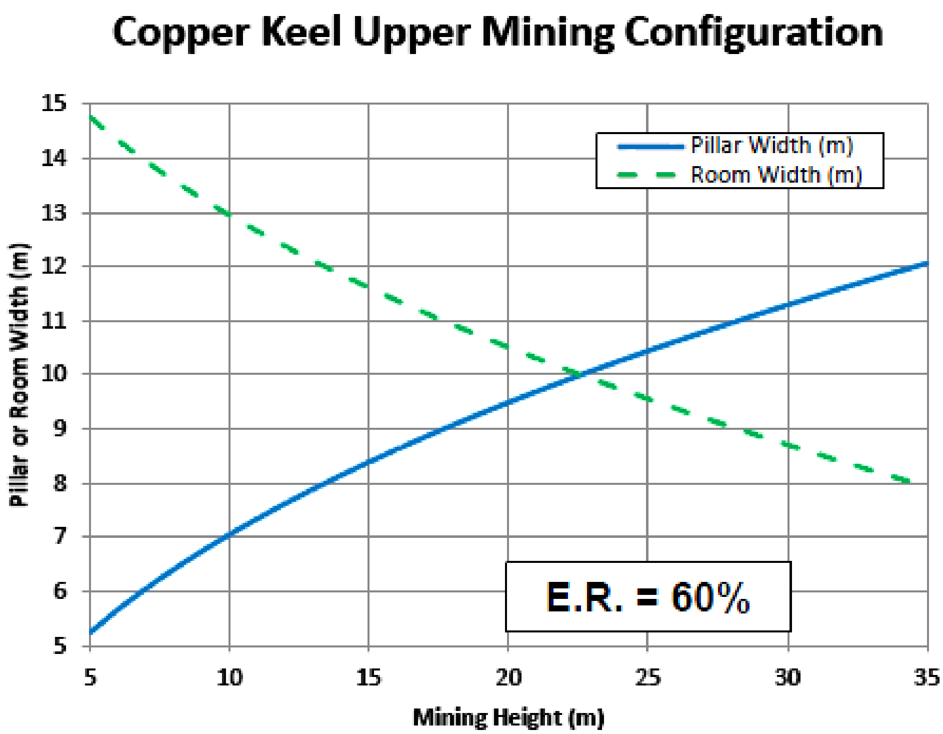
Golder also carried out pillar stability analyses in 2015. Permissible stope and pillar widths were estimated for the range of mining heights in the Minto South deposit, shown in Figure 6-2 below. The average extraction ratios shown are based on the distribution of ore thickness. These analyses assumed an intact rock strength for ore of 80 MPa, which recent lab testing indicates is a conservative assumption. Analyses are updated as more information is gained during the deposit development.

Figure 6-2: Variable Rib Pillar and Stope Width with Constant Drill Drift Centerline.



It is not feasible to provide a single figure for each stope since the thickness of ore (height of stope) varies in each stope. The figure below shows the required pillar size for different stope heights. As shown in figure 6-3, the pillar width can be 5.3 m to 12 m, i.e., 14.7 m to 8 m stope width, respectively (resulting in drift centerlines 20 m apart).

Figure 6-3: Summary of permissible stope and pillar widths (Golder, 2015).



6.5 Ground Support Requirements

Ground support requirements for underground development are contained in the Minto GCMP. The following table summarizes ground support elements and requirements for development openings.

Table 6-5: Ground Support Elements.

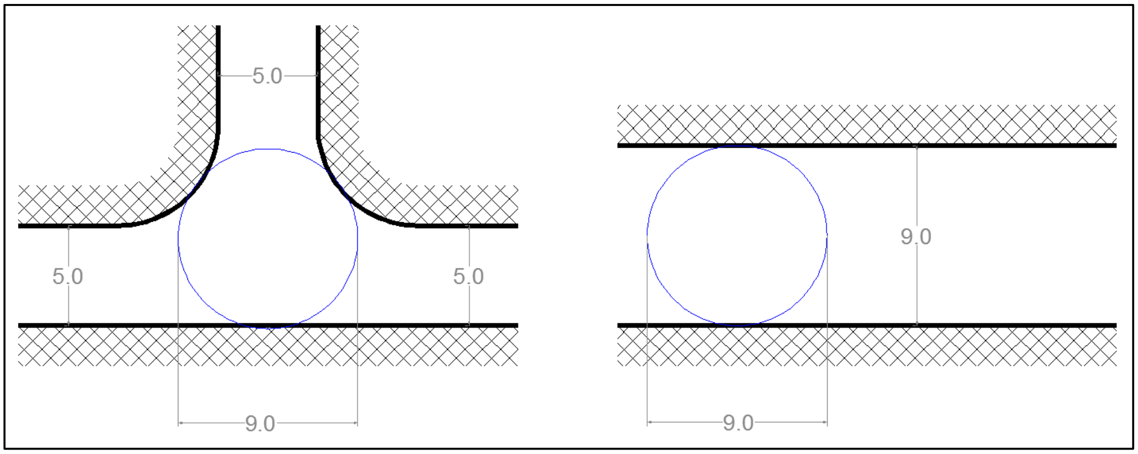
Support Element	Description	Minimum Breaking (tensile) Strength	Comment
Bolts	12T Standard Swellex (27 mm)	12 tonnes	Used for development bolting.
	24T Super Swellex (36 mm)	24 tonnes	Used for brow support and additional support at intersections or large spans.
	#6 (20mm) (3/4”) threaded rebar bolt w/ full column resin	13 tonnes	-
	#6 (20mm) (3/4”) forged head rebar bolt w/ full column resin	18 tonnes	-
	Split-sets (35 mm)	6 tonnes	Used for face bolting or pinning screen.
Plates	Domed - 15 x 15 cm (6” x 6”), 6 mm (1/4”) Flat - 12.5 x 12.5 cm (5” x 5”), 6 mm (1/4”)	5 tonnes	-
Resin	30mm x 610mm cartridges 30 second (fast) 180 second (slow)	-	-
Mesh	6 gauge welded wire mesh	~ 2-3 tonnes bag strength	Galvanized or Bright depending on the use of the excavation.
Straps	0 gauge welded wire mesh straps	-	Used for stope brow support and additional pillar support where required.

Table 6-6: Minimum Ground Support for Development and Production Openings.

