THURBER ENGINEERING LTD.

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BC Ministry of Transportation and Infrastructure
2100 Labieux Road
Nanaimo, B.C. V9T 6E9

Attention: Ryan Gustafson, P.Eng.,

CANAL ROAD RE-ALIGNMENT
METAL LEACHING / ACID ROCK DRAINAGE ASSESSMENT
SOUTH PENDER ISLAND, BC

Dear Ryan,

As requested, Thurber Engineering Ltd (Thurber) has conducted a preliminary metal leaching (ML) and acid rock drainage (ARD) assessment of the exposed rock along a 300 m segment of Canal Road on South Pender Island. This letter report provides a summary of our background research, site observations and analytical testing results.

It is a condition of this letter report that Thurber's performance of its professional services is subject to the attached Statement of Limitations and Conditions.

1. BACKGROUND

This section of Canal Road is located approximately 3 km from the Pender Canal bridge, immediately to the east of the Mt. Norman Access Road and bordering the Beaumont-Gulf Islands National Park Reserve. The roadway in this section has been showing signs of movement for several years, observed by local residents and BC MoTI staff by the existence of tension cracks along and across the roadway.

Following the atmospheric river events of November 2021, the BC Ministry of Transportation and Infrastructure (MoTI) identified possible worsening of this known active landslide. It is proposed to stabilize the section of Canal Road impacted by the landslide, which will include grading of road cuts and disturbing the bedrock.

When combined with water and oxygen, rocks containing sulfide minerals and/or elevated metals concentrations can generate acid rock drainage (ARD) and / or leach metals (ML) at near neutral pH. ML and ARD can cause environmental damage if the ML/ARD weathering products enter surface waterbodies. This ML/ARD assessment was conducted in accordance with the requirements of BC MoTI Technical Circular T-04/13.

2. METHODOLOGY

Our scope of work for this report consisted of the following:

- Completion of background research on the geology and geochemistry of the of study area.
- Field examination of existing rock exposures, including the collection of representative rock samples.
- Submission of rock samples collected by Thurber to an analytical laboratory and review and interpretation of the laboratory analyses conducted.
- Production of this summary report.

The background research included a review of available bedrock geology maps for the assessment area and review of available information contained within the provincial mineralogical database (MINFILE). The available geological mapping, ML/ARD study area and the MINFILE search area boundary are shown on Figure 1.

Thurber visually observed and collected rock samples from existing rock cut slopes within the study area during a field program conducted on May 16, 2022. A total of seven rock samples approximately 2 kg in size were collected from six surface sample locations around the site. Figure 2 shows the locations of individual ML/ARD samples collected. The rock samples selected for analyses were chosen as they appeared to be representative of the geology in the area and most likely to be potentially net acid generating (PAG). The rock samples collected were returned to Thurber's Calgary office where they were photographed and underwent visual assessment and lithologic description. The sample descriptions are provided on Table 1 in Appendix B. Photos collected during the field work and of the rock samples collected are included in Appendix D.

Six of the samples collected by Thurber were submitted to AGAT Laboratories in Calgary, AB for assessment of acid-base accounting (ABA) parameters (using unmodified Sobek methodology), 4-acid total metals determination and shake flask extraction testing (SFE). The ABA data and total metals results for the six rock samples submitted are presented on Table 2 and Table 3 in Appendix B. The results of the shake flask analysis are presented on Table 4 in Appendix B. Copies of all original laboratory reports are provided in Appendix C.

One sample was taken from a geotechnical test hole TH22-03 that was completed by Thurber as part of the related geotechnical investigation, located approximately 10 m to the north of SA5. This sample was not submitted for testing due to its recovered condition and close proximity to SA5, which was selected as a representative sample for the location.

3. GEOLOGICAL RESEARCH

The approximate centre of the study area is located at 48° 45' 32" N, 123° 13' 30" W. BCGS MapPlace 2 (Figure 1) identifies that the site is mapped as being underlain by the Nanaimo Formation, which is upper Cretaceous in age. This unit is regionally described as undivided sedimentary rocks typically comprised of a series of conglomerate, sandstone, siltstone, shale and some areas of coal.

A search of BC Ministry of Energy and Mines MINFILE was conducted for an approximate 145 km^2 area bounded by 48° 48’ 46” and 48° 42’ 19” N latitude and 123° 18’ 25” and 123° 08’ 36” W longitude as shown on Figure 1. Most of the MINFILE search area is located within 6 km from the centre of the site. A total of four MINFILE records were returned for the study area, however, none of the listed records relate to minerology susceptible to ML/ARD, as shown on Table 1. The location of the MINFILE listings provided below are also shown on Figure 1.

Table 1: Significant MINFILE Listings within 6 km of the Highway Project

MINFILE Name	Status	Latitude	Longitude	Significant Minerals	Associated Minerals	Rock Group / Formation
Saturna	Past Producer	48° 48’ 24”	123° 11’ 56”	Expanding Shale, Aggregate, Building Stone	-	Nanaimo Formation
Bradley Dyne	Past Producer	48° 46’ 53”	123° 12’ 05”	Sandstone, Building Stone, Dimension Stone	-	Nanaimo Formation
Pender Island	Past Producer	48° 45’ 53”	123° 15’ 24”	Sandstone, Building Stone, Dimension Stone	-	Nanaimo Formation
Hope Bay	Past Producer	48° 48’ 14”	123° 16’ 38”	Sandstone, Building Stone, Dimension Stone	-	Nanaimo Formation

The nearest listed site to the study area is Pender Island, an open pit that previously produced sandstone and building stone, located approximately 3.4 km to the northwest. The MINFILE sites

identified suggest that the Nanaimo Group has a low potential to host mineralogy that is potentially susceptible to the generation of ML/ARD.

4. SUMMARY OF ROCK SAMPLE LITHOLOGIC AND CHEMICAL ANALYSIS

4.1 Field Observations

As noted, six rock samples were collected from accessible bedrock outcrops spread across the site. The outcrops were noted to consist of massive to slightly fractured, competent rock. The rock type was observed to comprise of conglomerate, with up to cobble sized clasts in the west of the site and siltstone in the east with occasional fine gravel clasts. The outcrops typically weathered buff to green-grey with intermittent iron oxide staining on weathered surfaces. No visible pyrite/sulfide mineralization was observed at outcrop scale.

The sample collected from the test hole consisted of dark grey siltstone and silty sandstone, collected as silty gravel and cobble sized fragments from the drill core.

4.2 Rock Sample Observations

As indicated on Table 1 in Appendix B, our visual observations of the samples collected indicate that the geology within the study area consists of variably weathered sedimentary lithologies. Samples SA1, SA2 and SA3 were described as a pebble conglomerate comprising a coarse-grained arkosic sandstone matrix with basalt and chert pebble clasts, while samples SA4, SA5, SA6 and sample TH22-03 comprise of a thinly bedded sandy siltstone/silty fine-grained sandstone with occasional grading to medium-coarse sandstone and fine to medium basaltic gravel.

All of the rock samples displayed moderate to heavy iron staining on weathered exposure surfaces or joint faces, however no visible sulfides were noted at 10x magnification in any of the rock samples collected.

4.3 ABA Analysis

As is indicated in Table 2 (Appendix B), the paste pH for four of the six tested samples is basic (i.e. >7) with pH ranging from 7.2 to 7.9. Rocks with basic pH should have some potential to buffer future acid generation and suggest that ARD is currently not occurring in these samples. The paste pH for samples SA1 (6.9) and SA5 (6.7) while not substantially below a pH of 7, suggest that some excess acid generation (i.e. ARD) may currently be taking place in the samples.

Fizz ratings are a visual assessment of the presence of carbonate minerals in the rocks and hence, is a general indicator of their ability to neutralize acid. All the samples exhibited a “slight” fizz rating suggesting that the carbonate concentrations in the rock tested are low.

Sulfate sulfur was at or below the detection limit for all samples, meaning the total sulfur concentrations within the samples (i.e. made up of potentially acid generating sulfide minerals plus sulfate sulfur) was determined by the sulfide mineral content (sulfide sulfur).

Although all samples submitted for analysis were indicated to have no visually identifiable sulfide mineralization, ABA calculated sulfide sulfur was detected within five of the samples, ranging between 0.02% wt in sample SA2 and SA4 to 0.28% wt in sample SA6. Sample SA5 contained less than the detection limit for sulfide sulfur, which is 0.01% (i.e. 0.1 g of sulfide for 1 kg of rock).

The maximum potential acid (MPA) for each rock sample was calculated using two different methods including:

1) Multiplying the laboratory-measured sulfide sulfur concentrations by 31.25. These MPA values were calculated by the laboratory.

2) Multiplying the laboratory-measured total sulfur concentrations by 31.25. These MPA values were calculated by Thurber.

The total sulfur method for the determination of MPA is typically more conservative than the laboratory reported MPA values as the calculation is based on the inclusion of potentially non-acid generating forms of sulfur and may be more applicable to weathered rock samples. However, considering the total sulfur and the sulfide sulfur concentrations were determined to be the same in five of the six samples, the MPA values for both methods ranged from 0.6 kg $CaCO_3$/T in sample SA2 to a value of 8.8 kg $CaCO_3$/T for SA6. Sulfide sulfur detected within sample SA1 was 0.13% wt while the total sulfur detected within the sample was reported at 0.14% wt, producing MPA values of 4.1 $CaCO_3$/T and 4.4 $CaCO_3$/T for the respective methods.

The neutralization potential (NP) of a rock is a measure of the rock’s ability to neutralize acid. NP generally consists of a faster acting component supplied by the presence of carbonate minerals and a slower acting component supplied by the presence of a variety of common minerals, including feldspars, pyroxenes, amphiboles, micas, and clays. Both forms neutralize acid but the faster acting NP may be more effective, although it can depleted relatively quickly.

AGAT calculated NP values are low, ranging from 14.2 Kg $CaCO_3$/T equivalent (SA5) to 22.4 kg $CaCO_3$/T equivalent (SA1). All samples had little to no measured carbonate carbon,

suggesting that most of the NP is likely a result of the presence of relatively slow acting mineral-induced (i.e. non-carbonate) neutralization.

The laboratory-supplied NP assumes that all the NP will be available for acid neutralization reactions however, Price (1997) discusses that not all measured NP from the Sobek procedure is available to neutralize internal acidity. While the amount of unavailable NP can range from 0 kg $CaCO_3$/T to 60 kg $CaCO_3$/T, Morin and Hutt (2005) recommend that 10 Kg $CaCO_3$/T be removed from calculated NP to account for unavailable NP. This “effective” NP (ENP) has been calculated by Thurber for each sample. All calculated ENP results range from 4.2 Kg $CaCO_3$/T identified in SA5 to 12.4 kg $CaCO_3$/T identified in SA1.

The ratio between NP and MPA (i.e. NP/MPA), called the Neutralization Potential Ratio (NPR) is one of two methods used to estimate ARD potential in the tested rocks. Price (1997) notes that NPR values of greater than 2 are net non-acid generating (NAG). NPR of between 1 and 2 are said to have an uncertain behaviour regarding ARD potential while samples with an NPR of less than 1 are said to be potentially net acid generating (PAG). NPR has been calculated using the MPA and NP/ENP results as shown on the blue-headed columns of Table 2 in Appendix B. NAG-NPR based samples are denoted with green-coloured shading. Yellow shading is used for samples with uncertain behavior while orange is used for samples that are classified as PAG.

A review of the NPR data indicates the following:

- In general, the Thurber-calculated NPR are lower than the lab-calculated NPR results due to the reduced ENP.
- Both lab calculated and Thurber calculated NPR results have similar interpretations, including SA1, SA2, SA3, SA4 and SA5 are classed as NAG with NPR of >2.
- There is a difference in interpretation for sample SA6, being classed as “NAG” by using the laboratory’s methodology with an NPR of 2.1 and “PAG” by Thurber’s methodology with an NPR of 0.9.

A less widely used indicator of acid rock drainage potential is the calculation of the Net Neutralization Potential (NNP) which is based on the difference between NP and MPA (i.e. NP - MPA). Using this method, NNP values of greater than +20 kg $CaCO_3$/T are NAG while NNP values of less than -20 kg $CaCO_3$/T are PAG. NNP values that are greater than -20 kg $CaCO_3$/T but less than +20 kg $CaCO_3$/T are said to have uncertain net acid generating behavior depending on the possible presence of highly reactive sulfide minerals and/or the presence of slowly-reacting or inaccessible NP (Robertson and Broughton, 1992). The NNP assessment on Table 2 in Appendix B is provided in the columns with tan-shaded column headers.

The NNP results for the ARD samples are generally less definitive than the NPR-based results, but all samples have values greater than +9 kg $CaCO_3$/T but less than +20 kg $CaCO_3$/T, indicating uncertain ARD potential. However, the positive NNP values indicate a potential excess of NP over MPA assuming relatively standard levels of unavailable NP. The NNPs ranged from a low of +9.9 kg $CaCO_3$/T for SA6 to a high of +18.6 kg $CaCO_3$/T for SA3.

