Factual Data Report. Hydrogeological Site Investigation, Touquoy In-Pit Tailings Disposal

Final Report

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Table of Contents

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

Executive Summary

Stantec Consulting Ltd. (Stantec) have completed a site investigation to collect additional data required to support the detailed design for planned in-pit tailings disposal at the Touquoy Mine site. The investigation is part of the overall hydrogeological characterization work with the objective of advancing the knowledge of the bedrock and overburden soils conditions around the open to and to better define the hydrogeological conditions of the site. Specifically, the investigation program was designed to investigate the presence of preferential pathways, such as fractures and faults not characterized in previous investigations/field assessments that was identified as a data gap in the earlier in-pit disposal groundwater modeling.

To identify the data gaps and define the site investigation requirements, a comprehensive review of available historical information was completed. Based on this review an investigation program consisting of borehole drilling, in-situ hydraulic conductivity testing, downhole geophysical surveys and monitor well installations was recommended. A total of 12 boreholes with drill depths ranged from approximately 40 meters to 120 meters was completed around the pit with each borehole targeting presence of preferential seepage pathways, such as fractures and faults. In addition, to help confirm and delineate the extent of historical underground workings in the southwest corner of the Open Pit, a ground penetration radar GPR) survey was completed.

The bedrock hydraulic conductivities obtained from the new 2021 investigations are generally within or below the historical ranges used for the previous modelling. In addition, a review of the 2021 data show there was no significant variation of hydraulic conductivity associated with fault zones identified in the pit area. This indicates that despite structural features logged within the tested intervals, those features appear to be hydraulically isolated and/or localized such that they are not increasing the overall hydraulic conductivity within the bedrock immediately surrounding boreholes. These results are consistent with regular observations of the faults exposed in the Open Pit which have identified some discrete seepage but generally total flow from these exposed faults is very low.

Based on the findings of the 2021 investigation, the structural geology (fault) model provided by Atlantic Gold appears representative of the actual site conditions. The 3D structural model completed by Stantec which incorporates the AMNS structural model and the results of the 2021 boreholes show that geological faults zones are within the areas as anticipated.

The knowledge of the underground workings at the site has been advanced based on the work described herein, review and integration of available historical records, the geological model prepared by AMNS, and documented observations of the pit wall during construction. GPR surveys have provided additional data related to underground workings outside of the pit shell. This information has been cross-validated and combined to develop a detailed understanding of the geological environment proximate to the Open Pit. All available location information related to the underground workings has been presented on Drawing No. 4 (Appendix B). Three-Dimensional views of the underground workings are shown on

Drawing No. 6. As shown on the drawings, the workings that intersect the pit wall are generally located in the western area of the pit.

Taken together, consideration of previous site investigations, the structural geology model, and site investigations undertaken in 2021/2022 the findings of this work:

- Validate the geological model developed by AMNS (July 2020, updated February 2022, Appendix E)
- Provide confidence in the understanding of the location and lateral extent of the underground workings
- Confirm that the data used in the original groundwater flow and solute transport model (Stantec 2021) submitted with EARD were conservative; with the new data demonstrating generally lower permeability.

1.0 INTRODUCTION

Stantec Consulting Ltd. (Stantec) was retained by Atlantic Mining NS Inc. (AMNS) to complete a site investigation to collect additional data required to support the detailed design for planned in-pit tailings disposal at the Touquoy mine site. The investigation is part of the overall hydrogeological characterization work with the objective of advancing the knowledge of the bedrock and overburden soils conditions around the Open Pit to and to better define the hydrogeological conditions of the site.

Specifically, the program was designed to investigate the presence of preferential pathways, such as fractures and faults not characterized in previous investigations/field assessments. This was identified as a data gap from previously completed modelling for in-pit disposal (Stantec 2021).

The scope of the investigation was preliminarily defined in memo tilted Touquoy In-Pit Disposal: Preliminary Scope of Work (Rev B), dated April 14, 2021 (Doc No. MEM-195-900.300-B-14APR21). The following sections outline the development of the investigation scope.

This report has been prepared specifically and solely for the project described above. This Factual Data Report provides the results of the 2021 investigations and other available relevant information related to the hydrogeological characterization of the site.

1.1 BACKGROUND

As part of the overall hydrogeological characterization work, a review of available information was completed to identify data gaps and assist in further defining the investigation requirements. The results of the review were submitted in a memo titled Touquoy In-Pit Tailings Disposal – Hydrogeological Characterization – Task 1A – Review of Available Information on June 22, 2021 (Doc No. MEM-198-900.5500-A-16JUNE21).

The review included available boreholes and in-situ testing, geological models and mapping, hydrogeological modelling, and mapping of the historical workings. One key document reviewed was the structural geology mapping completed by AMNS (Structural Modeling third update, July 2020). This mapping provided the location and orientation of faults in the Open Pit and formed the basis for this scope of work to investigate the presence of preferential seepage pathways, such as fractures and faults. The geological model of the Open Pit is discussed in detail in Section 4 of this document.

1.2 SCOPE OF WORK

The recommended scope summarized in the June 22, 2022, memorandum reference above consisted of the following:

1. Complete 12 boreholes around the perimeter of the Open Pit. The specifications and rationale of the proposed borehole locations around the Open Pit are summarized on Table 1-1 below. Boreholes were focused on fault areas defined by AMNS, especially along the western and south-western areas between Moose River and the Open Pit. For each of the boreholes the following was recommended:
   a. Complete in-situ packer testing in all boreholes to characterize the hydraulic conductivity profiles of the bedrock.
   b. Completed downhole geophysical logging in select boreholes to further understand the extent of fractures, water bearing zones, and collect structural geological data. Surveys included optical televiewer, acoustic televiewer, mechanical caliper, fluid temperature/resistivity, and heat pulse flow meter.
   c. Install Casagrande-type piezometers in each borehole to measure water levels and collect water quality samples to characterize groundwater levels and flow directions, recharge and discharge zones, and groundwater quality.
2. Conduct falling/rising head tests in seven existing monitoring wells in the southwestern portion of the pit (HT-1 to HT-8).
3. Install three drive-point piezometers in the sediments of the nearby surface water receivers that may be affected by dewatering and/or seepage. Conduct falling/rising head tests in the drive point piezometers to estimate the hydraulic conductivity of the sediments.
4. Excavate up to nine test pits along the alignment of the proposed spillway to confirm depth to bedrock and characterize the overburden.