Type		Span (m)	Primary Support (typical)	Comment
1	**Development Drifts (typical ground conditions)**	5.1	2.4 m 12T Standard Swellex bolts only, or 2.4 m resin rebar in back around perimeter of mesh sheets 1.8 m resin rebar in back and walls to pin mesh at center 1.8 m resin rebar in walls to 1.5 m above floor 1.5 m x 1.5 m bolt spacing in a diamond pattern 0.9 m Split-sets (35 mm) Used for pinning screen only Welded wire mesh to 1.5 m above floor	Life of mine infrastructure in typical ground conditions. Overlap mesh by three squares.
2	**Production Drifts (typical ground conditions)**	6.0	2.4 m 12T Standard Swellex bolts only, or 2.4 m resin rebar in back around perimeter of mesh sheets 1.8 m resin rebar in back and walls to pin mesh at center 1.8 m resin rebar in walls to 1.5 m above floor 1.5 x 1.5 m bolt spacing in a diamond pattern 0.9 m Split-sets (35 mm) Used for pinning screen only Welded wire mesh to 1.5 m above floor	Non-permanent development (e.g., stope undercut drifts) in typical ground conditions. Overlap mesh by three squares.
3	**Poor ground – fault zones**	≤ 6.0	2.4 m 12T Standard Swellex bolts only, or 2.4 m resin rebar in back around perimeter of mesh sheets 1.8 m resin rebar in walls to 1.5 m above floor 1.5 x 1.5 m bolt spacing in a diamond pattern 0.9 m Split-sets (35 mm) Used for pinning screen only *Additional*: 3.6 m, 24T Super Swellex, diamond pattern, 1.5m x 1.5m centers Welded wire mesh to 1.5 m above floor	Poor ground, typical in fault zones. Overlap mesh by three squares.
Intersection Secondary Support				
1,2,3	**Intersections**	≤ 9.5*	To be installed in addition to the primary support pattern outlined above: 3.6 m 24T Super Swellex in back and shoulders 1.5 x 1.5 m bolt spacing - Installed at least one row past the intersection in each direction.	Intersection support to be installed prior to taking wall slash, as per MIN-OP-SWP-005 Underground Intersection Development and Ground Support

Ground support design of typical intersections with spans of up to 9.5 m can be applied to the support design for a passing lane with a span of up to 9.5 m. Span is defined as the diameter of the largest circle which can be drawn between pillars and walls (after Pakalnis and Vongpaisal 1993). The circle's center represents the point farthest from a wall or pillar carrying the load. As seen in the figure below, a circumference is used to identify the maximum effective span of an excavation. In the case of a typical intersection or a passing lane, the span is approximately 9 m.

Figure 6-4: Maximum Effective Span of an Intersection or a Passing Lane.



6.6 Monitoring

Monitoring is described in detail in the Minto Underground Ground Control Plan (version 2021 or later). The following table summarizes the primary elements of the monitoring programs.

Table 6-7: Summary of Ground Control Monitoring.

Element	Description
Inspections	• Daily inspections of active production openings by geotechnical engineer, Minto supervision and/or contractor supervision • Monthly inspections of fresh air raise/manway • Quarterly inspections by the geotechnical engineer of all development and production openings • Ground control logbook maintained by underground shifters and checked by geotechnical engineer
Geotechnical mapping	Rock quality and structure mapping is carried out regularly by geotechnical engineers/geologists to identify major structures and changing conditions for use in geotechnical analysis and mine design.
Cavity monitoring surveys (CMS)	Carried out in open stopes, typically after each blast.

6.7 Hydrogeological Assessment

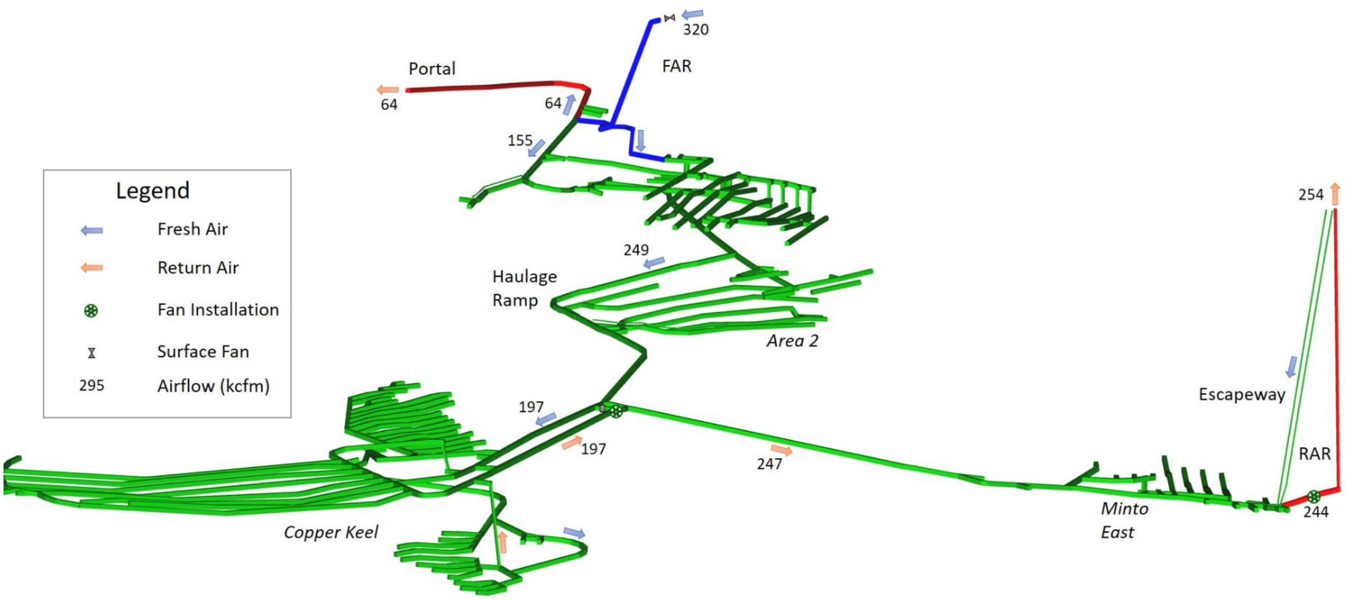
A detailed hydrogeological assessment has not been completed to define the potential inflows in Copper Keel; however, with the development and production completed to date, Minto has extensive experience with the hydrogeological regime and operational requirements at the site. Inflows encountered to date in the Minto South Underground have been associated with discrete water-bearing faults and with un-grouted diamond drillholes. Occasionally, curtain grouting is utilized to displace large, localized flows. Otherwise, the water is handled by the Minto East Pump Station at the bottom of the main ramp and the other sump pump stations. The total discharge from the mine to the surface in 2021 was 746,000 m^3.