4.4 Total Metals Analysis

Price (1997) suggested that metal analytes in rocks at concentrations above 10 times their average crustal abundance can provide an initial identification of significant mineral concentrations. However, the occurrence of a metal at concentrations well above crustal abundance does not conclusively indicate that the metal will be leached at a high rate from the material. Rather, the metal leaching rate is related to the metal's mineralogical association and the infiltrating groundwater or precipitation geochemistry. Elevated concentrations of certain elements commonly reflect the deposit's mineralized nature and does not necessarily indicate that environmental impacts will result from the exposure of these elements.

Metals concentrations in the rock samples compared to average crustal abundances, 3x average crustal abundance and 10x average crustal abundance are shown on Table 3 in Appendix B. The metal concentrations were obtained using the 4-acid digestion method and represent near total dissolution of the metals in the rock samples being tested.

The following samples contained metal concentrations at greater than 3x average crustal abundance:

- Arsenic in five of the six samples. Arsenic is susceptible to near-neutral pH metal leaching.
- Bismuth in SA2 and SA3, however bismuth is not a provincially or federally environmentally regulated substance in BC.
- Chromium in SA2.
- Lithium in SA5 and SA6.
- Rhenium in five of the six samples, however rhenium is not a provincially or federally environmentally regulated substance in BC.
- Sulfur in SA1.
- Antimony in all samples. Antimony is susceptible to near-neutral pH metal leaching.
- Thorium in five of the six samples.

The following samples contained metal concentrations at greater than 10x average crustal abundance:

- Arsenic in SA5
- Bismuth in SA1, SA4, SA5 and SA6, however bismuth is not a provincially or federally environmentally regulated substance in BC.
- Selenium in all samples. The detection limit for selenium is typically 0.5 ppm which is consistent with the 10x crustal abundance concentration of 0.5 ppm. The selenium identified in the samples ranges from 0.8 ppm (SA1) to 1.4 ppm (SA6). Selenium is susceptible to near-neutral pH metal leaching.

The total metals data suggest that the samples have elevated metal concentrations that could be capable of leaching significant concentrations. All samples have bismuth, arsenic, antimony and selenium, however in addition to these metals SA6 had lithium, rhenium and thorium and therefore may have the highest risk of near neutral pH ML. SA6 was also identified as PAG.

4.5 Shake Flask Testing

Shake flask testing is a kinetic test whereby a crushed rock sample (<6.5 mm diameter) and water (with a pH of between 5 and 6) are slurried together (i.e. 250 g of powdered rock in 750 ml of water) in a flask for 24 hours, after which, the water is tested for dissolved metallic parameters. SFE results can provide some indication of the potential for near-neutral pH metal leaching at pH levels consistent with natural rainfall.

Thurber requested that AGAT Labs conduct SFE analyses on all samples submitted for ABA and total metals analysis (6 samples total). The SFE results are shown on Table 4 in Appendix B with comparisons to the BC Water Quality Guidelines (WQGs) for the protection of freshwater Aquatic Life. The BC WQGs provide policy direction to those making decisions affecting water quality as the WQGs have a goal of protecting the most sensitive species, for the most sensitive life stage, at all times, with essentially a no adverse effects level (pers. comm. BC MoE). Although WQGs do not have any direct legal standing, once approved, BC WQGs must be considered in any decision affecting water quality made within the BC Ministry of Environment. WQGs are used to assess water quality and may be used as the basis for determining the allowable limits in waste discharge authorizations. Exceeding a WQG does not imply that unacceptable risks exists, but rather that the potential for adverse effects may be increased and additional investigation may be required.

Review of the data on Table 4 in Appendix B indicates no exceedances of WQGs in any samples.

4.6 XRD

The samples SA1 and SA6 were submitted for analysis by X-Ray Diffraction (XRD) using Rietveld refinement to assist with mineral identification.

The XRD results are presented in Table 5 in Appendix B. The XRD results are generally as anticipated for the rock types with no unusual minerals identified.

Pyrite was detected in small concentrations at 0.1% in sample SA1. Although no sulphides were observed within the sample during the visual identification, the XRD pyrite data correlates well with the ABA sulfide concentrations shown on Table B.2, with the tested sample providing a detected sulfide value of 0.13% wt.

5. DISCUSSION AND CONCLUSIONS

Review of the NPR data indicates that sample SA6 was determined to be marginally PAG based on the total sulfur and ENP based NPR assessment methodology with an NPR of 0.98 (i.e. NPR <1 is classified as PAG). This sample has the highest reported sulfide content (i.e. 0.28%) of all of the samples tested. It is likely that most of the ENP in the sample is a result of the presence of relatively slow acting mineral-induced (i.e. non-carbonate) neutralization. It is important to note that the pH of the weathered sample SA6 was near neutral at 7.4 which may suggest that significant acid generation in the weathered rock has not yet occurred (or may not occur). The remainder of the rock samples analyzed are NAG because of much lower AP resulting from very low sulfur (including sulfide) content and NPR exceeding (or greatly exceeding) 2.

The alternative NNP assessment provides less definitive assessment results than the NPR methodology, indicating that most of the samples tested have an uncertain potential to generate ARD. However, all samples had positive NNP values indicating an excess of NP over MPA. Sample SA6 had the lowest NNP of the samples tested being 9.9.

The extent of the marginally PAG bedrock at, and beyond the SA6 sample location is unknown. Sample SA5 was collected from <20 m away from SA6 and was found to be NAG, suggesting that the PAG rock at SA6 may be of limited local extent within the outcrop, however, the potential area of PAG rock could extend to the east.

Delineation of the area of PAG rock would require additional site investigation and analyses, however, as a conservative measure an estimate of rock disturbance surrounding SA6 has been undertaken in Section 6 to assess the volume of potentially PAG rock on the eastern extent of the proposed re-route.

No areas of active ARD were apparent within the existing cutslope and if ARD were to occur in association with the rock at sample SA6 (or other rock in the area) the time to onset and strength of potential ARD generated is currently unknown and cannot be determined without the completion of kinetic testing. However, it is our opinion given the available static lab testing results that if ARD were to occur, the ARD would most likely be relatively weak to moderate in strength.

Our assessment of the whole rock total metals concentrations in each of the rock samples found several elevated total metals concentrations above crustal abundance, however there were only a few metals that exceeded concentrations above 3x and 10x crustal abundance. Nonetheless, it is likely that these elevated metal concentrations are not a metal leaching concern given the low concentrations of these elements detected within the SFE data. There were no exceedances identified within the data and, as a result, the available shake flask data suggest that there is low potential for near-neutral pH ML.

6. PAG ROCK VOLUME ESTIMATE

A ground disturbance volume estimate in the area surrounding sample SA6 (from halfway between SA5 and SA6 to the eastern extent of the proposed road cut) were provided to Thurber by McElhanney and are summarized in Table 2. The volumes provided are best available estimates based on the latest available grade plan and bedrock outcrop mapping.

Table 2: Estimated Rock Volumes

Volume Estimate (m3) In-Situ (Non-Bulked) Volumes	
Estimated Grade cut	**Estimated Total Rock Volume**
1,000	500 – 800**

Note: ** Best estimate. The actual volume of rock that will be encountered within this area is currently uncertain, since the grade plans were produced prior to bedrock outcrop mapping and drilling records.

For the purposes of this initial assessment, the above volume estimate for the disturbed rock within the area surrounding SA6 will be considered consistent with the PAG lab result and represents the potential volume of PAG rock to be excavated from the eastern extent of the road cut.

It should be noted that these volume estimates are approximate only and will be subject to future changes in the grade plan and any future ML/ARD assessment results. Supplemental testing

could reveal differences in ML/ARD potential over relatively short distances due to the “nugget effect” where the mineralogy of bedrock varies over very small scales (cm).

It should also be noted that PAG rock could still be encountered elsewhere within the rock cut given the often restricted and variable nature of sulfide mineralization / high metals concentrations. As a result, if any changes in rock type from those tested to date are encountered, then additional sampling and testing for ML/ARD potential should be considered.

7. MANAGEMENT AND ML/ARD MITIGATION

7.1 General Considerations

The development of site-specific mitigation designs should include consideration of the following site elements and conditions:

- Any regulatory or permitting requirements,
- Phase of construction, construction schedule, available and permitted working room (on and off the right-of-way) and site-specific construction activities,
- Volume / area of exposed or disturbed PAG rock,
- Available assessment data,
- Indications of active or past ML/ARD within the rock mass or adjacent areas,
- Proximity of surface water bodies,
- Results of available pre-construction and/or construction phase surface water quality testing,
- Nature of blast rock and exposed rock faces,
- Site drainage conditions,
- Topography, local soil material type, grainsize and availability,
- Availability and proximity of municipal or commercial landfills and/or metal mine sites where the disturbed rock could be relocated for off-site disposal,
- Availability of suitable high neutralizing potential (NP) blending material including imported crushed limestone or lime,
- The potential time delay in the onset of ML/ARD and the potential intensity of the ML/ARD.

It should be noted that no areas of active ARD were apparent within the existing cutslope and if ARD were to occur in association with the rock at sample SA6 (or other rock in the area) the time to onset and strength of potential ARD generated is currently unknown and cannot be determined without the completion of kinetic testing. As noted in the discussion above, it is our opinion that if ARD were to occur, it would most-likely be relatively weak to moderate in strength.

7.2 Management and Mitigation

Management of indicated PAG rock is required during the planning, construction and operational phases of the project. Potential acid generation can be reduced or controlled by regulating one or more of the reaction components (i.e. water and/or oxygen). Typical mitigation measures can utilize covers, underwater storage, blending with a non-PAG material and collection and treatment of acid drainage or combinations of mitigation measures.

Options for mitigation are generally grouped into two broad categories including:

- Mitigation of exposed rock cuts.
- Mitigation of disturbed rock material

Options for mitigation for the two categories, together with some of the benefits and limitations of each mitigation method for the assumed weak intensity ML/ARD are presented in Tables 3 and 4.

Table 3. Summary of Mitigation ML/ARD Options For In-Situ Rock Cuts.

Item No.	Mitigation Option	Benefits	Site Limitations
1.	Capping road cut with Shotcrete	• Works well for use on areas with generally weak ARD (pH >4) as is considered to be likely at the Canal Road site. • Good option when fine grained soil is in limited supply. • Can be used on steep or high cut slopes. • Not prone to erosion like soil. • Shotcrete likely to be used on site elsewhere so can be available reducing cost considerably.	• May not be suitable on fractured or unstable rock cuts. • Cut slope surface should be free of loose and broken rock, soil, vegetation, and ice. • May require drainage or drain holes in the rock and shotcrete to prevent build-up of water pressure behind. • May crack and spall over time and may require reinforcement (welded wire mesh or steel fibres). • Potential for dust problems during application. • Aesthetics.
2.	Leaving rock cuts exposed	• Potential lowest cost option. • Leaving the rock cuts exposed to dry out and undergo future monitoring / mitigation if required.	• Likely of limited effectiveness in slowing rate of ARD generation during wet winter months. This option is best suited to dry climates. • Likely only suitable where surface water run-off from rock

Table 3. Summary of Mitigation ML/ARD Options For In-Situ Rock Cuts.

Item No.	Mitigation Option	Benefits	Site Limitations
			cuts cannot drain into open waterbodies. • Requires surface water management (i.e. diversion and collection berms, ditch isolation etc) to control potential contaminated runoff. • May not be very effective if drainage controls are not monitored and maintained. • Possible concerns regarding visual appearance of apparently unmitigated slope with potential rusty staining.

Table 1. Summary of Mitigation ML/ARD Options For Disturbed Rock Material.

Item No.	Mitigation	Benefits	Site Limitations
1.	Disposal Off-Site at an approved Municipal or Commercial Landfill	• Likely small volumes and could be cost effective option. • No long-term liabilities. • No long-term environmental monitoring requirements. • If the landfill accepts the rock material, there is little to no regulatory burden to establish and utilize this mitigation option.	• Potential for double handing and long transport distances. • Landfills must be pre-approved prior to use. • Commercial agreements need to be in place prior to the construction phase. This will likely include a process of rock characterization (beyond standard ML/ARD assessment) so that the landfill is comfortable with the material that they are to receive and that it fits within their landfill permit requirements. These characterization requirements, such as providing leachability testing, must be known early in the process so that the required assessment data can be collected and provided. • May require MOTI and / or Municipal approvals for hauling rock on public roads and

Table 1. Summary of Mitigation ML/ARD Options For Disturbed Rock Material.