Table 1-1 Touquoy In-Pit Disposal - Proposed Borehole and Rationale

BH ID	Depth (m)	Az (deg)	Inclination (deg)	Expected Fault Zone Interval	Rationale / Comments
BH21-01	60	170	-60	20 to 50 m interval	Characterize the hydraulic conductivity of fault E FX1 (South). Observed seasonal seepage fault (wet season) along the western pit wall
BH21-02	60	170	-60	10 to 40 m interval	Characterize the hydraulic conductivity of fault NS FX3. Observed seepage along the western pit wall
BH21-03	120	n/a	-90	30 to 80 m interval	Characterize the hydraulic conductivity of fault E FX2. Observed continuous seepage fault along the western pit wall E FX2 fault was not modelled by AMNS. The fault (main anticline axis) located south of NS FX3 fault.
BH21-04	60	40	-60	None	Characterize the hydraulic conductivity and bedrock geological conditions in the southwest corner with potentially fault that shifted up. Observed seepage along the southwest corner pit wall. Historical underground working

Table 1-1 Touquoy In-Pit Disposal - Proposed Borehole and Rationale

BH ID	Depth (m)	Az (deg)	Inclination (deg)	Expected Fault Zone Interval	Rationale / Comments
BH21-05	60	100	-60	20 to 50 m interval	Characterize the hydraulic conductivity of fault NE FX3. Observed seasonal seepage fault (wet season) along the southwestern pit wall
BH21-06	60	n/a	-90	20 to 50 m interval	Characterize the hydraulic conductivity of fault NE FX1. Observed continuous seepage fault along the eastern end pit wall
BH21-07	40	30	-60	10 to 30 m interval	Characterize the hydraulic conductivity of fault NW FX1 (East). Observed continuous seepage fault along the eastern end pit wall
BH21-08	40	270	-60	10 to 40 m interval	Characterize the hydraulic conductivity of fault NS FX5. Observed continuous seepage, but low discharge rate, from fault along the northwestern end pit wall.
BH21-09	120	45	-60	None	Characterize the hydraulic conductivity and bedrock geological conditions in the southwest corner with potentially fault that shifted up. Historical underground working
BH21-10	60	360	-60	20 to 50 m interval	Characterize the hydraulic conductivity of NE FX.
BH21-11	60	45	-60	10 to 30 m and 30 to 60 m intervals	Characterize the hydraulic conductivities of faults NW FX1 (East end) and NW FX1 (West end) trending northerly toward Moose River.
BH21-12	40	n/a	-90	5 to 25 m interval	Characterize the hydraulic conductivity of the fault E-FX4 between the Open Pit and the Moose River.

Due to scheduling and site logistics related to winter weather conditions the Casagrande-type piezometers, drive-point piezometers, and the test pits were not completed. It is understood that these items will be completed when the weather and related site conditions improve in spring 2022.

In addition, based on site reconnaissance observations and borehole drilling findings, a ground penetration survey (GPR) was completed to help verify the location of the historical underground workings in the area between the Open Pit and Moose River. Details of the GPR Survey are provided in Section 5.4.

2.0 SITE DESCRIPTION AND GEOLOGY

The Touquoy Gold Project is an Open Pit gold mine located approximately 60 kilometers (km) northeast of Halifax in the Moose River Gold Mines District in Halifax County, Nova Scotia, Canada as shown on Figure 2-1.

Site areas associated with major project components include the Mill Site Plant Management Areas (PLM), Open Pit Mine (OPM), Tailings Management Facility (TMF), Waste Rock Storage Area (WRSA), and ancillary facilities as shown on the General Site Plan (Drawing No.1, Appendix B). This investigation was limited to the Open Pit Mine area.

Surficial geology at the site generally consists of a thin layer of organics and surficial soils underlain by stony glacial till. There are also drumlins features located at the site comprised of glacial till with greater silty/clay content than the stony till. Glacial till is underlain by bedrock.

Bedrock in the area predominantly consists of Maguma Group sediments of Nova Scotia. These are defined as a series of greywacke and argillite sedimentary rocks underlying approximately half of the province of Nova Scotia. Two main lithological units occur at the Touquoy Project: argillite and greywacke. Varying degrees of interbedding occur within these two units. The rocks have undergone significant alteration by a series of northeast-trending, tightly folded anticlines, and synclines, and are further altered by several northwest trending faults.