7 Ventilation

7.1 Current Ventilation

The Minto South ventilation plan was upgraded in 2018 after completing the Minto East exhaust raise, shown in Figure 7.1 below. Fresh air is supplied through 760 fresh air raises from the surface fan and heater assembly. The primary exhaust is now through the Minto East exhaust raise, where airflow is managed by installing a ventilation wall with exhausting fans at the base of the raise. The primary fresh air fan delivers 319 kcfm. Much of this air gets pulled to the return air raise from the three exhaust fans at the Minto East ventilation raise base. These fans pull 245 kcfm down through the main ramp, leaving 65 kcfm to exit the portal (providing fresh air throughout the mine). This setup was modeled before implementing the third exhaust fan and has been performing as modeled. There are two exhaust fans at the Copper Keel egress drift to pull 197 kcfm through the Copper Keel deposit. Please see the figure below:

Figure 7-1: Minto Mine - Current Ventilation



7.2 Ventilation Requirement for Equipment

The air volume required for the fleet currently in use is shown in the table below. Air volume requirements are calculated to ensure safe production. The amount of air required is largely determined by the number and size of diesel equipment operating underground. The air volume supplied must be able to dilute and remove dust and noxious gases, and diesel particulate matter generated by the use of such equipment. The table below shows permitted airflow for each type of equipment underground in cfm.

Table 7-1: Ventilation Requirements for Equipment Operating in the Minto South Underground.

Equipment type	Permitted airflow (cfm)
Cat 1700G LHD	21,300
Cat 1700K LHD	12,500
ST7 Copco LHD	19,000
Cat AD45 Haul Truck (New Models)	22,000
Cat AD45B Haul Truck	35,500
Epiroc MT42 Haul Truck	36,700
Sandvik Jumbo	9,200
MacLean Bolter	9,200
MineCat Utility Tractor	9,900
MineCat Mancarrier	6,000
Toyota Mancarrier	7,300
Kubota RTV-X1140W Mancarrier	1,800
Getman A64 Emulsion Loader	7,900

The amount of air available underground dictates what is achievable in development and production (and the utilization of underground equipment). The ventilation plans are developed to ensure the maximum amount of air required for operating equipment, and louvers are used in active areas to manage air in the working headings. The 2021/2022 additions/replacements of LHDs and trucks with lower-emission engines has improved overall airflow quality in the mine. The equipment will not be utilized UG if there is not adequate air available. This is monitored with weekly ventilation surveys and regular Workplace Inspections (WPIs) by supervisors and superintendents and by real time gas monitors being installed in key areas of the ramp and mine.

8 Ancillary Infrastructure

8.1 Compressed Air

Compressed air is supplied throughout the Minto South deposits using a reticulated 4” airline network.

Minto currently has three Atlas Copco GA-315 (1811 cfm at 125 psi, 350 hp) air compressors. One compressor operates steadily, a second automatically supplements the first during periods of high demand, and a third is kept on standby to provide redundancy. These compressors are located in the tailings filtration building adjacent to the mill. Air is piped underground via a borehole from the surface to the underground workings in Minto East. An air dryer is installed on surface in the line supplying the underground operation.

Mobile electric equipment such as jumbos and bolters is equipped with compressors. The central compressors are needed only for long-hole drilling, jackleg/stoper drilling, pneumatic dewatering pumps in development headings, and other minor uses.

8.2 Underground Electrical Power

Power enters the Minto South Underground at 4160V via the portal and is distributed with Teck cable, typically 350 MCM three-conductor. It is converted to the 600V working voltage of mobile equipment, pumps, and fans by one of four air-cooled skid-mounted substation units. Minto currently has two 750 kVA units and two 1000 kVA units.

A second power line was lowered down the return air raise at Minto East in 2021. Once tied in this second line, it will provide additional power to the lower substations and reduce voltage drop at the bottom of the mine.

8.3 Water Supply

Water is supplied throughout the mine with a reticulated 4” water line network. This water is pulled from the discharge system at the top of the main ramp before it exits the mine at the south portal.

8.4 Dewatering

Water will generally drain from the stopes to main sumps in each active mining area. These sumps are then piped to the pumping station installed in Minto East.

The pumping station consists of a three-stage settling sump system and redundant high-pressure 125 hp pumps, which transfer water directly to the surface via a pipeline installed in a borehole. From the surface breakthrough location, a short section of insulated and heat-traced pipe transfers water to the adjacent Main Pit Tailings Management Facility (MPTMF), which receives the underground water stream. In addition to the Minto East Pump Station, excess water is pumped through a chain of sumps up the main ramp to the surface via UG1.

8.5 Communications

The mine-wide VHF leaky feeder radio system will be extended to future mine workings. This provides three channels: one for ramp traffic, one spare, and one emergency channel. The latter is repeated on the surface, providing a unified site-wide emergency channel.

Refuge stations are equipped with radios, telephones connected to the mine’s internal communications network via a fiber-optic network, and an analog emergency communication system (Femco phone).

Femco phones are installed inside and outside the refuge stations, the base of the fresh air raise at 760 level, the surface muster station adjacent to the portal, and the underground shop on the surface.

8.6 Blasting Procedure and Infrastructure

The mine’s electric central blasting system will be extended into all mining areas. This system typically fires a single electric blasting cap, which is used to initiate the network of non-electric caps that time and fire each hole in a development blast.

Stope blasts are timed and initiated by electronic detonators, namely, Dyno Nobel Digishot Plus. These are programmed and initiated via the same blast line network.

The mine is completely cleared of personnel for both production and development blasting. Every person entering the mine places a lock on a tagboard. The key for the blast box is locked behind the board and can only be accessed when all personnel has removed their locks.

8.7 Explosive Storage and Handling

Emulsion is used for both long-hole production and development. A bulk emulsion product known as Dyno Titan 7000, formulated for underground use, and having high viscosity, is used to load blasts. This product is delivered via one of two dedicated mobile loading units – one for development rounds and a larger unit for long-hole stope blasts.

In development, a perimeter blasting product (Dynosplit D) is used where required to reduce overbreak in the back, and Dyno AP (a cartridge emulsion) is used in wet lifter holes.

The following table lists the magazines on site:

Table 8-1: Explosives Magazines.

License No.	Location	Capacity
YT-535	Surface	40,000 dets
YT-533	Surface	60,000 kg
YT-541	Surface	75,000 dets
YT-534	Surface	10,000 kg
YT-542	Surface	30,000 kg
YT-551	Surface	35,000 kg
YT-553	Underground	4,000 dets
YT-550	Underground	30,000 kg

The Minto South Underground has two magazines, one for detonators and one for bulk and packaged explosives. Both are equipped with concrete floors and lockable gates. The powder magazine is large enough to store and handle 1.5 tonne totes of emulsion used by the development loader. In 2021, the underground bulk explosive mag, YT-550, was split into two locked storage areas to separate the packaged explosive from the emulsion totes. The larger longhole loading unit is parked on the surface at Dyno Nobel’s office/shop/silo complex.

9 Mine safety

9.1 General Mine Safety

Minto Mine and its contractors emphasize safety in all duties at the mine; this philosophy is shared by senior management and supervisors. Minto's safety program includes the following:

- *Zero Harm Safety System* and associated safety card, used and checked daily by supervisors.
- A central system for tracking incident reports and the corrective actions arising from them.
- Safe work procedures (SWPs) for routine tasks that present a risk of injury.
- Job hazard assessments (JHAs) for non-routine tasks; these are used as the basis for SWPs if a job becomes routine.
- Routine job observations and workplace inspections by supervision and technical personnel.