Item No.	Mitigation	Benefits	Site Limitations
			highways, and within city limits (i.e. depending on vehicle used to transport the rock material).
2.	On-Site Encapsulation Disposal (Small Volume)	• Can be cost effective. • Likely minimal handling, hauling and standard characterization. • Range of potential designs are possible from small landfill-style encapsulations, to covered encapsulation of blast rock as subgrade below road pavement or backfilled against cut slope and capped with sloping fine grained soil. • Potential effectiveness of the mitigation will vary with design.	• Constructing encapsulation pit may require permitting and regulatory and landowner approvals • Encapsulation pit required to be engineered and constructed prior to use. • Limited space within proposed construction area restricts encapsulation options including at the Canal Road site. • Only small volumes are suitable for on-site encapsulation disposal (due to space limitations). • Road likely to built on rock subgrade and therefore unlikely to need fill material. • Disposal sites should be located away from open fresh waterbodies. • Due to limited access to fine-grained, low permeable soils to use as capping material, may also require use of High-Density Polyethylene (HDPE) covers to keep water away from stored material. • Soil covers may require long-term maintenance. • Soil covers may not entirely stop infiltration and acid drainage. • Requires long-term environmental monitoring / potential liability.

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Table 1. Summary of Mitigation ML/ARD Options For Disturbed Rock Material.

Item No.	Mitigation	Benefits	Site Limitations
3.	Disposal at Sea	• From an ML/ARD treatment perspective, this may be the best option to dispose of PAG and ML-susceptible rock. • No long-term liabilities.	• Requires federal permit and environmental approvals. • May require First Nation approval. • High degree of regulatory uncertainty. • Possible negative public perception. • Acquiring necessary permits and approvals could be a time-consuming process and may require special studies of both the rock material and potential receiving sites. • There is more work to be done to evaluate feasibility. • Recent projects have elected not to pursue this option as the environmental impacts are not well known.
4.	Blending	• Adding a neutralizing agent to disturbed PAG rock can buffer future acid generation. Potentially allowing the disposal of limited amount of PAG rock on site. • Buffering, when combined with encapsulation may offer a relatively high level of environmental protection.	• Source location for suitable blending material (i.e. limestone additive) needs to be identified. There is no naturally available suitable blending material within the project area (i.e. no limestone or carbonaceous bedrock, other existing rock on site has low available NP). • Commercial arrangements will have to be made with the provider/s prior to the construction phase. • Costly to import suitable blending material to site and effectively blend with PAG rock. • Significant amount of PAG rock and blending material handling is required, including crushing of both materials. • There is limited space to conduct the blending on site.

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Table 1. Summary of Mitigation ML/ARD Options For Disturbed Rock Material.

Item No.	Mitigation	Benefits	Site Limitations
			• Risk of not achieving correct blending ratio during mixing. If mixture is not homogenous then local acidic conditions may arise i.e. blending has performance limitations. Also, the high rainfall environment could deplete the added neutralization potential prior to the completion of acid generation. • Requires long-term post construction environmental monitoring.
5.	Relocation to a Nearby, On-site or Off-site Temporary Holding Area	• Manage working space at the construction site. • Could be implemented with any of the mitigations noted above. • Potential relatively short haul distances. • Allows for further ML/ARD sampling and classification to confirm and refine PAG rock volumes for mitigation and/or removal from site. • Allows for the potential implementation of blending if that is to be considered.	• Potential use of existing undeveloped pit on North Pender Island. • Temporary rock holding sites need to be identified and approved in advance of construction. • Limited space within the construction area • Approval and permitting for additional workspace or permanent easement may be required. • Sites require ground preparation and application of an acid resistant HDPE liner to prevent infiltration of surface run-off. • Temporary stockpiles at the site should be tracked and staked and different classes of rock material kept separated. • May require temporary covers (i.e. poly sheeting) on stockpiles. • Site will require drainage and surface water controls. • Double handling of rock material to ultimately move PAG and ML-susceptible rock to

Table 1. Summary of Mitigation ML/ARD Options For Disturbed Rock Material.

Item No.	Mitigation	Benefits	Site Limitations
			permanent off-site disposal facilities or possible return of NAG tested or treated rock material to construction for reclamation.

7.3 Further Testing

Additional analytical rock sample collection and analysis could be conducted by a retained qualified professional during the rock excavation phase of construction. Excavated material would be stockpiled at a pre-determined temporary storage area to allow the qualified professional to visually observe the bedrock lithology and collect additional rock samples to be submitted for analyses of ABA. Additional testing to meet acceptance criteria can also be scheduled at this stage, such as leachability testing as required by potential existing disposal sites.

The standard laboratory minimum turn-around time for processing of static analysis of ML/ARD is likely up to 5 weeks, although faster service is available with the application of significant cost surcharges (i.e. 100% to 300% surcharge over the initial cost). Temporary segregation and storage of potential PAG rock while testing and/or waiting for results of laboratory testing may be necessary.

7.4 Other Considerations

Segregation and storage on or near the site workspace minimizes the cost of material handling and is preferred if there is space available. Short-term measures such as placing PAG materials in a temporary covered and engineered storage facility can be used to reduce the probability of developing ARD and releasing contaminated runoff. Interim storage of PAG rock at an off-site location may be feasible in areas where there is limited space, however, a suitable location would need to be identified, engineered, permitted and constructed prior to use.

Any other rock in the excavations outside of the area identified as potential PAG rock that are found in the excavations to contain significant concentrations of sulfide mineralization should also be segregated and temporarily retained/stockpiled until ML/ARD testing can be carried out.

REFERENCES

BC Ministry of Transportation and Infrastructure. 2013. Evaluating the Potential for Acid Rock Drainage and Metal Leaching at Quarries, Rock Cut Site and from Stockpiled Rock or Talus Materials Used by the MoTI. Technical Circular T-04/13.

BC Ministry of Environment. 2016, British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife and Agriculture – Summary Report. Water Protection and Sustainability Branch.

MapPlace 2 Online GIS https://www2.gov.bc.ca/gov/content/industry/mineral-exploration-mining/british-columbia-geological-survey/mapplace. Accessed by Thurber June 24, 2022.

Muller, J.E. (1977) Geology of Vancouver Island. *Geological Survey of Canada*, Open File 463, 2 maps plus marginal notes.

Muller, J.E. (1980) Geology of Victoria, West of 6th Meridian, British Columbia. *Geological Survey of Canada.* Map 1553A. Scale 1:100,000

Price, W. 1997. Draft Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia. BC Ministry of Employment and Investment.

Robertson, A, Broughton, L. 1992. Reliability of Acid Rock Drainage Testing. Steffen, Robertson and Kirsten, Vancouver. BC.

8. CLOSURE

We trust the above meets your immediate needs. If you have any questions regarding the proposed methodology or wish to discuss, please contact us at your earliest convenience.

Thurber Engineering Ltd.
Paul Wilson, M.Sc., P.Geo.
Review Geoscientist

Victoria Smith, M.Sc., FGS, GMICE, GIT (AB)
Engineering Geologist-in-Training

Attachments:

- Statement of Limitations and Conditions
- Appendix A – Data Summary Figures
- Appendix B – Data Summary Tables
- Appendix C – Lab Certificates
- Appendix D – Site and Sample Photographs

THURBER

STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

5. INTERPRETATION OF THE REPORT

a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.

d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

APPENDIX A

FIGURES

MAYNE ISLAND

SAMUEL ISLAND

092B 070
HOPE BAY

092B 043
SATURNA

NORTH
PENDER
ISLAND

SATURNA
ISLAND

092B 068
BRADLEY DYNE

092B 069
PENDER
ISLAND

uKN

SOUTH
PENDER
ISLAND

BLUNDEN ISLET

uDSiM

uDSiM

uKN

EMJlgd

LTrMH

MORESBY
ISLAND

uDSiM

uKN

UNITED STATES

LEGEND:

PROPOSED ROAD ALIGNMENT

MINFILE SEARCH AREA BOUNDARY

MINFILE RECORD WITHIN 6 km OF SITE LOCATION

FIGURE 2 EXTENT

BEDROCK GEOLOGY

STRATIGRAPHIC UNIT - STRATIGRAPHIC NAME

EMJlgd - ISLAND PLUTONIC SUITE

LTrMH

uDSiM

uKN

DRAFT

NOTES:

1 DRAWING MUST BE USED IN CONJUNCTION WITH THE ATTACHED REPORT REFERENCE 33450 DATED AUGUST 2022 AND IS SUBJECT TO ANY LIMITATIONS DESCRIBED THEREIN.

2 BEDROCK GEOLOGY AND FAULTS FROM CUI, Y., MILLER, D., SCHIARIZZA, P., AND DIAKOW, L.J., 2017. BRITISH COLUMBIA DIGITAL GEOLOGY. BRITISH COLUMBIA MINISTRY OF ENERGY, MINES AND PETROLEUM RESOURCES, BRITISH COLUMBIA GEOLOGICAL SURVEY OPEN FILE 2017-8, 9P. DATA VERSION 2018-04-05.

3 PROPOSED ROAD ALIGNMENT PROVIDED BY BC MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE

2 1 0 2 km

UTM 10 NAD 83

BRITISH COLUMBIA
Ministry of Transportation

CANAL ROAD ROCK EXCAVATION SITE METAL LEACHING/ACID ROCK DRAINAGE ASSESSMENT - PENDER ISLAND, BC

BEDROCK GEOLOGY AND MINFILE SEARCH AREA

FIGURE 1

DRAWN BY	CMM
DESIGNED BY	VSS
APPROVED BY	PJW
SCALE	1:50,000
DATE	AUGUST 5, 2022
FILE No.	33450_G01_A

THURBER ENGINEERING LTD.

C:\Users\CMcClarty\GIS\33450-Canal Road, Pender Island\GIS\Workspaces\33450_G01_A.mxd modified 2022-08-05 by cmcclarty

LEGEND:

PROPOSED ROAD ALIGNMENT

PROPOSED ROAD EXTENTS

ML/ARD SAMPLE

NON-NET ACID GENERATING (NAG)

POTENTIALLY NET ACID GENERATING (PAG)

NOT TESTED

DRAFT

NOTES:

1 DRAWING MUST BE USED IN CONJUNCTION WITH THE ATTACHED REPORT REFERENCE 33450 DATED AUGUST 2022 AND IS SUBJECT TO ANY LIMITATIONS DESCRIBED THEREIN.

2 BEDROCK GEOLOGY AND FAULTS FROM CUI, Y., MILLER, D., SCHIARIZZA, P., AND DIAKOW, L.J., 2017. BRITISH COLUMBIA DIGITAL GEOLOGY. BRITISH COLUMBIA MINISTRY OF ENERGY, MINES AND PETROLEUM RESOURCES, BRITISH COLUMBIA GEOLOGICAL SURVEY OPEN FILE 2017-8, 9P. DATA VERSION 2018-04-05.

3 PROPOSED ROAD ALIGNMENT PROVIDED BY BC MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE.

50 25 0 50 m

UTM 10 NAD 83

BRITISH COLUMBIA
Ministry of Transportation

CANAL ROAD ROCK EXCAVATION SITE METAL LEACHING/ACID ROCK DRAINAGE ASSESSMENT - PENDER ISLAND, BC

ML/ARD SAMPLE LOCATIONS AND RESULTS SUMMARY

FIGURE 2

DRAWN BY	CMM
DESIGNED BY	VSS
APPROVED BY	PJW
SCALE	1:1,500
DATE	JULY 14, 2022
FILE No.	33450_G02_A

THURBER ENGINEERING LTD.

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THURBER

APPENDIX B

DATA SUMMARY TABLES

THURBER

PROJECT: CANAL ROAD, PENDER ISLAND
THURBER FILE: 33450
TABLE 1: ROCK SAMPLE SUMMARY

ML/ARD Sample #	Rock Sample Description	Visible Sulfide at 10x?	Sample Submitted for ML/ARD Analysis? (Y/N)	Reason	Analysis Conducted	AGAT Sample No.	Sulfide Detected by Analysis (Y/N)
SA1	Dark reddish grey, poorly sorted matrix supported pebble CONGLOMERATE. Matrix of medium to coarse grained micaceous arkosic sandstone with rounded gravel to cobble sized clasts of basalt and chert. Moderate iron staining. No sulfides observed. No fizz with 5% HCl.	N	Y	Representative sample of the location. Iron staining identified within the sample	4-Acid Metals, ABA, SFE, XRD	3932638	Y
SA2	Dark reddish grey, poorly sorted matrix supported pebble CONGLOMERATE. Matrix of medium to coarse grained micaceous arkosic sandstone with rounded gravel to cobble sized clasts of basalt. Moderate iron staining. No sulfides observed. No fizz with 5% HCl.	N	Y	Representative sample of the location. Iron staining identified within the sample	4-Acid Metals, ABA, SFE	3932639	Y
SA3	Dark reddish grey, poorly sorted matrix supported pebble CONGLOMERATE. Matrix of medium to coarse grained micaceous arkosic sandstone with rounded gravel to cobble sized clasts of basalt. Moderate iron staining. No sulfides observed. No fizz with 5% HCl.	N	Y	Representative sample of the location. Iron staining identified within the sample	4-Acid Metals, ABA, SFE	3932640	Y
SA4	Dark brownish grey to medium grey finely bedded micaceous sandy SILTSTONE with layers grading to fine to coarse sandstone. Occasional fine gravel of basalt and chert in the coarser grained areas. Moderate to heavy iron staining on joint surfaces. No sulfides observed. No fizz with 5% HCl.	N	Y	Representative sample of the location. Iron staining identified within the sample	4-Acid Metals, ABA, SFE	3932641	Y
SA5	Dark brownish grey to medium grey finely bedded fine grained micaceous SANDSTONE with occasional fine gravel of basalt. Moderate to heavy iron staining on joint surfaces. No sulfides observed. No fizz with 5% HCl.	N	Y	Representative sample of the location. Iron staining identified within the sample	4-Acid Metals, ABA, SFE	3932642	N
SA6	Dark brownish grey to medium grey finely bedded fine grained micaceous SANDSTONE with occasional fine gravel of basalt. Moderate to heavy iron staining on joint surfaces. No sulfides observed. No fizz with 5% HCl.	N	Y	Representative sample of the location. Iron staining identified within the sample	4-Acid Metals, ABA, SFE, XRD	3932643	Y
TH22-03	Dark brownish grey to medium grey finely bedded silty fine grained micaceous SANDSTONE with occasional fine gravel of basalt. Moderate to heavy iron staining on joint surfaces. No sulfides observed. No fizz with 5% HCl.	N	N	Sample not selected for testing due to condition of sample and sample spacing.			