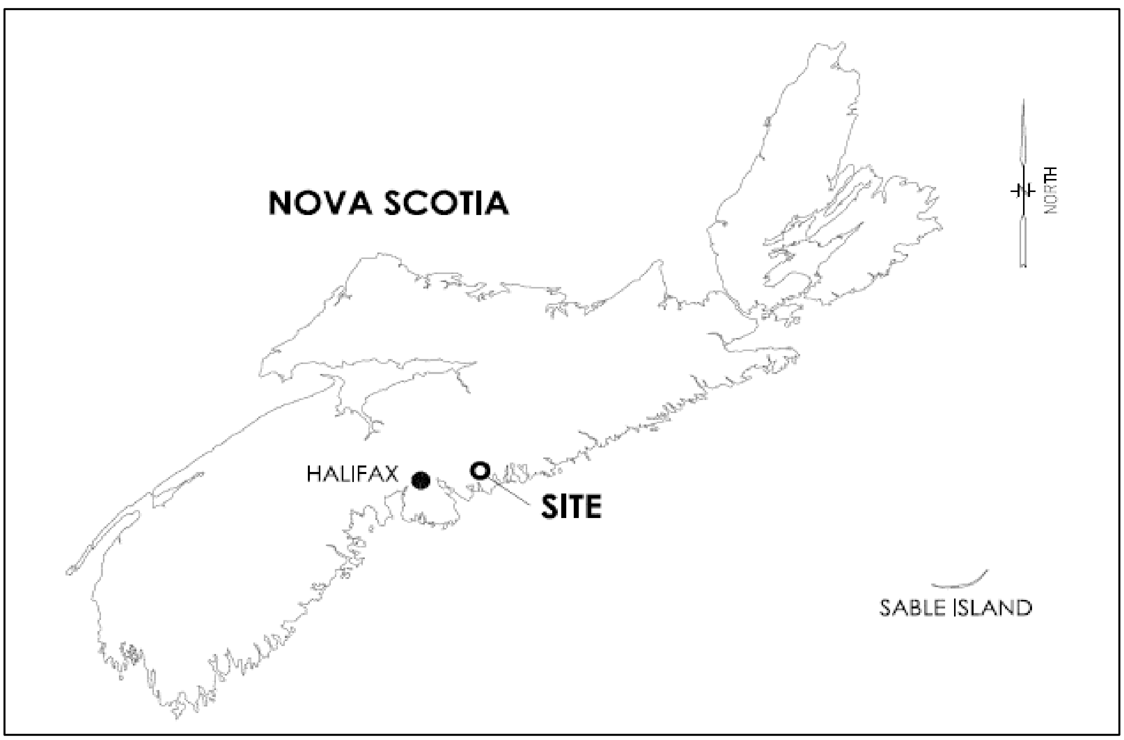

Figure 2-1 Site Location Plan

3.0 PREVIOUS SITE INVESTIGATIONS

Across the Touquoy Gold Mine site various borehole investigations and monitoring well installations have been completed since 2015. The corresponding bedrock conditions and associated hydraulic conductivity data that was collected during these investigations was used to complete hydrogeological analysis and interpretation of the hydrostratigraphy and boundary conditions for the 2021 groundwater modelling (Stantec Consulting Ltd., 2021). Further details of these investigations and associated data that was used for this assessment are provided below.

3.1 OPM WELLS

Monitoring wells titled OPM-1 A/B to OPM-7 A/B were installed between March and June 2016 by GHD Limited (GHD) (GHD Limited, 2016a/b). OPM monitoring wells are located around the perimeter of the Open Pit mine and are shown on Drawing No. 2 in Appendix B with the corresponding logs and historical hydraulic conductivity results in Appendix D1 and D3 respectively.

The OPM wells are nested consist of one shallow well (naming convention with suffix A) at 6.1 m depth and a deep well (naming convention with suffix B) at a depth of 15.3 m. The shallow well was installed to intercept the water table in the till/upper weathered and shallow fractured bedrock. The deep well was installed in more competent bedrock. Well No. OPM-1 B was limited to a depth of 13.2 m, as per condition 8(a)(iv) of the IA (GHD Limited, 2016a/b).

3.2 HT WELLS

Eight shallow groundwater wells noted as HT-1 to HT-8 were installed by Stantec in June 2018. The HT monitoring wells are located around the perimeter of the Open Pit mine and are shown on Drawing No. 2 in Appendix B with the corresponding logs and historical hydraulic conductivity results in Appendix D2 and D3 respectively.

Prior to the removal of historic tailings, these wells were installed to assess whether removal of these tailings and subsequent dewatering of the Open Pit mine would have an impact on groundwater quality (Stantec Consulting Ltd., 2018). The HT monitoring wells were installed at depths ranging from 5.72 m to 8.94m below ground surface.

3.3 OTHER DATA

In addition to the above noted OPM and HT wells, various other borehole investigations and monitoring well installations have been completed across the Touquoy Site including the Tailings Management Storage area. The corresponding bedrock hydraulic conductivity data that was collected during these investigations was used to complete hydrogeological analysis and interpretation of the hydrostratigraphy and boundary conditions for the 2021 groundwater modelling (Stantec Consulting Ltd., 2021). Approximately 125 hydraulic conductivity tests from these earlier investigations were used to define the model. The hydraulic conductivity results of the historical data across the Touquoy Gold Mine site are presented in Figure 6-3 in Section 6.3.3.

4.0 STRUCTURAL GEOLOGY (FAULT) MODEL

A structural geology fault model for the Open Pit was provided by AMNS in a document entitled "*Structural Modeling – 3rd Update"* dated July 2020. A copy of this report is provided in Appendix E.

The July 2020 model identified a total of 13 faults in the pit area. Faults were described as primary, secondary, and tertiary with the classification of each based on the ability to visually identify each in the field. Of the 13 faults identified there were four (4) in the primary class, six (6) in the secondary class, and three (3) in the tertiary class. In reference to the comments in Section 1.1, this structural model provided the location and orientation of faults in the Open Pit and formed the basis for this scope of work to investigate the presence of preferential pathways, such as fractures and faults. As noted in Section 1.2 each of the 12 boreholes was planned to intersect the geological faults or related features at depth and characterize the hydraulic conductivity of each.

After the completion of the borehole drilling and a review of the findings, AMNS geological team provided an update to the July 2020 structural model in February 2022. Details of the updated model was presented in a document entitled "*Structural Modeling – Update February 22, 2022*." A copy of this document is in Appendix E. The updated structural model identified a total of 22 faults with, five (5) in the primary class, eight (8) in the secondary class, and nine (9) in the tertiary class. While there was a total of 9 additional faults identified in the 2022 updated, there was only 1 additional fault in the primary class (E FX 4) which was a previously noted fault that was recategorized as primary. In addition, there were 2 additional faults in the secondary class, and 6 in the tertiary class.

A drawing showing the surface traces of the various faults within the open pit area is provided in Drawing No. 5, Appendix B. Further commentary on the geological model in relation to the 2021 investigation is provided in Section 6.4.

5.0 2021 SITE INVESTIGATION

5.1 BOREHOLE DRILLING

The drilling program commenced on September 25, 2021, and was completed on November 26, 2021. Logan Geotech Inc. (Logan) advanced twelve (12) boreholes through overburden and bedrock using NQ diameter diamond coring techniques until the target depth was reached. Borehole drilled depths ranged from approximately 40 meters to 120 meters. No sampling of the overburden soils was completed during the investigation. Bedrock samples were recovered using a standard core tube assembly. Bedrock core was logged in the field by Stantec for solid core recovery, rock quality designation (RQD), and occurrence of fractures and/or joints. Photographs of the core were taken in the field as well as following the field program, when required.

Except for boreholes BH21-03 and BH21-09, all boreholes were advanced in the locations originally planned. Boreholes BH21-03 and BH21-09 locations were adjusted due to the surface expression of underground workings (identified subsidence) which presented a safety risk for the drilling operation. The two boreholes were shifted at the surface to minimize the risks and re-oriented (as required) to ensure that they intersected the target zones and the target depths.

The borehole locations and exploration depths are summarized in Table 5-1 and are shown on Drawing No. 2 in Appendix B. The results of the borehole drilling are documented in Section 6.1.