9.2 Emergency Response

Two portable refuge stations are currently maintained in underground workings. They are positioned to provide refuge for the Copper Keel and Minto East zones. In 2022, a permanent refuge station will be constructed in the current Copper Keel refuge location to allow the portable station to be relocated deeper into the mine. Once development is complete, an additional refuge station will be added to both the Area 2 and Minto East expansion areas.

Refuge stations are equipped with compressed oxygen cylinders, CO_2 scrubbers, potable water, first aid equipment, emergency lighting, emergency food rations, and chemical toilets. With Minto's air compressors moved to the surface, they have also been connected to the compressed air system; this provides a second source of breathable air.

Refuge stations are equipped with a digital telephone line, a backup analog telephone (Femco), and mobile radios to communicate with the mine's leaky feeder system. Each refuge station is equipped to supply oxygen to 16 people for 96 hours, independent of the compressed air now also available.

The mine currently has four escape ways:

1. The fresh air raise from the surface to 760 level is equipped with ladders.
2. A sub-level escapeway with ladders connects the Area 2 ramp at the 685 m elevation to the 710 level, which receives fresh air directly from the surface via open stopes that connect to the 760 level.
3. An escapeway from the lowest point in the mine at Minto East directly to the surface 300 m above.
4. A sub-level escapeway with ladders in Copper Keel, which connects the 56 level to the 62 level. This escape way is also the main ventilation intake for the 62 level.

All underground personnel are required to carry Ocenco M-20 self-contained self-rescuer (SCSR) devices, which provide oxygen from a compressed gas cylinder for 15 to 20 minutes (up to 32 minutes if the user is resting). In addition to the personal devices, 22 devices with longer performance durations of 60 minutes are available, split in two caches located near active mining faces. These caches also contain first aid supplies, an oxygen therapy unit, water, food, flashlights, and blankets.

A mine-wide stench gas warning system is installed at the surface fan to alert underground workers in the event of an emergency. This system can be triggered from the mill control room.

Minto has an emergency response team trained in underground mine rescue techniques. Details are contained in Minto's Emergency Response Plan.

9.3 Fire Suppression

Fire extinguishers are provided and maintained in accordance with regulations and best practices at electrical installations, pump stations, wash bays, and refuge stations. Every vehicle carries at least one fire extinguisher of adequate size and proper type. Heavy equipment is equipped with central fire suppression systems.

For the use of the mine's emergency response team, a trailer containing a foam sprayer, hoses, an inflatable bulkhead, and other firefighting supplies is parked near the 760 fresh air raise.

9.4 Hours of Work

Minto holds an underground hours-of-work variance issued on April 24, 2018, permitting the following:

- A maximum of 11 hours of work underground for any worker during any 24 hours period if working in enclosed cabs with a HEPA-filtration system.
- A maximum of 10 hours of work underground for all other workers during any 24-hour period.
- A shift schedule of up to 12 hours/day, seven days/week for up to 4 weeks on and 2 weeks off.

9.5 Industrial Hygiene and Fatigue Management Programs

An industrial hygiene (IH) consultant, EHS Partnerships Ltd., was engaged to assist Minto in the development of an underground IH plan and a fatigue risk management program (acceptable to YWCHSB) for, but not limited to, air quality, noise, and fatigue. Regular testing has taken place since underground operations commenced, and results of this program were included in the hours of work variance.

9.6 First Line Supervisory Training

The Company will comply with the Yukon Occupational Health and Safety (OH&S) regulation by maintaining First Line Supervisor's Certificates for all supervisors.

9.7 Diesel Equipment

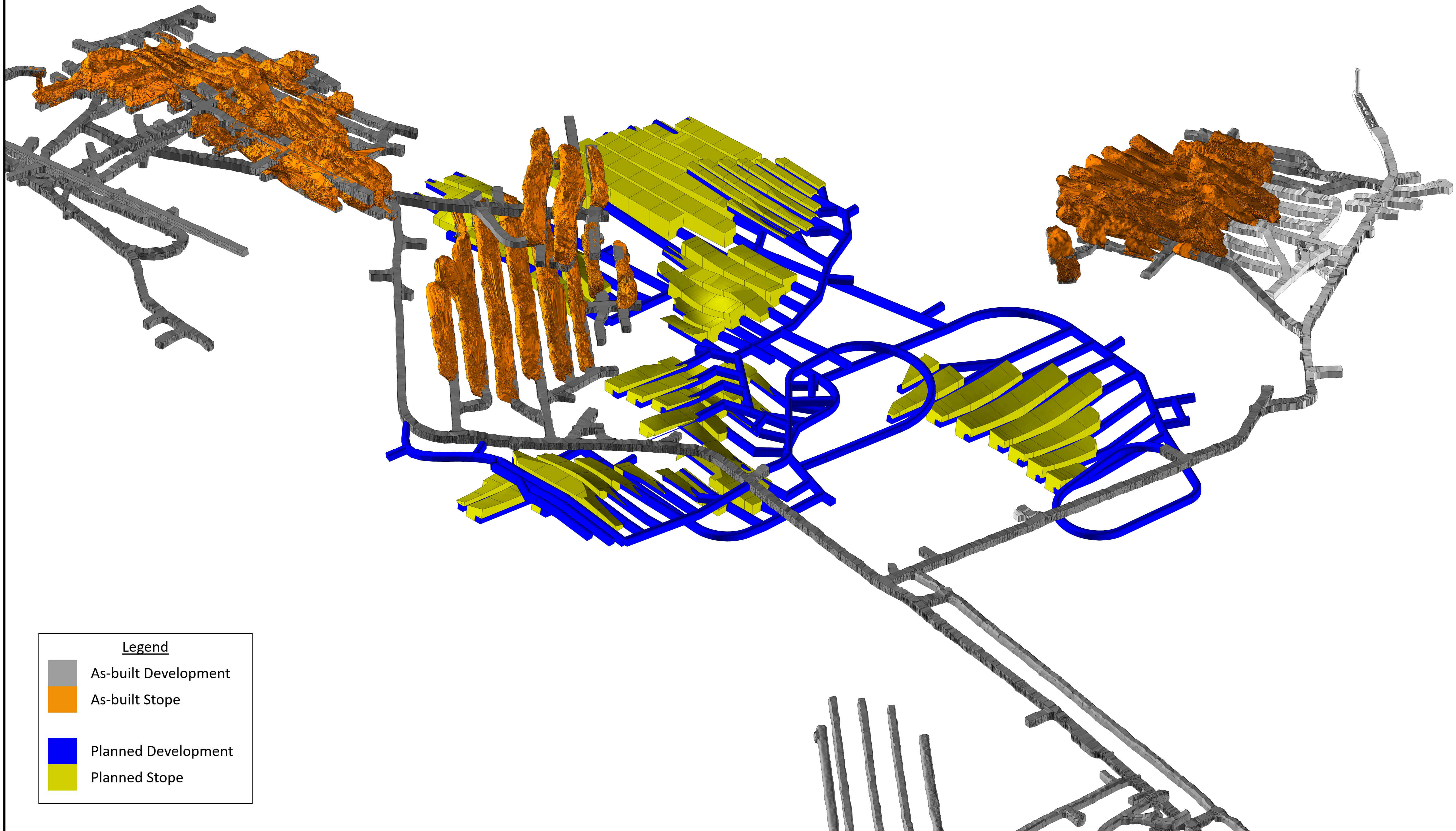
All diesel equipment used in the underground operation is permitted and maintained to comply with sections 15.58, 15.59, 15.61, and all related sections of the *Yukon Occupational Health and Safety Regulation*. There is an underground fueling station located on the Minto East Ramp.