THURBER

PROJECT: CANAL ROAD, PENDER ISLAND
THURBER FILE: 33450
TABLE 2: ACID / BASE ACCOUNTING SUMMARY

Laboratory and Thurber Calculated ABA Data

As Provided by AGAT										Calculated By Thurber	
Sample No.	AGAT Sample No.	Paste pH	Fizz Rating	Total Inorganic Carbon	Total Sulfur	Sulfur Speciation		Maximum Potenital Acid Sulfide Sulfur (MPA)	ABA Neutralization Potential (NP)	Maximum Potential Acid Total Sulfur (MPA)	Effective NP (Unavailable NP Removed)
						Sulfate Sulfur	Sulfide Sulfur				
		pH Units		wt%	wt%	wt%	wt%	Kg $CaCO_3$/T	Kg $CaCO_3$/T	Kg $CaCO_3$/T	Kg $CaCO_3$/T
SA1	3932638	6.9	Slight	<0.02	0.14	0.01	0.13	4.1	22.4	4.4	12.4
SA2	3932639	7.9	Slight	0.047	0.02	<0.01	0.02	0.6	18.4	0.6	8.4
SA3	3932640	7.5	Slight	<0.02	0.03	<0.01	0.03	0.9	19.5	0.9	9.5
SA4	3932641	7.2	Slight	<0.02	0.02	<0.01	0.02	0.6	16.3	0.6	6.3
SA5	3932642	6.7	Slight	<0.02	<0.01	<0.01	<0.01	<0.2	14.2	<0.2	4.2
SA6	3932643	7.4	Slight	<0.02	0.28	<0.01	0.28	8.8	18.6	8.8	8.6

ABA Assessment / Interpretation

Samples		As Reported by AGAT		Calculated by Thurber		Provided by AGAT		Calculated by Thurber	
Sample No.	AGAT Sample No.	Neutralization Potential Ratio (NPR)	NPR-BASED ARD CLASSIFICATION	Neutralization Potential Ratio (NPR)	NPR-BASED ARD CLASSIFICATION	Net Neutralization Potential (NNP) NP-Sulfide MPA	NNP-BASED ARD CLASSIFICATION	Net Neutralization Potential (NNP)	NNP-BASED ARD CLASSIFICATION
		NP/Sulfide MPA		ENP/Total Sulfur MPA		Kg $CaCO_3$/T		Kg $CaCO_3$/T	
SA1	3932638	5.5	NAG	2.83	NAG	18.3	UNCERTAIN	18.0	UNCERTAIN
SA2	3932639	29.4	NAG	13.44	NAG	17.8	UNCERTAIN	17.8	UNCERTAIN
SA3	3932640	20.8	NAG	10.13	NAG	18.6	UNCERTAIN	18.6	UNCERTAIN
SA4	3932641	26.1	NAG	10.08	NAG	15.7	UNCERTAIN	15.7	UNCERTAIN
SA5	3932642	n/a	NAG	n/a	NAG	14.2	UNCERTAIN	14.2	UNCERTAIN
SA6	3932643	2.1	NAG	0.98	PAG	9.9	UNCERTAIN	9.9	UNCERTAIN

NPR ARD Status based on Price (1997).

- NAG = Not Likely Net Acid Generating (i.e. NPR >2) or Total or Sulfide Sulfur Not Detected
- Uncertain Behaviour (NPR >1 to <2)
- PAG = Potentally Net Acid Generating (i.e. NPR <1)

NNP ARD Status based on Robertson and Broughton (1992).

- NAG = Not Likely Net Acid Generating (i.e. NPP >+20)
- Uncertain Behaviour (NPP >-20 to <+20) or MPA is undetectable in which case NAG
- PAG = Potentally Net Acid Generating (i.e. NPP <-20)

Kg $CaCO_3$/T = kilograms of calcium carbonate per tonne of rock equivalent
wt% = weight percent of total rock
Maximum Potential Acid = Total or Sulfide Sulfur x 31.25 (as indicated)
Neutralization Potential (NP) was determined based on standard Sobek method (MEND, 1991)
Thurber ENP is laboratory NP - 10 Kg CaCO3/T to account for potential unavailable NP
Neutralization Potential Ratio (NPR) = NP / MPA based on non-rounded MPA and NP values using Sulfur species and NP or ENP as indicated
Net Neutralization Potential (NNP) = NP - MPA based on non-rounded MPA and NP values using Sulfur species as indicated and NP.
NPP assessment implicitly recognizes that up to 20 Kg CaCO3/T of NP is unavailable.
n/a = Result not calculated when total or Sulfide Sulfur is not detected. Assumed NAG.
0.4 Blue shading where Sulfide Sulfur >0.3% or paste pH <7

THURBER

PROJECT: CANAL ROAD, PENDER ISLAND
THURBER FILE: 33450
TABLE 3: METALS CONCENTRATIONS SUMMARY

Sample	AGAT Sample No.	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	In	K	La	Li	Mg	Mn	Mo
		ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm
Crustal Abundance		**0.075**	**8.23**	**1.8**	**425**	**3**	**0.0085**	**4.15**	**0.15**	**66.5**	**25**	**102**	**3**	**60**	**5.63**	**19**	**1.5**	**3**	**0.25**	**2.1**	**39**	**20**	**2.3**	**950**	**1.2**
10X Crustal Abundance		**0.75**	**82.3**	**18**	**4250**	**30**	**0.085**	**41.5**	**1.5**	**665**	**250**	**1020**	**30**	**600**	**56.3**	**190**	**15**	**30**	**2.5**	**21**	**390**	**200**	**23**	**9500**	**12**
SA1	3932638	0.079	6.4	10.63	634	1.16	0.097	1.27	0.069	33.9	10.9	303	1.9	17.9	4	15.9	0.11	1.38	0.04	1.4	17.6	31.7	0.889	526	3.05
SA2	3932639	0.083	6.53	7.52	604	1.01	0.07	1.74	0.111	29.4	12.3	325	1.06	22.1	4.83	15.9	0.11	1.52	0.047	0.96	13.7	27.6	1.23	690	2.77
SA3	3932640	0.069	5.81	12.94	624	0.84	0.062	1.06	0.062	32	10.6	250	0.725	15.5	3.23	14.5	0.13	1.74	0.043	1.02	15.5	25.3	0.83	572	3.03
SA4	3932641	0.07	8.09	12.77	758	1.34	0.193	1.28	0.082	37.3	18.7	235	3.87	28.7	5.66	20.1	0.11	1.34	0.051	1.57	18.5	57.7	1.29	571	1.8
SA5	3932642	0.077	10.4	19.72	842	1.38	0.218	1.32	0.109	39.7	27.3	208	5.26	42.2	5.27	26.1	0.14	1.7	0.069	1.59	20	100	1.73	700	1.33
SA6	3932643	0.20	9.71	15.8	1270	1.70	0.22	1.67	0.165	49.4	36.2	261	5.77	42.6	5.30	26.60	0.18	1.69	0.077	1.55	23.8	98.1	2.13	1060	1.16

Sample	AGAT Sample No.	Na	Nb	Ni	P	Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
		%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Crustal Abundance		**2.4**	**20**	**84**	**1050**	**14**	**90**	**0.0007**	**0.0350**	**0.2**	**22**	**0.05**	**2.3**	**370**	**2**	**0.5**	**1.2**	**0.565**	**0.85**	**2.7**	**120**	**1.25**	**33**	**70**	**165**
10X Crustal Abundance		**24**	**200**	**840**	**10500**	**140**	**900**	**0.007**	**0.35**	**2**	**222**	**0.5**	**23**	**3700**	**20**	**5**	**12**	**5.65**	**8.5**	**27**	**1200**	**12.5**	**330**	**700**	**1650**
SA1	3932638	1.62	6.69	28.7	453	9.43	47.9	0.0028	0.15	0.74	12.2	0.782	1.38	251	0.48	0.045	5.18	0.267	0.299	1.48	89.9	0.72	11.3	57.8	54.2
SA2	3932639	1.83	4.78	24.8	775	7.85	29.2	0.0027	0.028	0.73	15.4	0.851	1.28	275	0.31	0.037	3.33	0.325	0.193	1.17	103	0.667	15.4	68.5	57.5
SA3	3932640	1.87	5.47	21.9	800	7.31	29	0.0021	0.035	0.86	13.5	0.907	1.34	205	0.37	0.049	4.42	0.292	0.182	1.5	82.8	0.785	16.6	59	54.5
SA4	3932641	1.29	8.93	38.5	747	12.2	73	0.0028	0.014	0.69	16.9	0.842	1.6	276	0.58	0.054	6.47	0.344	0.395	1.74	151	0.942	10.9	96.2	43.1
SA5	3932642	1.11	9.4	51	912	13.6	94.2	0.0041	0.017	0.88	25.8	0.965	1.83	249	0.63	0.084	7.03	0.455	0.438	2.07	233	1.23	14.2	133	53.3
SA6	3932643	1.20	8.75	75.4	558	14.5	96.0	0.0051	0.01	0.90	29.4	1.47	1.84	363	0.6	0.097	6.53	0.481	0.445	1.83	256	1.22	23.30	157	51.2

Notes:

10	Metal concentration above average continental crustal abundance.
30	Metal concentration above 3X average continental crustal abundance.
200	Metal concentration above 10X average continental crustal abundance.

THURBER

PROJECT: CANAL ROAD, PENDER ISLAND
THURBER FILE: 33450
TABLE 4: SHAKE FLASK EXTRACTION

SAMPLE NO.	BC Water Quality Guidelines	SA1	SA2	SA3	SA4	SA5	SA6
AGAT Sample No.		3932638	3932639	3932640	3932641	3932642	3932643
Metals (mg/L)							
Silver	0.00005**	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008
Aluminum	0.05+	0.005	0.037	0.036	0.031	0.019	0.016
Arsenic	0.005**	<0.0002	0.0002	0.0005	<0.0002	<0.0002	<0.0002
Boron	1.2**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Barium	1***	0.0120	0.0086	0.0140	0.0016	0.0012	0.0017
Beryllium	0.00013***	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cadmium	0.000211+	0.00002	<0.00001	0.00001	<0.00001	<0.00001	<0.00001
Calcium		8.77	0.66	2.68	0.21	0.19	0.19
Cobalt	0.004**	0.0013	0.0003	0.0006	0.0001	0.0001	<0.0001
Chromium	0.0089***	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Copper	0.00172**	<0.0005	0.0008	0.0008	0.0007	0.0006	0.0006
Iron	0.35+	<0.02	0.03	0.02	0.04	<0.02	<0.02
Mercury	0.00002++	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Potassium		2.21	2.27	2.37	0.92	0.46	0.41
Lithium		0.0011	<0.0005	<0.0005	<0.0005	<0.0005	0.0006
Magnesium		2.63	0.29	0.92	0.09	0.07	0.10
Manganese	1.04**	0.1310	0.0139	0.088	0.0045	0.0021	0.0034
Molybdenum	1**	0.0003	0.0002	0.0004	0.0001	<0.0001	0.0001
Sodium		4.74	1.59	2.02	0.75	0.75	0.78
Nickel	0.095***	0.0017	<0.0005	0.0006	<0.0005	<0.0005	<0.0005
Phosphorus		<0.05	<0.05	<0.05	0.06	0.05	<0.05
Lead	0.0065**	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Sulfur		6.0	1.4	1.7	<0.5	<0.5	<0.5
Antimony	0.009	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Selenium	0.002**	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Silicon		1.42	2.00	1.90	2.62	2.81	3.08
Tin		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Strontium		0.0558	0.0069	0.0166	0.0018	0.0018	0.0023
Tellurium		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Thorium		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Titanium		<0.0005	0.0015	0.0009	0.0021	0.0005	0.0007
Thallium	0.0008***	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Uranium	0.0085***	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Vanadium		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Tungsten		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Zinc	0.015**	<0.001	<0.001	0.002	<0.001	0.001	<0.001
Zirconium		<0.0001	0.0002	<0.0001	<0.0001	<0.0001	<0.0001
pH		6.16	6.64	6.46	6.63	6.23	6.69
Electrical Conductivity		158.5	23.9	45.62	9.601	7.819	7.669

Notes:

All results are expressed as mg/L.