Table 5-1 2021 Borehole Coordinates

Borehole ID	Easting	Northing	Ground Surface Elevation (m AMSL[1])	Azimuth (°)	Inclination (°)	Borehole Depth (m) (along axis)	Borehole Depth (m BGS[2]) (Vertical) [Elev. (m)]
BH21-01	504208	4981045	111.272	170	-60	61.0	52.83 [58.45]
BH21-02	504232	4980953	109.360	170	-60	61.6	53.34 [56.00]
BH21-03	504281	4980881	113.234	n/a[3]	-90	120.2	120.15 [-6.92]
BH21-04	504434	4980763	104.966	40	-60	60.4	52.30 [52.52]
BH21-05	504385	4980762	108.773	100	-60	61.4	53.20 [55.57]
BH21-06	504957	4981368	120.461	n/a[3]	-90	60.1	60.05 [60.41]
BH21-07	505058	4981041	118.930	30	-60	40.8	35.30 [83.60]
BH21-08	504410	4981294	118.030	270	-60	40.5	35.60 [82.43]
BH21-09	504313	4980811	112.001	45	-60	120.8	104.60 [7.39]
BH21-10	504565	4980750	110.311	360	-60	60.5	52.40 [57.43]
BH21-11	504783	4981455	119.072	45	-60	61.6	53.30 [65.91]
BH21-12	504224	4980999	110.133	n/a[3]	-90	41.1	41.06 [69.09]

Notes:
[1]- m AMSL = metres above mean sea level
[2]- m BGS = metres Below Ground Surface
[3]- n/a = not available/applicable

5.2 PACKER TESTING

A total of 76 hydraulic (packer) tests were carried out over selected intervals in BH21-01 to BH21-12 were advanced through the bedrock to collect data to compute hydraulic conductivity of the bedrock. A wireline inflatable single packer assembly lowered down through the drill string was used to isolate the test zones. Stantec defined the packer testing intervals based on review of the structural geology logging information as well as observations in the field and the field schedule. Generally, packer testing was completed as follows:

- Maximum test pressure was determined for the test interval. The test intervals were then calculated as 50%, 75%, 100% of the max test pressure and then stepped down back to 75% and 50% to test for hysteresis in the data.
- Water was slowly pumped through the drill rod at increasingly higher rates until measurable flow was recorded by the flow meter. Once the first test pressure had stabilized, the volume of water injected over a five-to-ten-minute interval was recorded.
- The test pressure was then increased by to the next pressure interval and the process was repeated.
- Details and observations for each test such as borehole number, borehole depth, length of test section, depth to groundwater level, test pressures, inflation pressures, and flow volumes were recorded.

The results of the packer testing and data analysis are documented in Section 6.3.

5.3 DOWNHOLE GEOPHYSICAL SURVEY

Terrane Geoscience Inc. (Terrane) completed downhole geophysical surveys of the 2021 boreholes except for BH21-06, BH21-07, and BH21-08.

The purpose of the survey was to further understand the extent of fractures, water bearing zones, and collect structural geological data. Downhole surveys included optical televiewer, acoustic televiewer, mechanical caliper, fluid temperature/resistivity, and heat pulse flow meter.

The geophysical survey was conducted between December 20th through 23rd, 2021. Terrane demobilized for the holiday season and returned to site to complete the field work January 7th, 9th, 10th, 20th - 25th, 2022. A total of twelve days were spent on site.

A summary memo titled Downhole Geophysical Investigation Results, Mooseland, Nova Scotia, dated February 11, 2022, along with the composite borehole log file in WellCAD™ with the raw optical and acoustic imagery completed by Terrane can be found in Appendix C5. Additional electronic data from the survey is on file with Stantec for future review and refence.

The results of the downhole survey regarding the subsurface conditions are also referenced in Section 6.1.

5.4 GROUND-PENETRATING RADAR SURVEY

Based on site reconnaissance observations and borehole drilling findings, a GPR Survey was completed to help verify the location of the historical underground workings in the area between the Open Pit and Moose River. The survey was conducted by d-Analytics between January 18th and January 26th, 2022.

d-Analytics report titled "*Touquoy Open-Pit Mine: Detection of Underground Mine Workings Using Ground-Penetrating Radar*" dated January 2022 is provided in Appendix C7. Drawing No. 3 and Drawing No. 6 located in Appendix B details the GPR survey lines and the various features identified from the survey.

5.5 SLUG TESTING

Slug testing to estimate the hydraulic conductivity was competed in the HT wells that were referenced in Section 3.2. Testing was limited to wells HT-4, HT-5, HT-6, HT-7, and HT-8. Testing in HT-1 was not conclusive since the water displacement with the slug was less than the minimum recommended value of 0.3 m. Testing was not completed in HT-2 and HT-3 because the wells were dry at the time of testing.

Testing was completed using the Bouwer-Rice (1976) test method. Data from the slug testing was incorporated into the hydrogeological model for the site. The results of the slug testing and data analysis are documented in Section 6.3.

6.0 SUMMARY OF RESULTS

6.1 SUBSURFACE CONDITIONS

This section provides a summary of the subsurface conditions encountered in the 12 boreholes completed during the 2021 investigation and other historical boreholes (OPM and HT wells) completed in proximity to the Open Pit. Due to the simplicity of the previous monitoring well logs, geological details beyond the overburden thickness of those logs are not discussed below.

The subsurface conditions observed in the 2021 boreholes are presented in detail on the Borehole Records provided in Appendix C2. An explanation of the symbols and terms used on the Borehole Records is provided in Appendix C1. Photographs of the bedrock core recovered for the 2021 boreholes are provided in Appendix C3. Monitoring well logs of the OPM and HT series monitoring wells are included in Appendix D1 and D2, respectively.

Overburden thickness in the area ranged from less than 1m to approximately 7m at BH21-07. Overburden at the site consists of glacial till described as a silty sand with gravel. Cobbles and boulders are found within the glacial till layers.

Bedrock encountered consisted of interbedded and laminated greywackes and argillites. During bedrock coring, the rock was described as very poor to excellent quality, fresh to highly weathered bedrock. RQD on recovered core samples was found to range from 0% (Poor) to 100% (Excellent). Details of the conditions encountered including core recovery, RQD, fracture index, orientation of the discontinuities, and the results of the hydraulic conductivity testing is provided on the Borehole Records in Appendix C2.

The rationale for selection of the 2021 borehole locations as noted Section 1.2 is provided in Table 6-1 below, with a summary of the findings.