9.8 Shotcrete

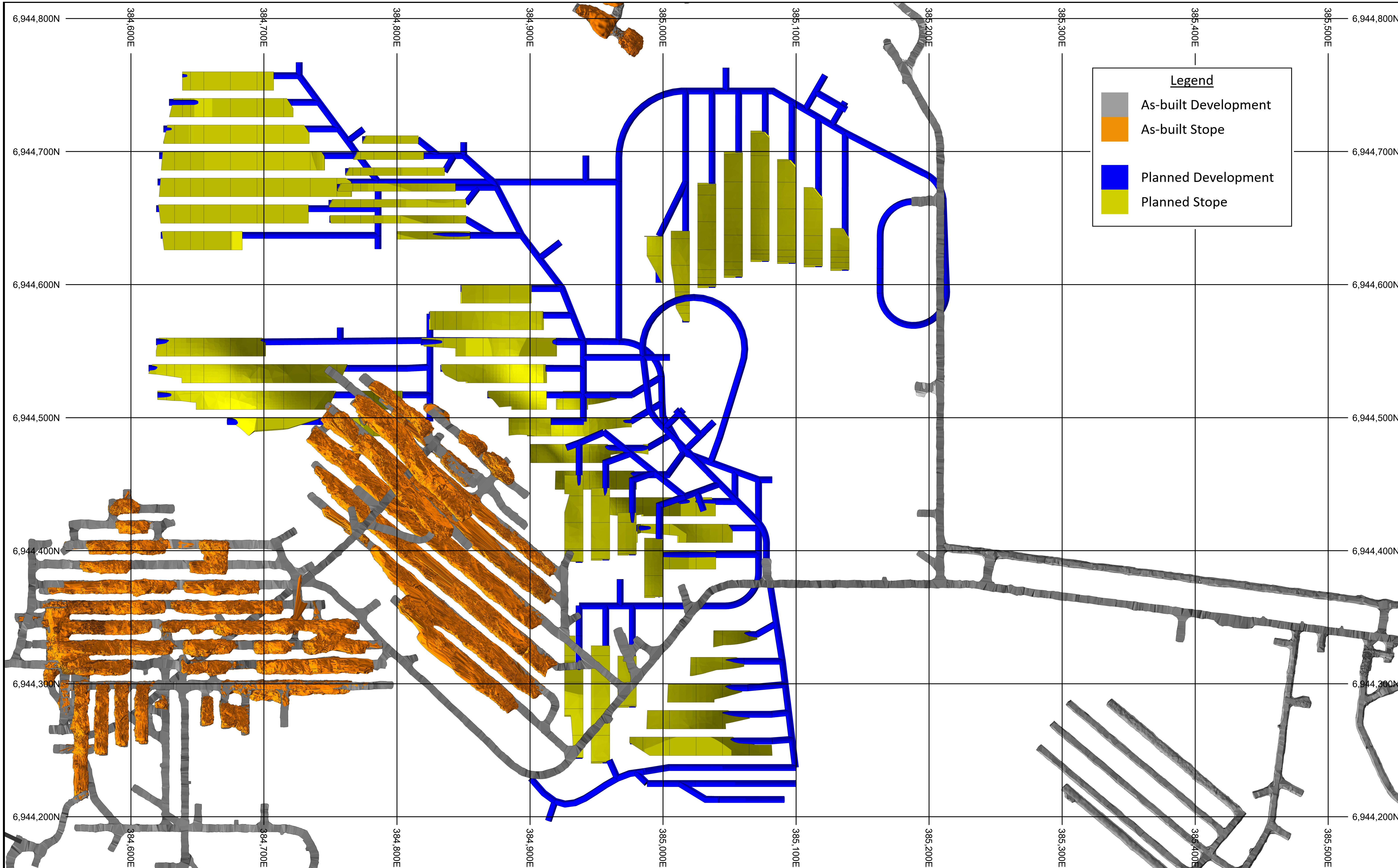
Shotcrete is not routinely used at Minto but is used on occasion for extra ground support when determined necessary by the rock mechanic. When required, it is sprayed wet using a unit mounted to a MineCat MC100F utility vehicle. A Marcotte M40 trans-mixer unit is used to mix shotcrete and transport it to the working face.