** The BC Water Quality Guidelines shown are based on total concentrations and long term maximum exposure and assume an average water hardness of 100 ug/L .

\+ Standards shown are specific to long term dissolved concentrations only.

++ Mercury is based on 30 day average guideline where methlymercury concentration is 0.5% of total mercury concentration. All detection limits are above the guideline.

*** Guidelines for barium, beryllium, chromium, nickel, antimony, thallium and vanadium are BC Working Water Quality Guidelines and based on total substance concentrations.

1 Tan shading denotes concentration that exceeds the BC Water Quality Guideline Concentration.

3 Yellow shading denotes concentration that exceeds 3x the BC Water Quality Guideline Concentration.

10 Red shading denotes concentration that exceeds 10x the BC Water Quality Guideline Concentration.

THURBER

PROJECT: CANAL ROAD, PENDER ISLAND
THURBER FILE: 33450
TABLE 5: X-RAY DIFFRACTION (XRD) SUMMARY TABLE

Results of quantitative phase analysis (wt.%) XRD-Rietveld - AGAT Laboratories - 2 samples

Sample No.	AGAT Sample No.	Minerals Detected													
		Augite	Quartz	Plagioclase feldspar	Potassium feldspar	Muscovite / Illite / Biotite	Epidote	Chlorite	Diopside	Kaolinite	Vermiculite	Anatase	Epistilbite	Pyrite	Total
SA1	3932638A	1.3	42.5	28.3	5.6	10.4	1	10.8						0.1	100
SA6	3932643A		31.6	27.2	4.5	10.6	1.2	10.4	1	9.1	2.5	1.1	0.8		100

THURBER

APPENDIX C

LABORATORY CERTIFICATES

AGAT Laboratories

2910 12TH STREET NE
CALGARY, ALBERTA
CANADA T2E 7P7
TEL (403)735-2005
FAX (403)735-2771
http://www.agatlabs.com

CLIENT NAME: THURBER ENGINEERING LTD.
Suite 350, 7330 Fisher Street SE
Calgary, AB T2H 2H8
(403) 253-9217
ATTENTION TO: Victoria Smith
PROJECT: 33450
AGAT WORK ORDER: 22C903479
ROCK ANALYSIS REVIEWED BY: Jewel Shibu, Lab Supervisor
DATE REPORTED: Jun 22, 2022
PAGES (INCLUDING COVER): 14
VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (403) 735-2005

*Notes

Disclaimer:

- *All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.*
- *All samples will be disposed of within 30 days after receipt unless a Long Term Storage Agreement is signed and returned. Some specialty analysis may be exempt, please contact your Client Project Manager for details.*
- *AGAT's liability in connection with any delay, performance or non-performance of these services is only to the Client and does not extend to any other third party. Unless expressly agreed otherwise in writing, AGAT's liability is limited to the actual cost of the specific analysis or analyses included in the services.*
- *This Certificate shall not be reproduced except in full, without the written approval of the laboratory.*
- *The test results reported herewith relate only to the samples as received by the laboratory.*
- *Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, warranties of merchantability, fitness for a particular purpose, or non-infringement. AGAT assumes no responsibility for any errors or omissions in the guidelines contained in this document.*
- *All reportable information as specified by ISO/IEC 17025:2017 is available from AGAT Laboratories upon request.*

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 22C903479

PROJECT: 33450

CLIENT NAME: THURBER ENGINEERING LTD.

ATTENTION TO: Victoria Smith

SAMPLING SITE:

SAMPLED BY:

(181-703) ABA Package in Soil - Thurber (CGY)

DATE RECEIVED: 2022-06-02

DATE REPORTED: 2022-06-22

				SAMPLE DESCRIPTION:	SA01	SA02	SA03	SA04	SA05	SA06
				SAMPLE TYPE:	Rock	Rock	Rock	Rock	Rock	Rock
				DATE SAMPLED:	2022-06-03 13:44	2022-06-03 13:44	2022-06-03 13:44	2022-06-03 13:44	2022-06-03 13:44	2022-06-03 13:44
Parameter	**Unit**	**G / S**	**RDL**		**3932638**	**3932639**	**3932640**	**3932641**	**3932642**	**3932643**
Paste pH	pH units		0.1		6.90	7.85	7.47	7.15	6.68	7.39
pH 1:1	pH units		0.1		7.51	8.04	7.69	7.70	7.18	7.68
Fizz Rating					Slight	Slight	Slight	Slight	Slight	Slight
Inorganic Carbon - Total	%		0.02		<0.02	0.047	<0.02	<0.02	<0.02	<0.02
Maximum Potential Acidity (MPA)	kgCaCO3/tonne		0.2		4.1	0.6	0.9	0.6	<0.2	8.8
Net Neutralization Potential	kgCaCO3/tonne				18.3	17.8	18.6	15.7	14.2	9.9
Neutralization Potential Ratio					5.5	29.4	20.8	26.1	NA	2.1
Standard ABA NP	kg CaCO3/tonne				22.4	18.4	19.5	16.3	14.2	18.6
Total Sulfur	%		0.01		0.14	0.02	0.03	0.02	<0.01	0.28
CaCO3 Equivalents	kgCaCO3/tonne		0.8		<0.8	3.9	<0.8	<0.8	<0.8	<0.8

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

3932638-3932643 NA = A result is not calculated when the MPA is <0.2

Analysis performed at AGAT Calgary (unless marked by *)

Certified By:

Jewel Shibu

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 22C903479

PROJECT: 33450

CLIENT NAME: THURBER ENGINEERING LTD.

ATTENTION TO: Victoria Smith

SAMPLING SITE:

SAMPLED BY:

(181-708) ABA Sulphur Speciation Package in Soil - Thurber (CGY)

DATE RECEIVED: 2022-06-02

DATE REPORTED: 2022-06-22

				SAMPLE DESCRIPTION:	SA01	SA02	SA03	SA04	SA05	SA06
				SAMPLE TYPE:	Rock	Rock	Rock	Rock	Rock	Rock
				DATE SAMPLED:	2022-06-03 13:44	2022-06-03 13:44	2022-06-03 13:44	2022-06-03 13:44	2022-06-03 13:44	2022-06-03 13:44
Parameter	**Unit**	**G / S**	**RDL**		**3932638**	**3932639**	**3932640**	**3932641**	**3932642**	**3932643**
Sulphate Speciated	%		0.01		0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sulphide Sulphur	%		0.01		0.13	0.02	0.03	0.02	<0.01	0.28

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Analysis performed at AGAT Calgary (unless marked by *)

Certified By:

Jewel Shibu

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http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 22C903479

PROJECT: 33450

CLIENT NAME: THURBER ENGINEERING LTD.

ATTENTION TO: Victoria Smith

SAMPLING SITE:

SAMPLED BY:

(181-752) Dissolved Metals - Shake Flask Extraction (Thurber) (mg/L) (CGY)

DATE RECEIVED: 2022-06-02

DATE REPORTED: 2022-06-22

		SAMPLE DESCRIPTION:		SFE SA01	SFE SA02	SFE SA03	SFE SA04	SFE SA05	SFE SA06
		SAMPLE TYPE:		SFE	SFE	SFE	SFE	SFE	SFE
		DATE SAMPLED:							
Parameter	Unit	G / S	RDL	3932703	3932704	3932705	3932706	3932707	3932708
Weight of Dry Sample	g			250.02	250.03	250.14	250.16	250.17	250.05
Volume of DI Water	mL			750	750	750	750	750	750
pH	pH units		0.01	6.16	6.64	6.46	6.63	6.23	6.69
Electrical Conductivity	µS/cm		1	158.5	23.91	45.62	9.601	7.819	7.669
Silver Dissolved	mg/L		0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008
Aluminum Dissolved	mg/L		0.001	0.005	0.037	0.036	0.031	0.019	0.016
Arsenic Dissolved	mg/L		0.0002	<0.0002	0.0002	0.0005	<0.0002	<0.0002	<0.0002
Boron Dissolved	mg/L		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Barium Dissolved	mg/L		0.0002	0.0120	0.0086	0.0140	0.0016	0.0012	0.0017
Beryllium Dissolved	mg/L		0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth Dissolved	mg/L		0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cadmium Dissolved	mg/L		0.00001	0.00002	<0.00001	0.00001	<0.00001	<0.00001	<0.00001
Calcium Dissolved	mg/L		0.05	8.77	0.66	2.68	0.21	0.19	0.19
Cobalt Dissolved	mg/L		0.0001	0.0013	0.0003	0.0006	0.0001	0.0001	<0.0001
Chromium Dissolved	mg/L		0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Copper Dissolved	mg/L		0.0005	<0.0005	0.0008	0.0008	0.0007	0.0006	0.0006
Iron Dissolved	mg/L		0.02	<0.02	0.03	0.02	0.04	<0.02	<0.02
Mercury Dissolved	mg/L		0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Potassium Dissolved	mg/L		0.05	2.21	2.27	2.37	0.92	0.46	0.41
Lithium Dissolved	mg/L		0.0005	0.0011	<0.0005	<0.0005	<0.0005	<0.0005	0.0006
Magnesium Dissolved	mg/L		0.05	2.63	0.29	0.92	0.09	0.07	0.10
Manganese Dissolved	mg/L		0.0002	0.131	0.0139	0.0880	0.0045	0.0021	0.0034
Molybdenum Dissolved	mg/L		0.0001	0.0003	0.0002	0.0004	0.0001	<0.0001	0.0001
Sodium Dissolved	mg/L		0.02	4.74	1.59	2.02	0.75	0.75	0.78
Nickel Dissolved	mg/L		0.0005	0.0017	<0.0005	0.0006	<0.0005	<0.0005	<0.0005
Phosphorus Dissolved	mg/L		0.05	<0.05	<0.05	<0.05	0.06	0.05	<0.05
Lead Dissolved	mg/L		0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Sulphur Dissolved	mg/L		0.5	6.0	1.4	1.7	<0.5	<0.5	<0.5
Antimony Dissolved	mg/L		0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Selenium Dissolved	mg/L		0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005

Certified By:

Jewel Shibu

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http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 22C903479

PROJECT: 33450

CLIENT NAME: THURBER ENGINEERING LTD.

ATTENTION TO: Victoria Smith

SAMPLING SITE:

SAMPLED BY:

(181-752) Dissolved Metals - Shake Flask Extraction (Thurber) (mg/L) (CGY)

DATE RECEIVED: 2022-06-02

DATE REPORTED: 2022-06-22

SAMPLE DESCRIPTION:				SFE SA01	SFE SA02	SFE SA03	SFE SA04	SFE SA05	SFE SA06
SAMPLE TYPE:				SFE	SFE	SFE	SFE	SFE	SFE
DATE SAMPLED:									
Parameter	**Unit**	**G / S**	**RDL**	**3932703**	**3932704**	**3932705**	**3932706**	**3932707**	**3932708**
Silicon Dissolved	mg/L		0.05	1.42	2.00	1.90	2.62	2.81	3.08
Tin Dissolved	mg/L		0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Strontium Dissolved	mg/L		0.0002	0.0558	0.0069	0.0166	0.0018	0.0018	0.0023
Tellurium Dissolved	mg/L		0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Thorium Dissolved	mg/L		0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Titanium Dissolved	mg/L		0.0005	<0.0005	0.0015	0.0009	0.0021	0.0005	0.0007
Thallium Dissolved	mg/L		0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Uranium Dissolved	mg/L		0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Vanadium Dissolved	mg/L		0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Tungsten Dissolved	mg/L		0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Zinc Dissolved	mg/L		0.001	<0.001	<0.001	0.002	<0.001	0.001	<0.001
Zirconium Dissolved	mg/L		0.0001	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	<0.0001

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

3932703-3932708 Shakeflask Extracts are Double Filtered

Analysis performed at AGAT Calgary (unless marked by *)

Certified By:

Jewel Shibu

AGAT Laboratories

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http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 22C903479

PROJECT: 33450

CLIENT NAME: THURBER ENGINEERING LTD.