Table 6-1 Touquoy In-Pit Disposal - Borehole Rationale and Findings

BH ID	Rationale / Comments	Findings
BH21-01	Characterize the hydraulic conductivity fault E FX1 (South). Target depth between 20 and 50m.	Intersected E FX1 fault at a drilled depth from 33.0 to 33.7 m.
BH21-02	Characterize the hydraulic conductivity of fault NS FX3. Target depth between 10 and 40m.	Intersected NS FX3 fault at a drilled depth from 16.8 to 21.4 m.
BH21-03	Characterize the hydraulic conductivity of fault E FX2. Target depth between 30 and 80m	Intersected underground workings (Void) from 6.4 to 7.1 m depth. Fault zone not encountered. The borehole location was revised based on field conditions by approximately 30 m to the north that likely resulted in missing the proposed target. A review of the February 2022 3D structural model and borehole trend shows the borehole did not cross the fault zone.
BH21-04	Characterize the hydraulic conductivity and bedrock geological conditions in the southwest corner with potentially fault that shifted up.	Zone of blocky/broken core intersected from 35.3 to 38.3 m depth that is within an area of underground workings.
BH21-05	Characterize the hydraulic conductivity of fault NE FX3. Target depth between 20 and 50m	Intersected NE FX3 & NE FX5 fault at a drilled depth from 10.1 to 11.0 m depth.
BH21-06	Characterize the hydraulic conductivity of fault NE FX1. Target depth between 20 and 50m.	Intersected NE FX1 fault a drilled depth from 36.1 m to 36.4 m. A televiewer survey was not completed in this borehole.
BH21-07	Characterize the hydraulic conductivity of fault NW FX1. Target depth between 20 and 50m.	Intersected a 0.05 m (50 mm) thick clay seam at a depth of 13.8 m. Broken and lost core in vicinity of approximately 10 to 18 m. Possible fault/shear zone a drilled depth from 35.2 m to 35.8 with a clay seam noted at 35.8 m These two faults are interpreted to be NW FX1 fault. The NW FX1 fault in the east fault complex which shows a range zone depicted as two surfaces in the model. A televiewer survey was not completed in this borehole.
BH21-08	Characterize the hydraulic conductivity of fault NS FX5. Target depth between 10 and 40m.	Intersected NS FX5 fault at a drilled depth from 28.1 m to 28.3 m and 30.1 m to 30.3 m. A televiewer survey was not completed in this borehole.

Table 6-1 Touquoy In-Pit Disposal - Borehole Rationale and Findings

BH ID	Rationale / Comments	Findings
BH21-09	Characterize the hydraulic conductivity and bedrock geological conditions in the southwest corner with potentially fault that shifted up. Historical underground working	Intersected E FX6 fault at a drilled depth from 9.0 to 13.0 m. An abundance of quartz veining observed in borehole. Zones of blocky/broken core in area of mapped underground workings from: • 36.0 to 37.4 m • 39.6 to 44.4 m • 53.9 to 54.6 m
BH21-10	Characterize the hydraulic conductivity of fault NE FX2. Target depth between 20 and 50m.	Possible fault/shear zone from 18.9 to 19.2 m in drill core. Fault is likely NE FX2
BH21-11	Characterize the hydraulic conductivities of the fault NW FX1. Target depth between 10 to 30m and 30 to 60m.	Intersected a 0.05 m (50 mm) thick clay seam at a depth of 13.2 m. Possibly NW FX1 fault Based on 3D Structural Model the NW FX1fault zone was intersected at about 40 m depth. However, there was no significant deformation or shearing noted in the recovered bedrock core or optical and acoustic the televiewer survey at the 40 m depth. This is like related to the fact that the NW FX1 fault is a “fault zone range” as opposed to a single plane(s) as depicted by two surfaces in the 3d CAD model. Therefore, the intersection at 13.2 m depth may be the actual location of the NW FX1 fault at this location.
BH21-12	Characterize the hydraulic conductivity of the fault E-FX4. Target depth between 5 and 25m.	Fault zone not encountered. A review of the February 2022 3D structural model and borehole trend shows the borehole did not cross the fault zone. It appears the alignment of the fault was modified in the February 2022 structural model as compared to the July 2020 model. The 3D model shows the fault is northwest of the borehole by approximately 50 m.

6.2 GROUNDWATER

Groundwater levels were measured in each BH21 boreholes, and the HT monitoring wells on three occasions between December 2021 and January 2022. Table 6-2 summarizes the groundwater levels at the time of observations. Groundwater levels can be expected to fluctuate during periods of heavy precipitation associated with seasonal weather trends, or a particular event, site use, adjacent site use, and construction activity.

Table 6-2 Summary of Groundwater Levels

Borehole ID	Elevation (m AMSL[1])	Depth to Groundwater (m BGS[2])			Groundwater Elevation (m AMSL[1])		
		7-Dec-21	8-Dec-21	24-Jan-22	7-Dec-21	8-Dec-21	24-Jan-22
BH21-01	111.27	1.91	1.80	3.57	109.36	109.47	107.60
BH21-02	109.36	16.41	15.22	11.67	92.95	94.14	97.69
BH21-03	113.23	7.29	7.10	8.59	105.94	106.13	104.64

Table 6-2 Summary of Groundwater Levels

BH21-04	104.97	0.97	0.40	0.10	104.00	104.57	104.87
BH21-05	108.77	2.30	0.004	2.84	106.47	107.47	108.47
BH21-6	120.46	0.33	0.02	0.26	120.13	120.44	120.20
BH21-07	118.93	Backfilled			Backfilled		
BH21-08	118.03	0.68	0.86	1.38	117.35	117.17	116.65
BH21-09	112.00	19.40	19.29	19.57	92.60	92.71	92.43
BH21-10	110.31	Surface Area Flooded			Surface Area Flooded		
BH21-11	119.07	Surface Area Flooded			Surface Area Flooded		
BH21-12	110.13	0.97	1.05	1.86	109.16	109.08	108.27
Borehole ID	**Elevation (m AMSL[1])**	**Depth to Groundwater (m BGS[2])**			**Groundwater Elevation (m AMSL[1])**		
		8-Dec-21	**24-Jan-22**	**28-Jan-22**	**8-Dec-21**	**24-Jan-22**	**28-Jan-22**
HT-1	112.09	3.93	3.94	4.89	108.16	108.15	107.20
HT-2	113.09	4.51	n/a[3]	n/a[3]	108.58	n/a[3]	n/a[3]
HT-3	111.91	6.74	7.14	n/a[3]	105.17	104.77	n/a[3]
HT-4	112.23	4.13	4.56	4.73	108.10	107.67	107.50
HT-5	111.71	1.77	2.20	2.53	109.94	109.51	109.18
HT-6	117.1	1.15	2.36	2.48	115.95	114.74	114.62
HT-7	117.82	1.07	1.61	1.77	116.75	116.21	116.05
HT-8	117.11	0.61	0.63	0.32	116.50	116.48	116.79

Notes:
[1]- m AMSL = metres above mean sea level
[2]- m BGS = metres Below Ground Surface
[3]- n/a = not available

6.3 BEDROCK HYDRAULIC CONDUCTIVITY

6.3.1 2021 Hydraulic Conductivity Testing

The results of the field hydraulic conductivity testing (packer and slug testing) for the 2021 investigation and the data referenced from the historical investigations are summarized in the following subsections.