Appendix A

Area2 ISO View and Plan View



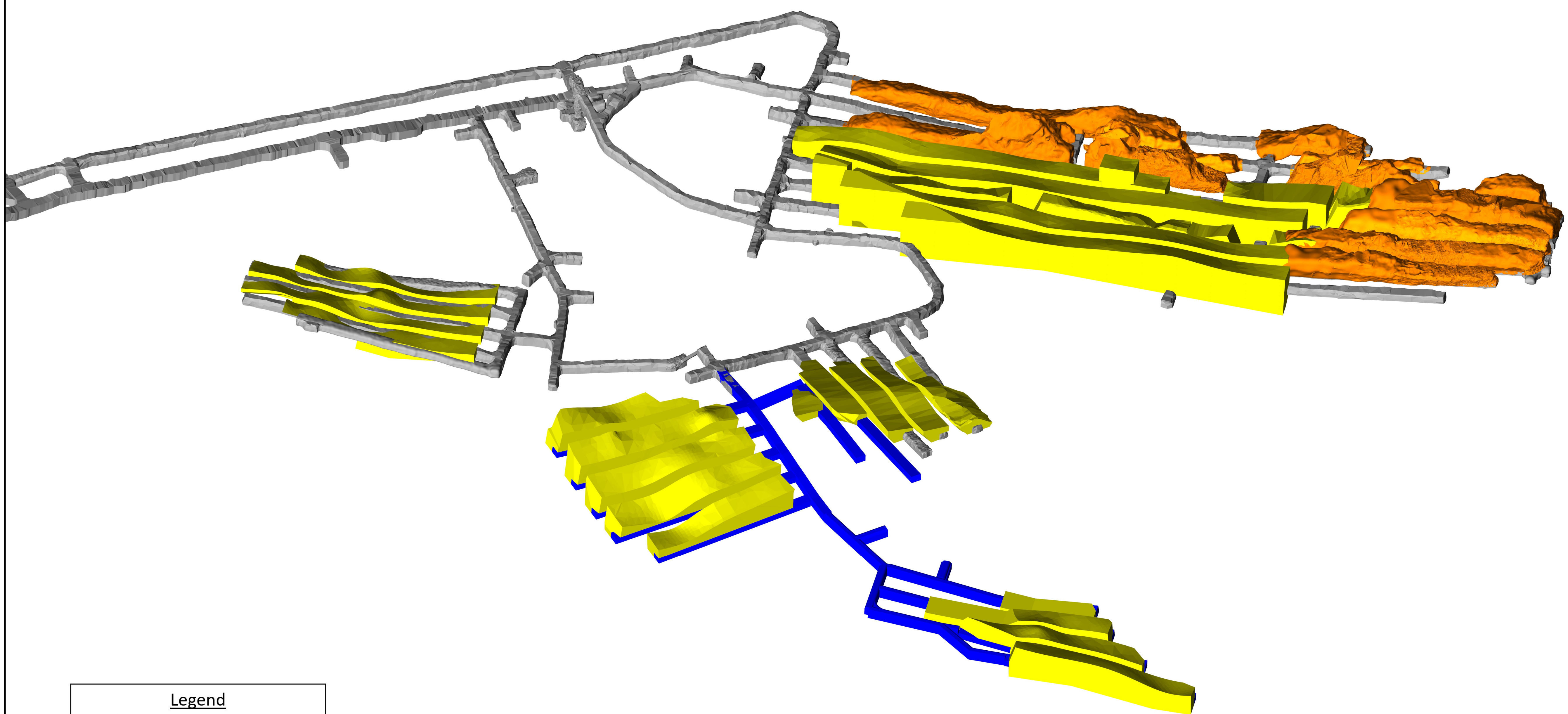
MINTO	LOOK NW ISO	DRAWN BY: J.Palkovits	DATE: 11/20/2021	REV: 0	JPP	A2 DETAILED DESIGNS	SCALE: 1:2500 DESWIK.FM\ dfm\ Longterm Planning\ Conceptual\ ENG_LOM_UG.dcf



MINTO	PLAN	DRAWN BY: J.Palkovits	DATE: 11/20/2021	REV: 0	JPP	A2 DETAILED DESIGNS	SCALE: 1:2500 DESWIK.FM\ dfm\ Longterm Planning\ Conceptual\ ENG_LOM_UG.dcf