ATTENTION TO: Victoria Smith

SAMPLING SITE:

SAMPLED BY:

(283-071) 4 Acid Digest - Metals Package, ICP-OES/ICP-MS finish (CGY)

DATE RECEIVED: 2022-06-02

DATE REPORTED: 2022-06-22

SAMPLE DESCRIPTION:				SA01	SA02		SA03		SA04	SA05	SA06
SAMPLE TYPE:				Rock	Rock		Rock		Rock	Rock	Rock
DATE SAMPLED:				2022-06-03 13:44	2022-06-03 13:44		2022-06-03 13:44		2022-06-03 13:44	2022-06-03 13:44	2022-06-03 13:44
Parameter	Unit	G / S	RDL	3932638	3932639	RDL	3932640	RDL	3932641	3932642	3932643
Ag	ppm		0.001	0.079	0.083	0.001	0.069	0.001	0.070	0.077	0.202
Al	%		0.001	6.40	6.53	0.001	5.81	0.001	8.09	10.4	9.71
As	ppm		0.005	10.63	7.52	0.005	12.94	0.005	12.77	19.72	15.80
Ba	ppm		0.05	634	604	0.05	624	0.05	758	842	1270
Be	ppm		0.02	1.16	1.01	0.02	0.84	0.02	1.34	1.38	1.70
Bi	ppm		0.002	0.097	0.070	0.002	0.062	0.002	0.193	0.218	0.219
Ca	%		0.0001	1.27	1.74	0.0001	1.06	0.0001	1.28	1.32	1.67
Cd	ppm		0.005	0.069	0.111	0.005	0.062	0.005	0.082	0.109	0.165
Ce	ppm		0.005	33.9	29.4	0.005	32.0	0.005	37.3	39.7	49.4
Co	ppm		0.005	10.9	12.3	0.005	10.6	0.005	18.7	27.3	36.2
Cr	ppm		1.0	303	325	1.0	250	1.0	235	208	261
Cs	ppm		0.005	1.90	1.06	0.005	0.725	0.005	3.87	5.26	5.77
Cu	ppm		0.5	17.9	22.1	0.5	15.5	0.5	28.7	42.2	42.6
Fe	%		0.01	4.00	4.83	0.001	3.23	0.01	5.66	5.27	5.30
Ga	ppm		0.005	15.9	15.9	0.005	14.5	0.005	20.1	26.1	26.6
Ge	ppm		0.01	0.11	0.11	0.01	0.13	0.01	0.11	0.14	0.18
Hf	ppm		0.001	1.38	1.52	0.001	1.74	0.001	1.34	1.70	1.69
In	ppm		0.001	0.040	0.047	0.001	0.043	0.001	0.051	0.069	0.077
K	%		0.001	1.40	0.960	0.001	1.02	0.001	1.57	1.59	1.55
La	ppm		0.05	17.6	13.7	0.05	15.5	0.05	18.5	20.0	23.8
Li	ppm		0.05	31.7	27.6	0.05	25.3	0.05	57.7	100	98.1
Mg	%		0.001	0.889	1.23	0.001	0.830	0.001	1.29	1.73	2.13
Mn	ppm		1.0	526	690	1.0	572	1.0	571	700	1060
Mo	ppm		0.005	3.05	2.77	0.005	3.03	0.005	1.80	1.33	1.16
Na	%		0.001	1.62	1.83	0.001	1.87	0.001	1.29	1.11	1.20
Nb	ppm		0.005	6.69	4.78	0.005	5.47	0.005	8.93	9.40	8.75
Ni	ppm		1.0	28.7	24.8	1.0	21.9	1.0	38.5	51.0	75.4
P	ppm		10.0	453	775	10.0	800	10.0	747	912	558
Pb	ppm		0.005	9.43	7.85	0.005	7.31	0.005	12.2	13.6	14.5

Certified By:

Jewel Shibu

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 22C903479

PROJECT: 33450

CLIENT NAME: THURBER ENGINEERING LTD.

ATTENTION TO: Victoria Smith

SAMPLING SITE:

SAMPLED BY:

(283-071) 4 Acid Digest - Metals Package, ICP-OES/ICP-MS finish (CGY)

DATE RECEIVED: 2022-06-02

DATE REPORTED: 2022-06-22

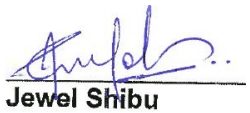
SAMPLE DESCRIPTION:				SA01	SA02		SA03		SA04	SA05	SA06
SAMPLE TYPE:				Rock	Rock		Rock		Rock	Rock	Rock
DATE SAMPLED:				2022-06-03 13:44	2022-06-03 13:44		2022-06-03 13:44		2022-06-03 13:44	2022-06-03 13:44	2022-06-03 13:44
Parameter	Unit	G / S	RDL	3932638	3932639	RDL	3932640	RDL	3932641	3932642	3932643
Rb	ppm		0.005	47.9	29.2	0.005	29.0	0.005	73.0	94.2	96.0
Re	ppm		0.0003	0.0028	0.0027	0.0003	0.0021	0.0003	0.0028	0.0041	0.0051
S	%		0.001	0.150	0.028	0.001	0.035	0.001	0.014	0.017	0.010
Sb	ppm		0.01	0.74	0.73	0.01	0.86	0.01	0.69	0.88	0.90
Sc	ppm		0.005	12.2	15.4	0.005	13.5	0.005	16.9	25.8	29.4
Se	ppm		0.002	0.782	0.851	0.002	0.907	0.002	0.842	0.965	1.47
Sn	ppm		0.05	1.38	1.28	0.05	1.34	0.05	1.60	1.83	1.84
Sr	ppm		0.005	251	275	0.005	205	0.005	276	249	363
Ta	ppm		0.05	0.48	0.31	0.05	0.37	0.05	0.58	0.63	0.60
Te	ppm		0.005	0.045	0.037	0.005	0.049	0.005	0.054	0.084	0.097
Th	ppm		0.001	5.18	3.33	0.001	4.42	0.001	6.47	7.03	6.53
Ti	%		0.0001	0.267	0.325	0.0001	0.292	0.0001	0.344	0.455	0.481
Tl	ppm		0.005	0.299	0.193	0.005	0.182	0.005	0.395	0.438	0.445
U	ppm		0.001	1.48	1.17	0.001	1.50	0.001	1.74	2.07	1.83
V	ppm		0.5	89.9	103	0.5	82.8	0.5	151	233	256
W	ppm		0.005	0.720	0.667	0.005	0.785	0.005	0.942	1.23	1.22
Y	ppm		0.005	11.3	15.4	0.005	16.6	0.005	10.9	14.2	23.3
Zn	ppm		0.5	57.8	68.5	0.5	59.0	0.5	96.2	133	157
Zr	ppm		0.02	54.2	57.5	0.02	54.5	0.02	43.1	53.3	51.2

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

3932638-3932643 As, Sb values may be low due to digestion losses.

Analysis performed at AGAT Calgary (unless marked by *)

Certified By:



Jewel Shibu

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Quality Assurance

CLIENT NAME: THURBER ENGINEERING LTD.

AGAT WORK ORDER: 22C903479

PROJECT: 33450

ATTENTION TO: Victoria Smith

SAMPLING SITE:

SAMPLED BY:

Rock Analysis

RPT Date: Jun 22, 2022			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
(181-703) ABA Package in Soil - Thurber (CGY)															
Paste pH	1	3932638	6.90	6.90	0.0%	< 0.1	100%								
pH 1:1	1	3932639	8.04	7.97	0.9%	< 0.1	100%								
Fizz Rating	1	3939213	Slight	Slight	0.0%										
Inorganic Carbon - Total	1	3939213	0.095	0.082	14.2%	< 0.02	89%	80%	120%						
Standard ABA NP	1	3939213	69.2	69.7	0.7%		101%	85%	115%						
Total Sulfur		3944329	0.04	0.05	16.4%	< 0.01	102%	90%	110%						
Comments: RPDs are calculated using raw analytical data and not the rounded duplicate values reported.															
(181-708) ABA Sulphur Speciation Package in Soil - Thurber (CGY)															
Total Sulfur		3944329	0.04	0.05	16.4%	< 0.01	102%	90%	110%						
Sulphate Speciated	3932237	3932237	0.04	0.03	NA	< 0.01	92%								
(283-071) 4 Acid Digest - Metals Package, ICP-OES/ICP-MS finish (CGY)															
Ag	3933505		0.137	0.122	12.1%	< 0.001		80%	120%						
Al	3021784	3021784	6.12	6.22	1.7%	< 0.001	98%	80%	120%						70%
As	3933505		3.83	3.99	4.1%	< 0.005		80%	120%						
Ba	3933505		1040	1030	0.2%	< .05		80%	120%						
Be	3933505		0.90	0.78	14.4%	< 0.02		80%	120%						
Bi	3933505		0.144	0.222	42.3%	< 0.002		80%	120%						
Ca	3021784	3021784	9.16	9.23	0.8%	< 0.0001	101%	80%	120%						
Cd	3933505		0.122	0.117	4.4%	< 0.005		80%	120%						70%
Ce	3933505		25.8	28.7	10.4%	< 0.005		80%	120%						
Co	3933505		6.99	6.80	2.7%	< 0.005		80%	120%						
Cr	3021784	3021784	138	138	0.4%	< 1.0	97%	80%	120%						
Cs	3933505		0.903	0.898	0.5%	< 0.005		80%	120%						
Cu	3021784	3021784	60.6	58.4	3.6%	< 0.5	92%	80%	120%						
Fe	3021784	3021784	3.35	3.38	0.8%	< 0.001	94%	80%	120%						
Ga	3933505		20.4	20.3	0.2%	< 0.005		80%	120%						
Ge	3933505		0.10	0.11	12.1%	< 0.01		80%	120%						
Hf	3933505		0.509	0.530	4.1%	< 0.001		80%	120%						
In	3933505		0.030	0.028	5.9%	< 0.001		80%	120%						
K	3021784	3021784	0.930	0.957	2.9%	< 0.001	99%	80%	120%						
La	3933505		12.6	13.7	8.4%	< 0.05		80%	120%						
Li	3933505		8.30	8.32	0.2%	< 0.05		80%	120%						
Mg	3021784	3021784	5.86	5.96	1.7%	< 0.001	99%	80%	120%						
Mn	3021784	3021784	676	695	2.7%	< 1.0	99%	80%	120%						
Mo	3933505		7.97	7.83	1.8%	< 0.005		80%	120%						
Na	3021784	3021784	0.448	0.457	1.8%	< 0.001	94%	80%	120%						
Nb	3933505		3.42	3.12	9.2%	< 0.005		80%	120%						

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AGAT WORK ORDER: 22C903479

PROJECT: 33450

ATTENTION TO: Victoria Smith

SAMPLING SITE:

SAMPLED BY:

Rock Analysis (Continued)

RPT Date: Jun 22, 2022			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Ni	3021784	3021784	37.1	38.9	4.9%	< 1.0	85%	80%	120%						
P	3021784	3021784	832	878	5.4%	< 10.0	103%	80%	120%						
Pb	3933505		10.6	10.5	1.8%	< 0.005		80%	120%						
Rb	3933505		26.1	26.2	0.3%	< 0.005		80%	120%						
Re	3933505		0.0045	0.0049	8.1%	< 0.0003		80%	120%						
S	3021784	3021784	0.499	0.502	0.6%	< 0.001	97%	80%	120%						
Sb	3933505		0.12	0.11	6.3%	< 0.01		80%	120%						
Sc	3933505		6.29	6.24	0.9%	< 0.005		80%	120%						
Se	3933505		0.593	0.495	18.0%	< 0.002		80%	120%						
Sn	3933505		0.91	0.94	3.6%	< 0.05		80%	120%						
Sr	3933505		780	785	0.7%	< 0.005		80%	120%						
Ta	3933505		0.22	0.22	0.4%	< 0.05		80%	120%						
Te	3933505		0.030	0.032	6.4%	< 0.005		80%	120%						
Th	3933505		2.13	2.30	7.7%	< 0.001		80%	120%						
Ti	3021784	3021784	0.278	0.284	2.2%	< 0.0001	89%	80%	120%						
Tl	3933505		0.218	0.219	0.5%	< 0.005		80%	120%						
U	3933505		1.21	1.26	4.0%	< 0.001		80%	120%						
V	3933505		55.1	56.9	3.2%	< 0.5		80%	120%						
W	3933505		0.856	0.850	0.6%	< 0.005		80%	120%						
Y	3933505		8.46	8.65	2.1%	< 0.005		80%	120%						
Zn	3933505		60.3	63.4	5.0%	< 0.5		80%	120%						
Zr	3933505		11.3	11.4	0.7%	< 0.02		80%	120%						
(181-752) Dissolved Metals - Shake Flask Extraction (Thurber) (mg/L) (CGY)															
pH	1	3932703	6.16	6.24	1.3%	< 0.01	100%	95%	105%						
Electrical Conductivity	1	3932703	158.5	154.5	2.6%	< 1	100%	90%	110%						
Silver Dissolved	3932703	3932703	<0.00008	<0.00008	0.0%	< 0.00008	100%	80%	120%						
Aluminum Dissolved	3932703	3932703	0.005	0.013	NA	< 0.001	98%	80%	120%						
Arsenic Dissolved	3932703	3932703	<0.0002	<0.0002	0.0%	< 0.0002	102%	80%	120%						
Boron Dissolved	3932703	3932703	<0.01	<0.01	0.0%	< 0.01	98%	80%	120%						
Barium Dissolved	3932703	3932703	0.0120	0.0132	9.7%	< 0.0002	98%	80%	120%						
Beryllium Dissolved	3932703	3932703	<0.0001	<0.0001	0.0%	< 0.0001	100%	80%	120%						
Bismuth Dissolved	3932703	3932703	<0.0001	<0.0001	0.0%	< 0.0001	104%	80%	120%						
Cadmium Dissolved	3932703	3932703	0.00002	0.00002	0.5%	< 0.00001	98%	80%	120%						
Calcium Dissolved	3932703	3932703	8.77	8.12	7.7%	< 0.05	97%	80%	120%						
Cobalt Dissolved	3932703	3932703	0.0013	0.0014	7.2%	< 0.0001	100%	80%	120%						
Chromium Dissolved	3932703	3932703	<0.0005	<0.0005	0.0%	< 0.0005	94%	80%	120%						
Copper Dissolved	3932703	3932703	<0.0005	<0.0005	0.0%	< 0.0005	96%	80%	120%						
Iron Dissolved	3932703	3932703	<0.02	<0.02	NA	< 0.02	103%	80%	120%						
Mercury Dissolved	3932703	3932703	<0.00005	<0.00005	0.0%	< 0.00005	100%	80%	120%						