6.3.1.1 2021 Borehole Packer Testing Results

The results of the packer tests were analyzed using the (Quinones-Rozo, 2010) solution with copies of the analysis forms presented in Appendix C4. In addition, a summary of the test results is provided in Table 6-3 and plotted in Figure 6-1. Estimates of hydraulic conductivity ranged from 1.5x10-9 m/s to 1.4x10-6 m/s.

It should be noted that there was no measurable flow into some tested borehole intervals at the pressure tested. Therefore, the upper bound hydraulic conductivity for the test interval was conservatively estimated using the lowest pressure step for the test intervals with no measurable flow into the borehole. Meaning the actual hydraulic conductivity of that bedrock within that test interval is lower than the estimated hydraulic conductivity for that interval based on this method.

In BH21-09 a Packer Test was not successfully completed a depth below ground surface from 40.37 to 48.17 m. In this interval the water pump in rates were >50 L/M and therefore pressure could not be achieved in test section. This test section is in an area of underground workings.

The data in Table 6-3 above is presented graphically in Figure 6-1. Figure 6-1 shows a decreasing trend of hydraulic conductivity with depth.

Table 6-3 Summary of Packer Test Results

Borehole ID	Packer Test Interval		Hydraulic Conductivity (m/s)	RQD (%)
	From (m BGS)	To (m BGS)		
BH21-01	4.11	11.91	1.4×10^{-6}	77
	11.93	19.73	2.9×10^{-8}	87
	19.73	27.52	4.7×10^{-8}	75
	27.50	35.29	5.0×10^{-9}	72
	35.32	43.11	4.1×10^{-9}	81
	43.11	52.83	2.5×10^{-8}	84
BH21-02	6.57	14.37	5.6×10^{-8}	45
	14.37	22.16	4.3×10^{-8}	52
	22.16	29.96	3.9×10^{-8}	66
	29.96	37.75	2.3×10^{-8}	72
	37.75	45.54	9.0×10^{-8}	68
	45.54	53.34	4.8×10^{-8}	55
BH21-03	17.06	26.06	1.1×10^{-7}	86
	26.06	35.06	4.6×10^{-8}	68
	35.06	44.06	2.0×10^{-8}	79
	44.06	53.06	2.7×10^{-9}	89
	53.06	62.06	7.6×10^{-9}	89
	62.06	71.06	4.7×10^{-9}	85
	71.06	80.06	5.0×10^{-9}	92
	80.06	89.06	1.5×10^{-9}	94
	89.06	98.06	4.6×10^{-9}	91
	98.06	107.06	1.5×10^{-9}	98
	107.06	120.15	2.8×10^{-9}	83

Table 6-3 Summary of Packer Test Results

Borehole ID	Packer Test Interval		Hydraulic Conductivity (m/s)	RQD (%)
	From (m BGS)	To (m BGS)		
BH21-04	5.33	12.82	4.1×10^{-8}	40
	13.12	20.26	4.3×10^{-9}	35
	20.91	28.06	6.1×10^{-9}	31
	26.98	35.85	4.0×10^{-9}	37
	34.77	43.65	3.2×10^{-9}	67
	44.30	52.31	2.8×10^{-9}	68
BH21-05	6.43	14.23	1.1×10^{-8}	58
	14.23	22.02	6.8×10^{-9}	50
	22.02	29.82	5.0×10^{-9}	59
	29.82	37.61	3.9×10^{-9}	67
	37.61	45.41	3.2×10^{-9}	73
	45.41	53.20	3.7×10^{-9}	88
BH21-06	8.8	17.05	1.1×10^{-8}	65
	17.8	26.05	5.7×10^{-8}	63
	26.08	35.05	4.5×10^{-9}	71
	35.8	44.05	6.9×10^{-8}	78
	44.8	53.05	9.4×10^{-9}	65
	53.8	60.05	3.2×10^{-9}	89
BH21-07	8.23	14.55	1.2×10^{-7}	7
	15.11	22.34	3.9×10^{-8}	32
	22.91	30.14	3.6×10^{-8}	23
	30.66	35.33	1.8×10^{-8}	67
BH21-08	3.9	11.69	8.7×10^{-8}	56
	12.34	19.49	8.7×10^{-9}	73
	20.14	27.28	2.1×10^{-8}	74
	27.28	35.07	7.3×10^{-9}	68

Table 6-3 Summary of Packer Test Results

Borehole ID	Packer Test Interval		Hydraulic Conductivity (m/s)	RQD (%)
	From (m BGS)	To (m BGS)		
BH21-09	9.20	16.99	1.4×10^{-7}	29
	16.99	24.79	9.7×10^{-9}	62
	24.79	32.58	4.4×10^{-8}	23
	32.58	40.37	6.1×10^{-9}	32
	40.37	48.17	**Note 1**	50
	48.17	55.96	3.3×10^{-7}	55
	55.96	63.76	2.3×10^{-9}	54
	63.76	71.55	6.0×10^{-9}	58
	71.55	79.35	3.5×10^{-9}	56
	79.35	87.14	8.1×10^{-9}	47
	87.14	94.93	2.7×10^{-9}	35
	94.93	104.62	1.0×10^{-8}	51
BH21-10	4.55	11.81	3.2×10^{-8}	48
	12.46	19.68	1.1×10^{-8}	78
	21.21	27.55	8.1×10^{-9}	76
	28.43	35.42	1.8×10^{-8}	81
	36.25	43.29	1.7×10^{-8}	64
	44.12	52.91	4.0×10^{-8}	69
BH21-11	7.19	14.33	8.5×10^{-8}	13
	14.98	22.13	4.0×10^{-8}	38
	22.78	29.92	1.9×10^{-8}	45
	30.57	37.72	4.4×10^{-9}	48
	38.36	48.11	5.0×10^{-9}	49
	46.16	53.30	3.0×10^{-9}	59
BH21-12	5.06	14.06	3.0×10^{-7}	71
	14.06	23.06	1.6×10^{-7}	72
	23.06	32.06	6.0×10^{-9}	53
	32.06	41.06	5.5×10^{-9}	62

Note 1: Could not complete Packer Test in BH21-09 from 40.37 to 48.17 (mbgs) as water pump in rates were >50 L/M and therefore pressure could not be achieved in test section. Test section in area of underground workings.