Appendix B

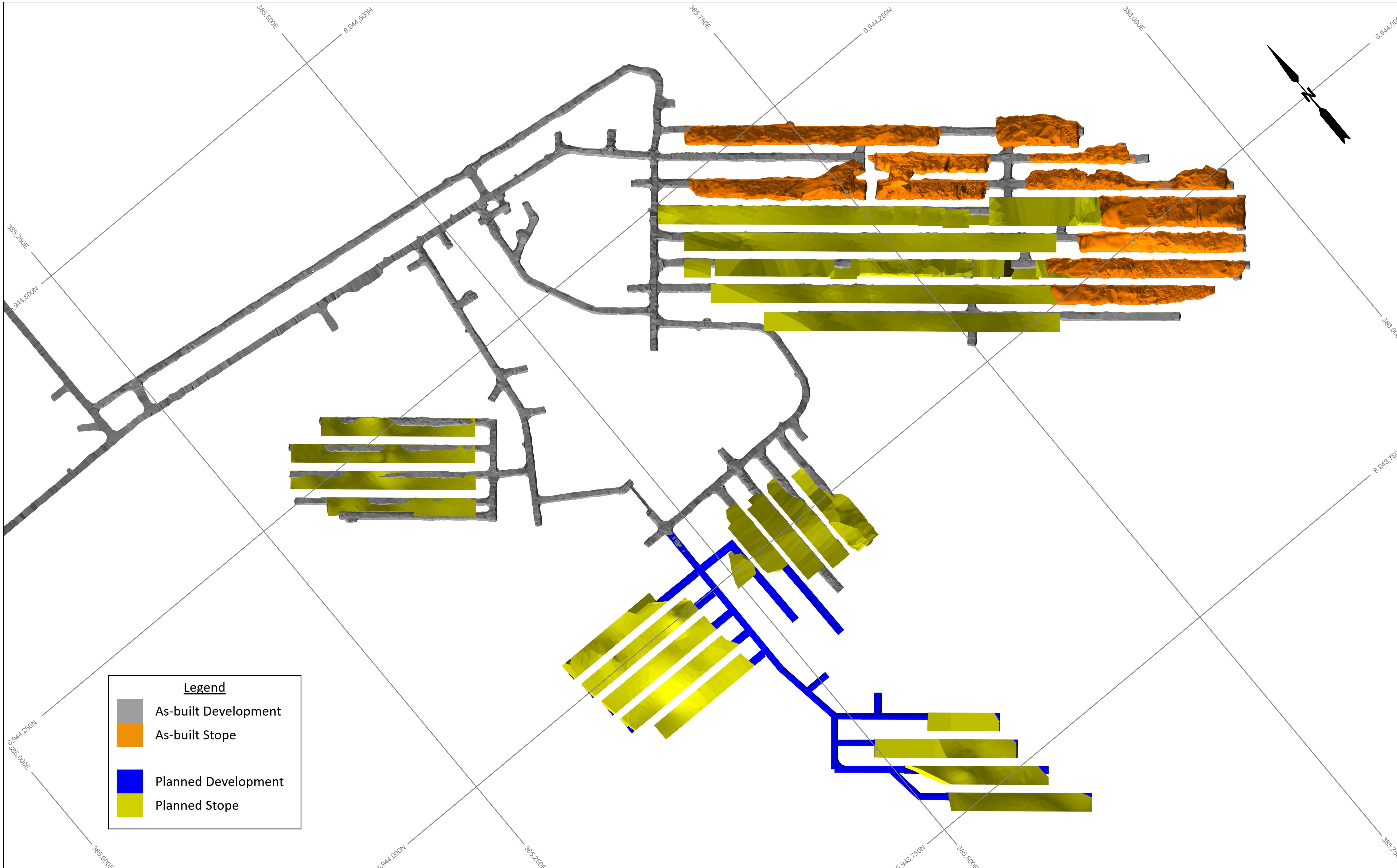
Copper Keel ISO View and Plan View



Legend

- As-built Development
- As-built Stope
- Planned Development
- Planned Stope

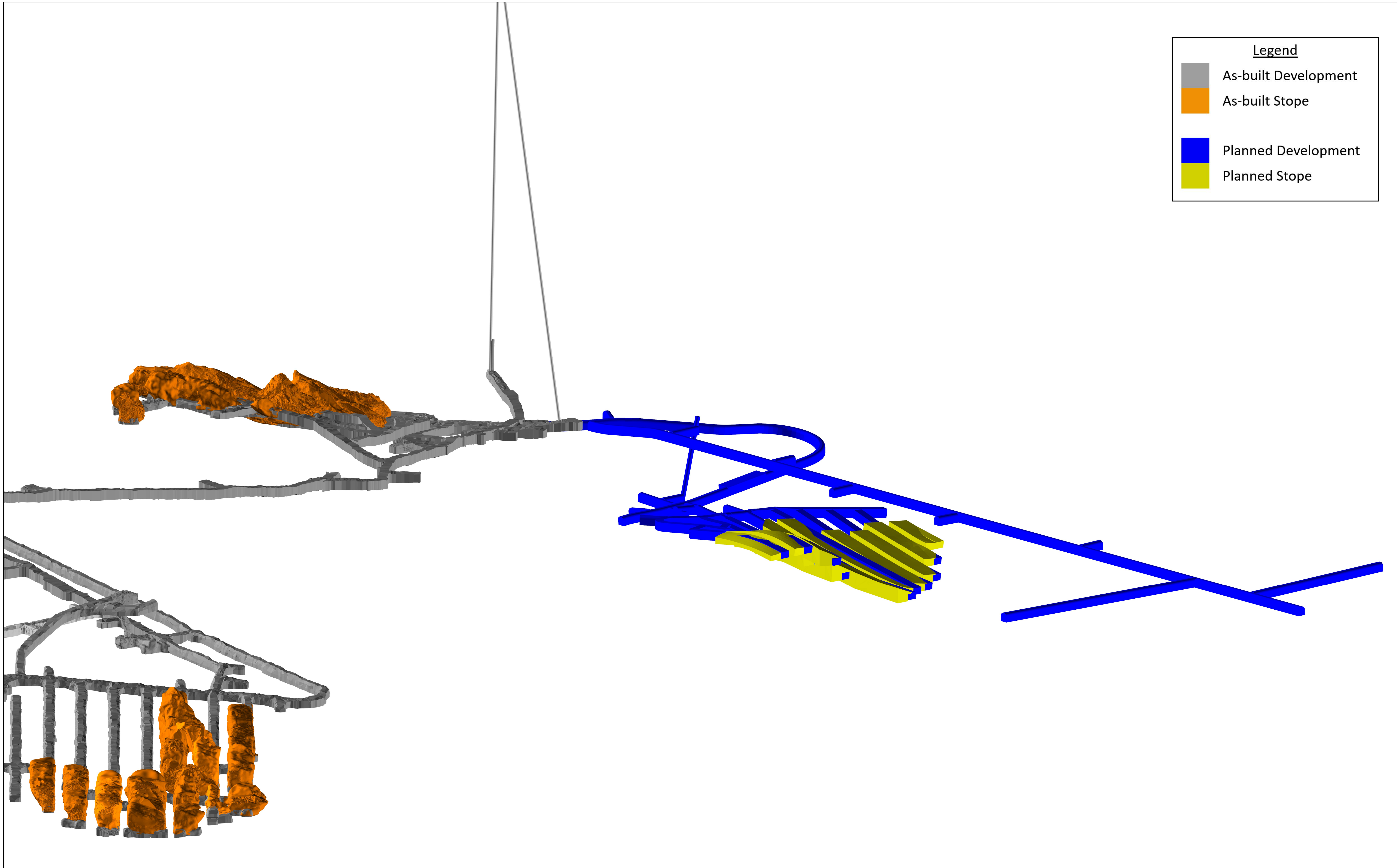
MINTO	COPPER KEEL CURRENT ISO	DRAWN BY: M.LAMBERT	DATE: 2/10/2022	REV: 0	ML	SCALE: 1:2500 DESWIK.FM\ dfm\ Longterm Planning\ Conceptual\ ENG_LOM_UG.dcf



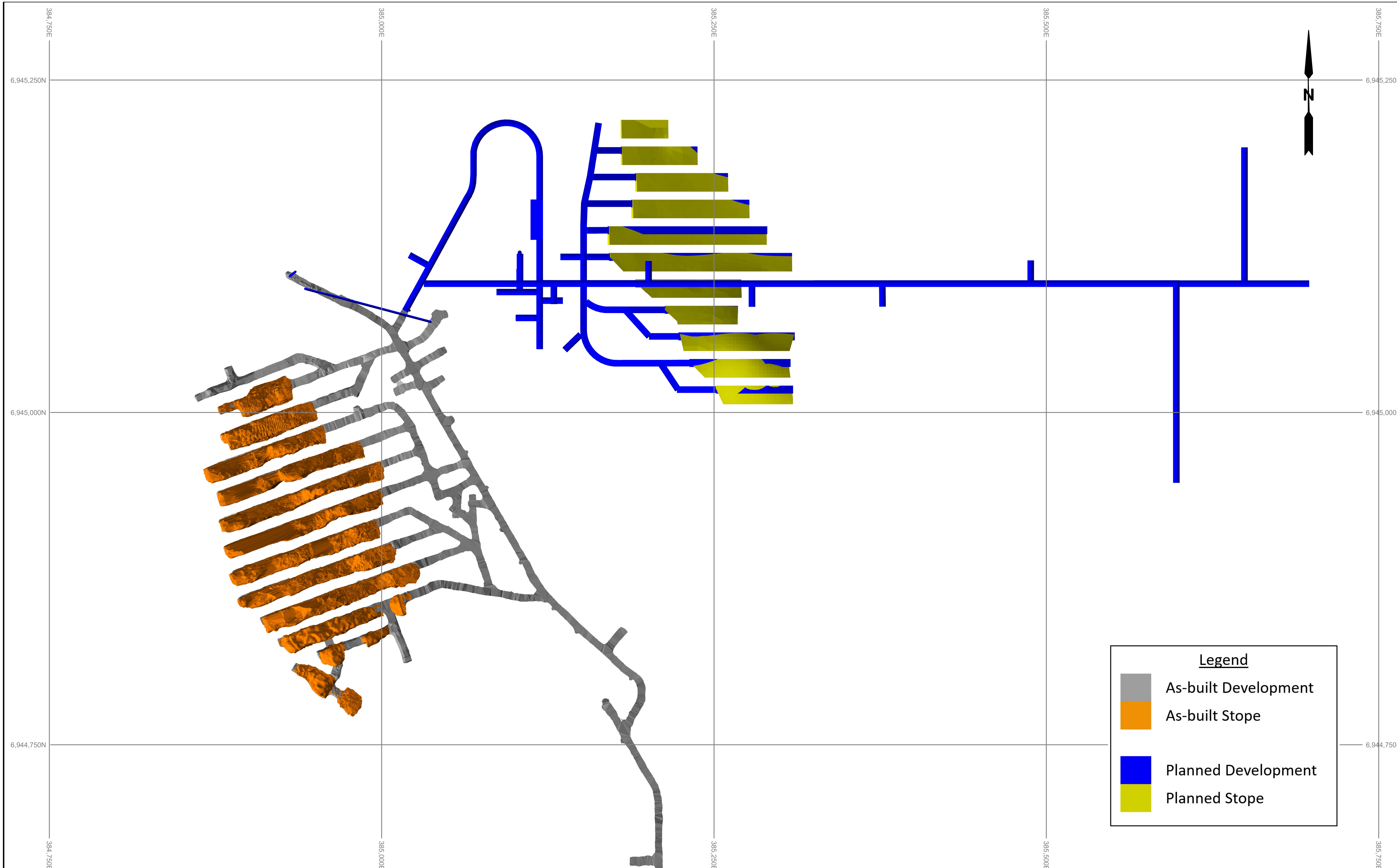
MINTO	COPEER KEEL CURRENT PLAN	DRAWN BY: M.LAMBERT	DATE: 2/10/2022	REV: 0	ML	SCALE: 1:2500 DESWIK.FM\ dfm\ Longterm Planning\ Conceptual\ ENG_LOM_UG.dcf