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AGAT WORK ORDER: 22C903479

PROJECT: 33450

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Rock Analysis (Continued)

RPT Date: Jun 22, 2022			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Potassium Dissolved	3932703	3932703	2.21	2.26	2.2%	< 0.05	104%	80%	120%						
Lithium Dissolved	3932703	3932703	0.0011	0.0012	9.2%	< 0.0005	96%	80%	120%						
Magnesium Dissolved	3932703	3932703	2.63	2.80	6.3%	< 0.05	105%	80%	120%						
Manganese Dissolved	3932703	3932703	0.131	0.120	8.8%	< 0.0002	91%	80%	120%						
Molybdenum Dissolved	3932703	3932703	0.0003	<0.0001	NA	< 0.0001	96%	80%	120%						
Sodium Dissolved	3932703	3932703	4.74	4.84	2.1%	< 0.02	103%	80%	120%						
Nickel Dissolved	3932703	3932703	0.0017	0.0018	6.0%	< 0.0005	98%	80%	120%						
Phosphorus Dissolved	3932703	3932703	<0.05	<0.05	NA	< 0.05	98%	80%	120%						
Lead Dissolved	3932703	3932703	<0.0005	<0.0005	0.0%	< 0.0005	102%	80%	120%						
Sulphur Dissolved	3932703	3932703	6.0	6.1	1.7%	< 0.5	103%	80%	120%						
Antimony Dissolved	3932703	3932703	<0.0001	<0.0001	0.0%	< 0.0001	96%	80%	120%						
Selenium Dissolved	3932703	3932703	<0.0005	<0.0005	0.0%	< 0.0005	102%	80%	120%						
Silicon Dissolved	3932703	3932703	1.42	1.48	4.1%	< 0.05	103%	80%	120%						
Tin Dissolved	3932703	3932703	<0.0005	<0.0005	0.0%	< 0.0005	92%	80%	120%						
Strontium Dissolved	3932703	3932703	0.0558	0.0579	3.6%	< 0.0002	94%	80%	120%						
Tellurium Dissolved	3932703	3932703	<0.0002	<0.0002	0.0%	< 0.0002	98%	80%	120%						
Thorium Dissolved	3932703	3932703	<0.0001	<0.0001	0.0%	< 0.0001	102%	80%	120%						
Titanium Dissolved	3932703	3932703	<0.0005	<0.0005	0.0%	< 0.0005	100%	80%	120%						
Thallium Dissolved	3932703	3932703	<0.00005	<0.00005	0.0%	< 0.00005	106%	80%	120%						
Uranium Dissolved	3932703	3932703	<0.00005	<0.00005	0.0%	< 0.00005	104%	80%	120%						
Vanadium Dissolved	3932703	3932703	<0.001	<0.001	0.0%	< 0.001	94%	80%	120%						
Tungsten Dissolved	3932703	3932703	<0.0001	<0.0001	0.0%	< 0.0001	100%	80%	120%						
Zinc Dissolved	3932703	3932703	<0.001	0.002	NA	< 0.001	98%	80%	120%						
Zirconium Dissolved	3932703	3932703	<0.0001	<0.0001	0.0%	< 0.0001	96%	80%	120%						

Comments: RPDs are calculated using raw analytical data and not the rounded duplicate values reported.

Certified By:

Jewel Shibu

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Method Summary

CLIENT NAME: THURBER ENGINEERING LTD.

AGAT WORK ORDER: 22C903479

PROJECT: 33450

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SAMPLING SITE:

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PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Rock Analysis			
Paste pH	ARD-181-18003	Sobek A.A. et al; Report EPA-600/2-78-054 (1978)	PH-METER
pH 1:1	ARD-181-18002	MEND Report 1.20.1 (2009)	PH-METER
Fizz Rating	ARD-181-18000	MEND Project 1.16.1b (Sect. 6.2.3) (March 1991)	PH-METER
Inorganic Carbon - Total	INOR-181-6027	Modified from ASTM E1915-11	LECO
Maximum Potential Acidity (MPA)	ARD-181-18000	MEND Project 1.16.1b (Sect. 6.2.3) (March 1991)	PH-METER
Net Neutralization Potential	ARD-181-18000	MEND Project 1.16.1b (Sect. 6.2.3) (March 1991)	PH-METER
Neutralization Potential Ratio	ARD-181-18000	MEND Project 1.16.1b (Sect. 6.2.3) (March 1991)	PH-METER
Standard ABA NP	ARD-181-18004	MEND Project 1.20.1, Version 0 (2009)	PH-METER
Total Sulfur	MIN-283-12001		LECO
Sulphate Speciated	INOR-181-6028	Modified from SM 4500-SO4 E	ICP/OES
Sulphide Sulphur	MIN-200-12037		N/A
Weight of Dry Sample			BALANCE
Volume of DI Water			None
pH	ARD-283-18011	Modified from SM 4500-H+	PH METER
Electrical Conductivity	ARD-283-18012	Modified from SM 2510 B	EC METER
Silver Dissolved	ARD-181-18006, MIN-283-12026	Modified from SM 3125 B	ICP-MS
Aluminum Dissolved	ARD-181-18006, MIN-283-12026	Modified from SM 3125 B	ICP-MS
Arsenic Dissolved	ARD-181-18006, MIN-283-12026	Modified from SM 3125 B	ICP-MS
Boron Dissolved	ARD-181-18006, MIN-283-12026	Modified from SM 3125 B	ICP-MS
Barium Dissolved	ARD-181-18006, MIN-283-12026	Modified from SM 3125 B	ICP-MS
Beryllium Dissolved	ARD-181-18006, MIN-283-12026	Modified from SM 3125 B	ICP-MS
Bismuth Dissolved	ARD-181-18006, MIN-283-12026	Modified from SM 3125 B	ICP-MS
Cadmium Dissolved	ARD-181-18006, MIN-283-12026	Modified from SM 3125 B	ICP-MS
Calcium Dissolved	ARD-181-18006, MIN-283-12025	Modified from SM 3120 B	ICP-OES
Cobalt Dissolved	ARD-181-18006, MIN-283-12026	Modified from SM 3125 B	ICP-MS
Chromium Dissolved	ARD-181-18006, MIN-283-12026	Modified from SM 3125 B	ICP-MS
Copper Dissolved	ARD-181-18006, MIN-283-12026	Modified from SM 3125 B	ICP-MS
Iron Dissolved	ARD-181-18006, MIN-283-12025	Modified from SM 3120 B	ICP-OES
Mercury Dissolved	ARD-181-18006, MIN-283-12026	Modified from SM 3125 B	ICP-MS
Potassium Dissolved	ARD-181-18006, MIN-283-12025	Modified from SM 3120 B	ICP-OES
Lithium Dissolved	ARD-181-18006, MIN-283-12026	Modified from SM 3125 B	ICP-MS

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PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Magnesium Dissolved	ARD-181-18006, MIN-283-12025	Modified from SM 3120 B	ICP-OES
Manganese Dissolved	ARD-181-18006, MIN-283-12025	Modified from SM 3120 B	ICP-OES
Molybdenum Dissolved	ARD-181-18006, MIN-283-12026	Modified from SM 3125 B	ICP-MS
Sodium Dissolved	ARD-181-18006, MIN-283-12025	Modified from SM 3120 B	ICP-OES
Nickel Dissolved	ARD-181-18006, MIN-283-12026	Modified from SM 3125 B	ICP-MS
Phosphorus Dissolved	ARD-181-18006, MIN-283-12025	Modified from SM 3120 B	ICP-OES
Lead Dissolved	ARD-181-18006, MIN-283-12026	Modified from SM 3125 B	ICP-MS
Sulphur Dissolved	ARD-181-18006, MIN-283-12025	Modified from SM 3120 B	ICP-OES
Antimony Dissolved	ARD-181-18006, MIN-283-12026	Modified from SM 3125 B	ICP-MS
Selenium Dissolved	ARD-181-18006, MIN-283-12026	Modified from SM 3125 B	ICP-MS
Silicon Dissolved	ARD-181-18006, MIN-283-12025	Modified from SM 3120 B	ICP-OES
Tin Dissolved	ARD-181-18006, MIN-283-12026	Modified from SM 3125 B	ICP-MS
Strontium Dissolved	ARD-181-18006, MIN-283-12026	Modified from SM 3125 B	ICP-MS
Tellurium Dissolved	ARD-181-18006, MIN-283-12026	Modified from SM 3125 B	ICP-MS
Thorium Dissolved	ARD-181-18006, MIN-283-12026	Modified from SM 3125 B	ICP-MS
Titanium Dissolved	ARD-181-18006, MIN-283-12026	Modified from SM 3125 B	ICP-MS
Thallium Dissolved	ARD-181-18006, MIN-283-12026	Modified from SM 3125 B	ICP-MS
Uranium Dissolved	ARD-181-18006, MIN-283-12026	Modified from SM 3125 B	ICP-MS
Vanadium Dissolved	ARD-181-18006, MIN-283-12026	Modified from SM 3125 B	ICP-MS
Tungsten Dissolved	ARD-181-18006, MIN-283-12026	Modified from SM 3125 B	ICP-MS
Zinc Dissolved	ARD-181-18006, MIN-283-12026	Modified from SM 3125 B	ICP-MS
Zirconium Dissolved	ARD-181-18006, MIN-283-12026	Modified from SM 3125 B	ICP-MS
Ag	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS
Al	MIN-283-12008.003 & MIN-283-12025.003		ICP/OES
As	MIN-283-12008.003 and MIN-283-12526.003		ICP/OES
Ba	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS
Be	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS
Bi	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS

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PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Ca	MIN-283-12008.003 & MIN-283-12025.003		ICP/OES
Cd	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS
Ce	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS
Co	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS
Cr	MIN-283-12008.003 & MIN-283-12025.003		ICP/OES
Cs	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS
Cu	MIN-283-12008.003 & MIN-283-12025.003		ICP/OES
Fe	MIN-283-12008.003 & MIN-283-12025.003		ICP/OES
Ga	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS
Ge	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS
Hf	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS
In	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS
K	MIN-283-12008.003 & MIN-283-12025.003		ICP/OES
La	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS
Li	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS
Mg	MIN-283-12008.003 & MIN-283-12025.003		ICP/OES
Mn	MIN-283-12008.003 & MIN-283-12025.003		ICP/OES
Mo	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS
Na	MIN-283-12008.003 & MIN-283-12025.003		ICP/OES
Nb	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS
Ni	MIN-283-12008.003 & MIN-283-12025.003		ICP/OES
P	MIN-283-12008.003 & MIN-283-12025.003		ICP/OES
Pb	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS
Rb	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS
Re	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS
S	MIN-283-12008.003 & MIN-283-12025.003		ICP/OES
Sb	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS
Sc	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS