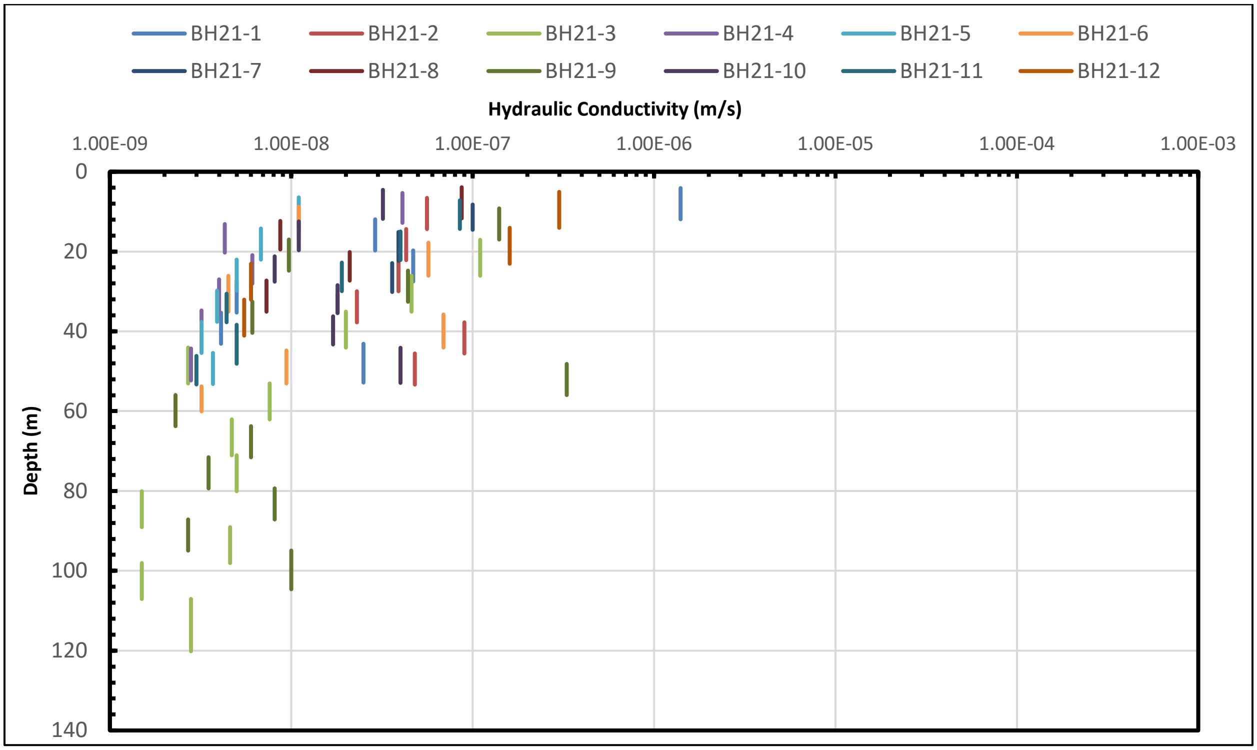

Figure 6-1 2021 Borehole Bedrock Hydraulic Conductivity Data

6.3.1.2 HT Wells Slug Testing

Slug tests were completed on six of the existing Historic Tailings monitoring wells (HT-1, and HT4-HT8), with the test intervals limited to the screened sections of the monitoring wells referenced. The slug test conducted in HT-1 did not achieve the proper displacement in accordance with the test procedure that has been attributed to a high permeability zone near the screened interval. In addition, tests were not conducted on HT-2 and HT-3 since the monitoring wells were dry.

Estimates of the hydraulic conductivity of the tested intervals ranges between 2.82x10-8 m/s to 9.20x10-7 m/s. Detailed results of completed slug tests and estimated hydraulic conductivities are provided in Appendix C6.

6.3.2 Hydraulic Conductivity - Open Pit Area

The hydraulic conductivity within the area of the Open Pit Mine as identified in Drawing No. 2 (Appendix B), including the 2021 packer tests and slug tests noted above, and the historical slug testing of the OPM monitoring wells identified in Section 3.1, are presented in Figure 6-2. Testing reports for the historical OPM wells can be found in Appendix D3.