Appendix C

Minto East ISO View and Plan View



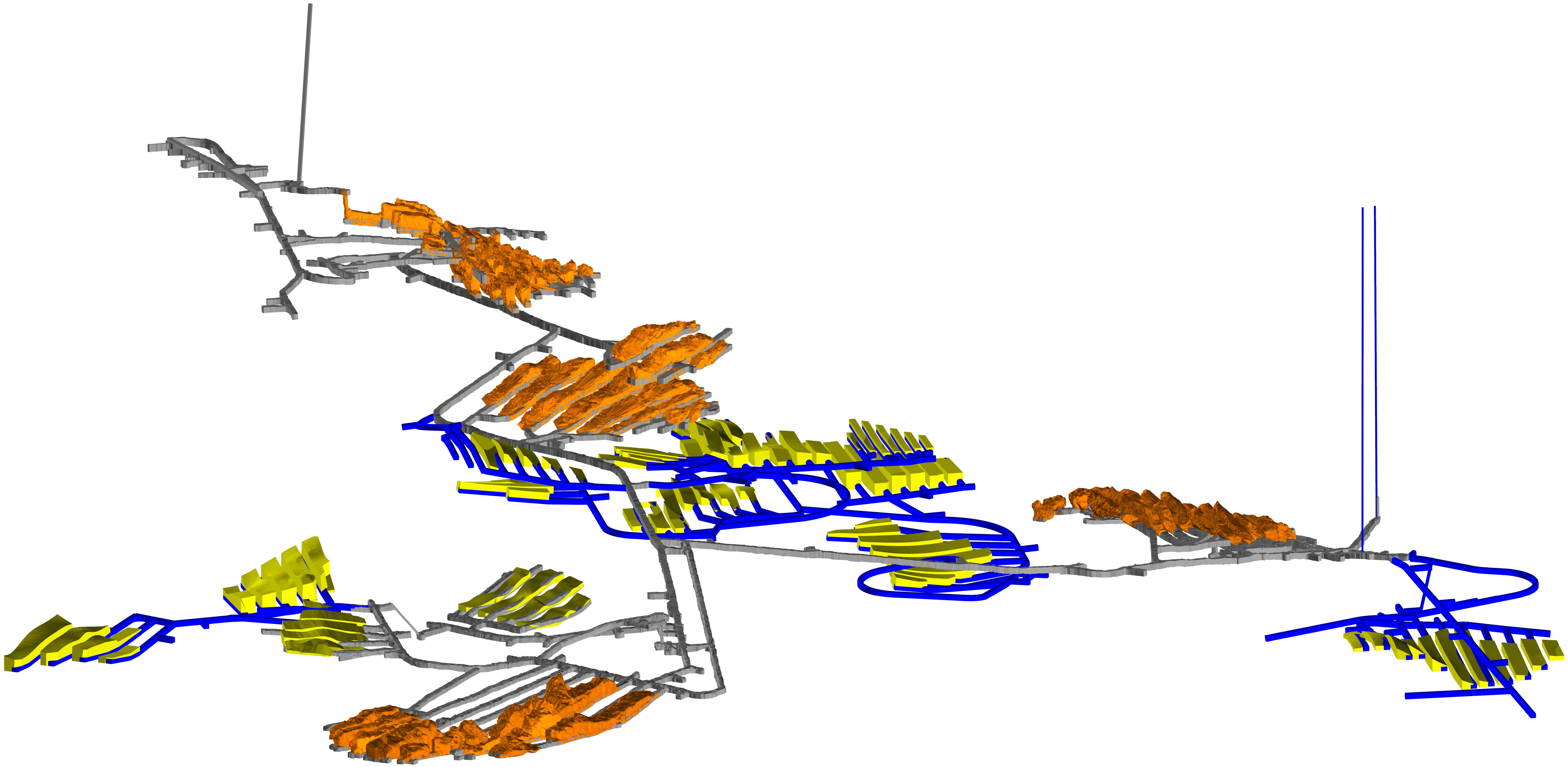
MINTO	MINTO EAST ISO	DRAWN BY: M.LAMBERT	DATE: 2/10/2022	REV: 0	ML	SCALE: 1:2000 DESWIK.FM\ dfm\ Longterm Planning\ Conceptual\ ENG_LOM_UG.dcf



MINTO | MINTO EAST PLAN | DRAWN BY: M.LAMBERT | DATE: 2/10/2022 | REV: 0 | ML | SCALE: 1:2500

DESWIK.FM\ dfm\ Longterm Planning\ Conceptual\ ENG_LOM_UG.dcf

Appendix D
Overall ISO View and Overall Plan View



Legend

- As-built Development
- As-built Stope
- Planned Development
- Planned Stope

MINTO	OVERALL VIEW ISO	DRAWN BY: M.LAMBERT	DATE: 2/10/2022	REV: 0	ML		SCALE: 1:4000 DESWIK.FM\ dfm\ Longterm Planning\ Conceptual\ ENG_LOM_UG.dcf

MINTO	OVERALL VIEW PLAN	DRAWN BY: M.LAMBERT	DATE: 2/10/2022	REV: 0	ML		SCALE: 1:6500 DESWIK.FM\ dfm\ Longterm Planning\ Conceptual\ ENG_LOM_UG.dcf