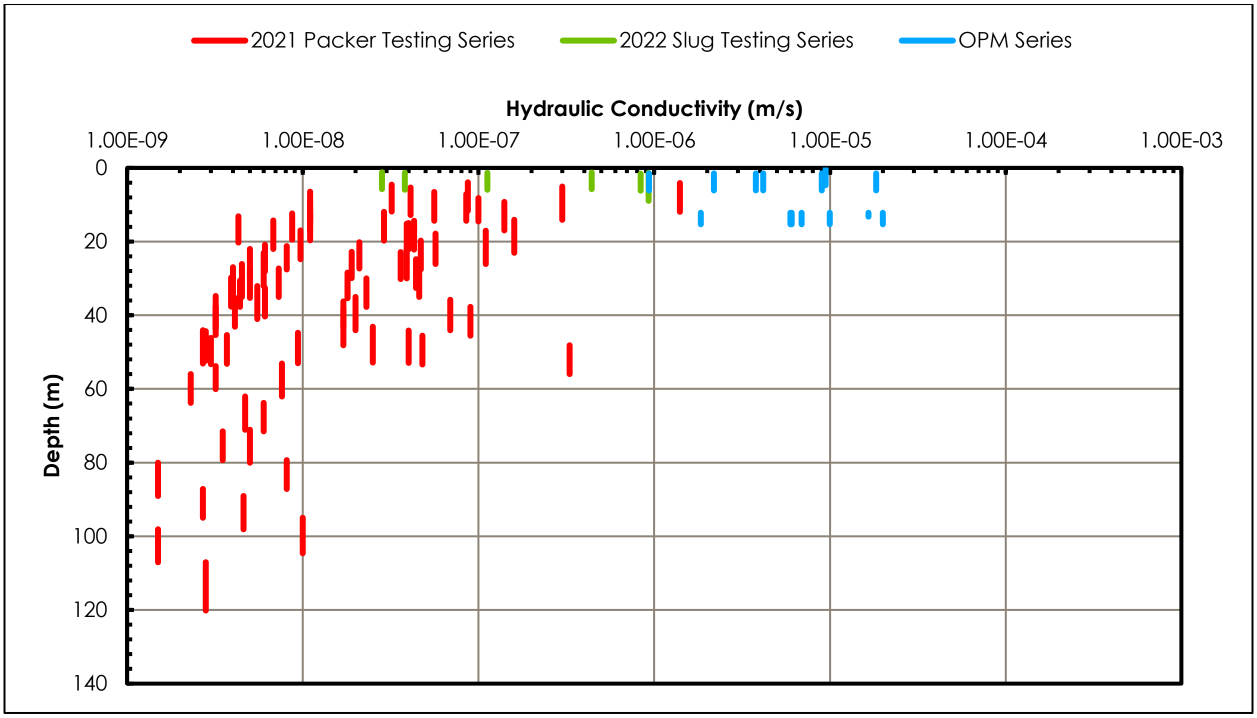

Figure 6-2 Hydraulic Conductivity of Bedrock - Open Pit Mine Area

6.3.3 Comparison of 2021 Hydraulic Conductivity with Historical Models

The results of the 2021 hydraulic conductivity testing and the results from previous investigations that were used for the earlier groundwater flow and solute transport modeling (Stantec Consulting Ltd., 2021) are presented in Figure 6-3.

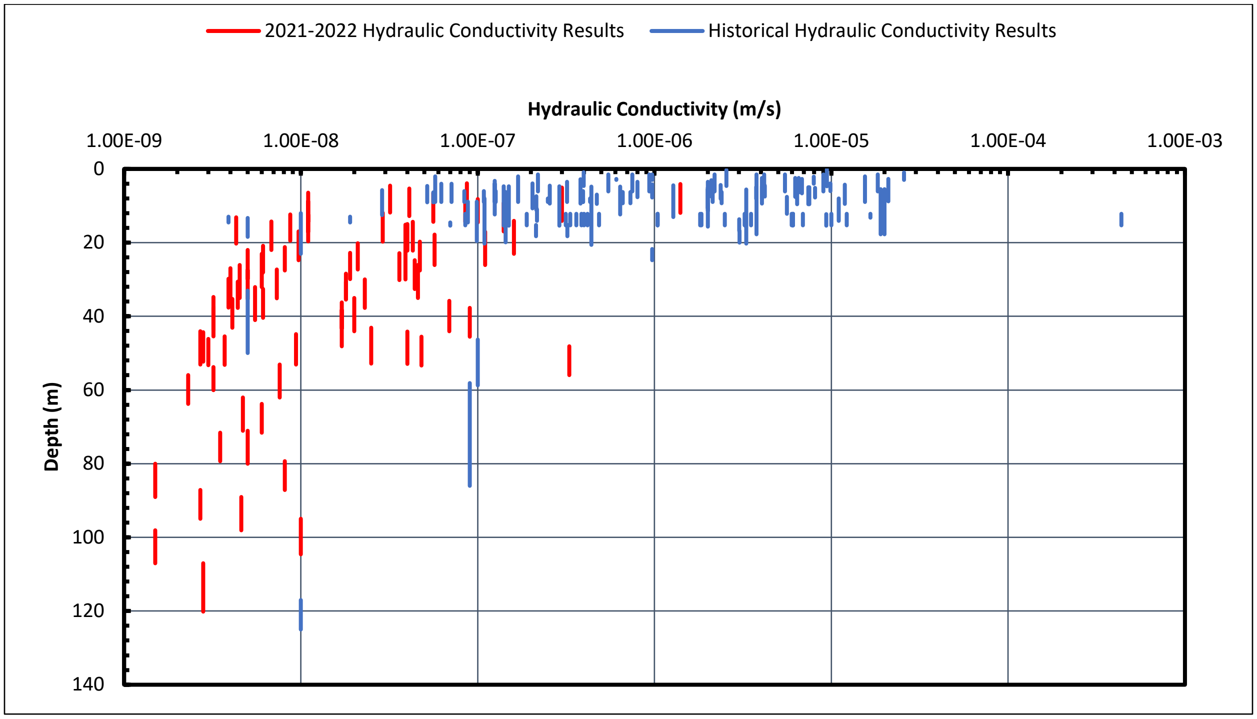

Figure 6-3 Compilation Bedrock Hydraulic Conductivity (Historical and 2021 Investigation)

As noted in Figure 6-3 the hydraulic conductivities obtained from the new 2021 investigations are generally within or below the historical ranges used for the previous modelling. In addition, a review of the 2021 data show there was no significant variation of hydraulic conductivity associated with fault zones identified in the pit area. This indicates that despite structural features logged within the tested intervals, those features appear to be hydraulically isolated and/or localized such that they are not increasing the overall hydraulic conductivity within the bedrock immediately surrounding boreholes. These results are consistent with regular observations of the faults exposed in the Open Pit which have identified some discrete seepage but generally total flow from these exposed faults is very low.

6.4 GEOLOGICAL MODEL / UNDERGROUND WORKINGS

Based on the findings of the 2021 investigation, the structural geology (fault) model provided by Atlantic Gold appears representative of the actual site conditions. The 3D structural model completed by Stantec which incorporates the AMNS structural model and the results of the 2021 boreholes show that geological faults zones are within the areas as anticipated.

The knowledge of the underground workings at the site has been advanced based on the work described herein, review and integration of available historical records, the geological model prepared by AMNS, and documented observations of the pit wall during construction. GPR surveys have provided additional data related to underground workings outside of the pit shell. This information has been cross-validated and combined to develop a detailed understanding of the geological environment proximate to the Open Pit. All available location information related to the underground workings has been presented on Drawing No. 4 (Appendix B). Three-Dimensional views of the underground workings are shown on Drawing No. 6. As shown on the drawings, the workings that intersect the pit wall are generally located in the western area of the pit.

Taken together, consideration of previous site investigations, the structural geology model, and site investigations undertaken in 2021/2022 the findings of this work:

- Validate the geological model developed by AMNS (July 2020, updated February 2022, Appendix E)
- Provide confidence in the understanding of the location and lateral extent of the underground workings
- Confirm that the data used in the original groundwater flow and solute transport model (Stantec 2021) submitted with EARD were conservative; with the new data demonstrating generally lower permeability

7.0 REFERENCES

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