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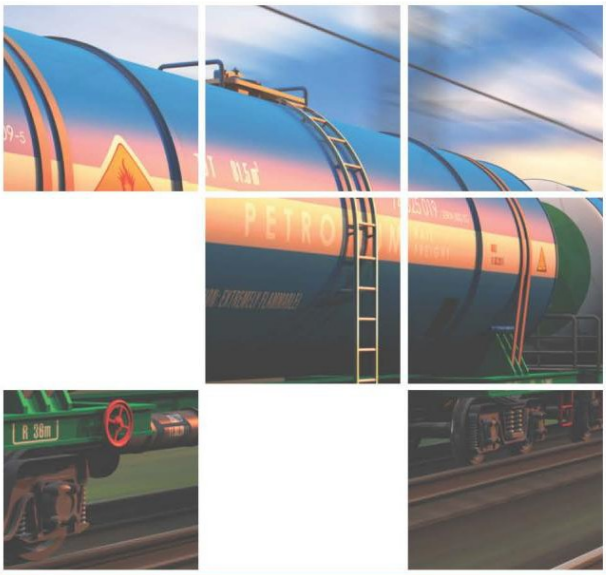
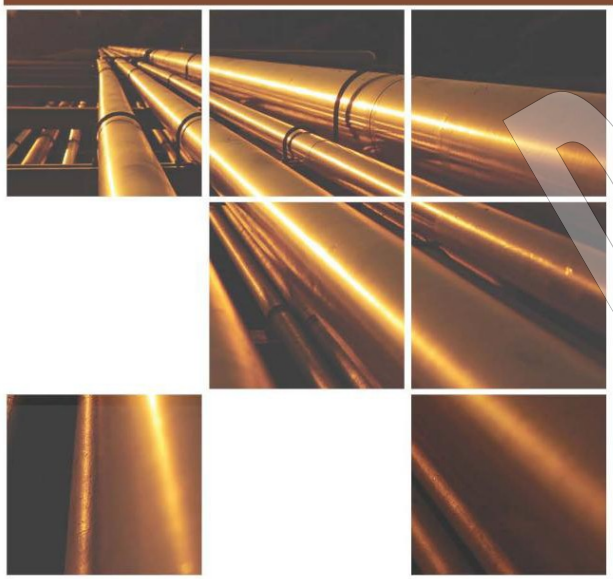
SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Se	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS
Sn	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS
Sr	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS
Ta	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS
Te	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS
Th	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS
Ti	MIN-283-12008.003 & MIN-283-12025.003		ICP/OES
Tl	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS
U	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS
V	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS
W	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS
Y	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS
Zn	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS
Zr	MIN-283-12008.003 and MIN-283-12526.003		ICP-MS



BULK X-RAY DIFFRACTION (XRD) ANALYSIS USING RIETVELD METHOD FOR ONE SAMPLE [SA01]



Company: THURBER ENGINEERING LTD

Work Order No: 22A21614 (22C903479)

Date: June, 2022

AGAT Geology Department
2730 39 Ave NE, Calgary
Alberta T1Y 7H6

AGAT Laboratories

Service Beyond Analysis

Bulk X-Ray Diffraction Analysis

Introduction: One sample with the below identification (**Table 1**) was obtained from Thurber Engineering Ltd. for Bulk X-Ray Diffraction (XRD) analysis at the Geology Division, AGAT Laboratories Ltd., Calgary.

Table 1: Sample background information

Sample #	Sample ID	Client Sample ID	Date and Time Sampled
1	3932638A	SA01	June 03, 2022 @ 1:44:58 PM

Sample Preparation: The sample was homogenized thoroughly. Approximately 1 gram of subsample was taken from the homogenized sample and was micronized using a planetary ball mill. The micronized subsample was then used for powder X-ray diffraction (XRD) analysis for quantitative phase analysis. The experimental setup for XRD for data collection is given as annexure-A.

Quantitative mineral/compounds analysis: Using HighScore program, the different mineral phases of the XRD pattern were identified. Once the mineral phases were identified, Rietveld refinement was performed by importing the trace pattern into TOPAS 5. This program (TOPAS 5) is used for Rietveld analysis to quantify the mineralogy. The XRD results are given in **Table 2**. The powder X-ray diffraction pattern refined by Rietveld method is also given in **Figure 1**.

Bulk XRD Analysis Results

Table 2: Results of quantitative mineral analysis (relative weight %) of X-ray diffraction data for sample 1 [SA01] using Rietveld method

Mineral Name	Compound Name	Ideal Chemical Formula	Concentration, wt.%
Quartz	Silicon oxide	SiO_2	**42.5**
Plagioclase feldspar	Sodium calcium aluminum silicate	$(CaNa)Al_{1-2}Si_{2-3}O_8$	**28.3**
Chlorite	Iron magnesium aluminum silicate	$(MgFe)_5Al(AlSi_3)O_{10}(OH)_9$	**10.8**
Muscovite	Potassium aluminum silicate hydroxide	$KAl_2(OH)_2(AlSi_3(O,OH)_{10})$	**10.4**
Potassium feldspar	Potassium aluminum silicate	$KAlSi_3O_8$	**5.6**
Augite	Calcium sodium iron titanium aluminum silicate	$(CaNa)(MgFeAlTi)(SiAl)_2O_6$	**1.3**
Epidote	Calcium aluminum iron silicate hydroxide	$Ca_2Al_2(FeAl)(SiO_4)(Si_2O_7)O(OH)$	**1.0**
Pyrite	Iron sulfide	FeS_2	**0.1**
		Total:	**100.0**

Comments: The XRD result (**Table 2**) shows that the rock sample consists mainly of tectosilicates (quartz, plagioclase feldspar, and potassium feldspar), with lesser amounts of mica (chlorite and muscovite). In addition, minor to trace amounts of pyroxene (augite), sorosilicate (epidote) and sulfide (pyrite) are also present.

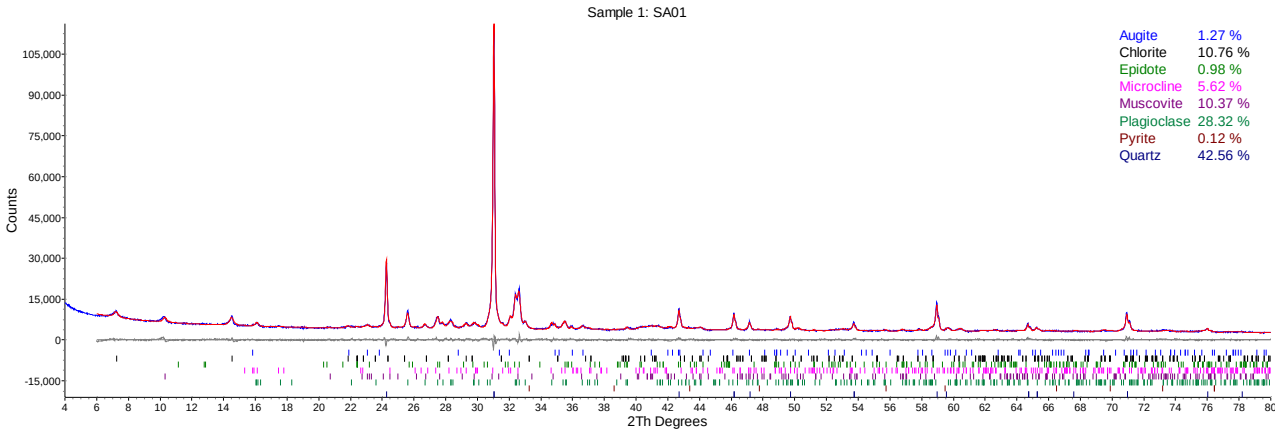
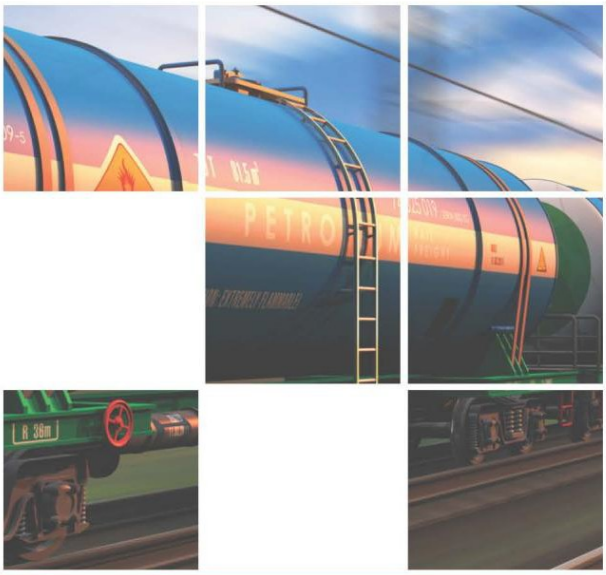


Figure 1: Powder X-ray Diffraction Pattern for Sample 1 [SA01] after Rietveld Refinement

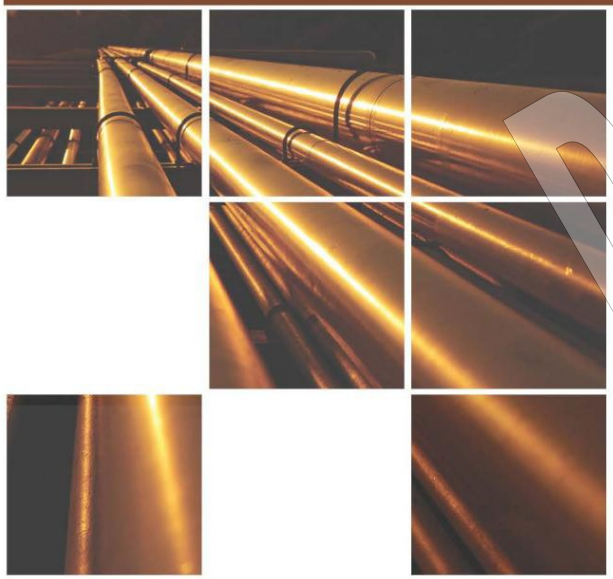
Annexure-A

Experimental Setup for X-Ray Diffraction Data Collection and Analysis:

Diffractometer Name:	Bruker D4 Endeavor XRD with a Lynx-Eye detector
Instrumental Parameters:	Radiation Source – Cobalt (Co)
	Generator settings - 40 mA, 35 kV
	Start position [°2θ] - 4
	End position [°2θ] - 80
	Step size [°2θ] - 0.02
	Scan step time [s] - 1
Data Analysis:	ICDD PDF-4 Mineral 2022 powder diffraction database
	X'PERT HighScore Software for mineral identification
	TOPAS Software for quantitative phase analysis
Detection Limit:	0.5 – 1.0 % depending on the type, nature of sample, and crystallinity



BULK X-RAY DIFFRACTION (XRD) ANALYSIS USING RIETVELD METHOD FOR ONE SAMPLE [SA06]



Company: THURBER ENGINEERING LTD

Work Order No: 22A21652 (22C903479)

Date: July, 2022

AGAT Geology Department
2730 39 Ave NE, Calgary
Alberta T1Y 7H6

AGAT Laboratories

Service Beyond Analysis

Bulk X-Ray Diffraction Analysis

Introduction: One sample with the below identification (**Table 1**) was obtained from Thurber Engineering Ltd. for Bulk X-Ray Diffraction (XRD) analysis at the Geology Division, AGAT Laboratories Ltd., Calgary.

Table 1: Sample background information

Sample #	Sample ID	Client Sample ID	Date and Time Sampled
1	3932643A	SA06	June 03, 2022 @ 1:44:58 PM

Sample Preparation: The sample was homogenized thoroughly. Approximately 1 gram of subsample was taken from the homogenized sample and was micronized using a planetary ball mill. The micronized subsample was then used for powder X-ray diffraction (XRD) analysis for quantitative phase analysis. The experimental setup for XRD for data collection is given as annexure-A.

Quantitative mineral/compounds analysis: Using HighScore program, the different mineral phases of the XRD pattern were identified. Once the mineral phases were identified, Rietveld refinement was performed by importing the trace pattern into TOPAS 5. This program (TOPAS 5) is used for Rietveld analysis to quantify the mineralogy. The XRD results are given in **Table 2**. The powder X-ray diffraction pattern refined by Rietveld method is also given in **Figure 1**.

Bulk XRD Analysis Results

Table 2: Results of quantitative mineral analysis (relative weight %) of X-ray diffraction data for sample 1 [SA06] using Rietveld method

Mineral Name	Compound Name	Ideal Chemical Formula	Concentration, wt.%
Quartz	Silicon oxide	SiO_2	**31.6**
Plagioclase feldspar	Sodium calcium aluminum silicate	$(CaNa)Al_{1-2}Si_{2-3}O_8$	**27.2**
Muscovite	Potassium aluminum silicate hydroxide	$KAl_2(OH)_2(AlSi_3(O,OH)_{10})$	**10.6**
Chlorite	Iron magnesium aluminum silicate	$(MgFe)_5Al(AlSi_3)O_{10}(OH)_9$	**10.4**
Kaolinite	Aluminum silicate hydroxide	$Al_2Si_2O_5(OH)_4$	**9.1**
Potassium feldspar	Potassium aluminum silicate	$KAlSi_3O_8$	**4.5**
Vermiculite	Magnesium iron aluminum silicon oxide hydroxide hydrate	$(MgFe^{3+}Al)_3(SiAl)_4O_{10}(OH)_2•4H_2O$	**2.5**
Epidote	Calcium aluminum iron silicate hydroxide	$Ca_2Al_2(FeAl)(SiO_4)(Si_2O_7)O(OH)$	**1.2**
Anatase	Titanium oxide	TiO_2	**1.1**
Diopside	Calcium magnesium silicate	$MgCaSi_2O_6$	**1.0**
Epistilbite	Calcium aluminum silicate hydrate	$CaAl_2Si_6O_{16}•5H_2O$	**0.8**
		Total:	**100.0**

Comments: The XRD result (**Table 2**) shows that the rock sample consists mainly of tectosilicates (quartz, plagioclase feldspar, potassium feldspar, and epistilbite), with lesser amounts of phyllosilicates (muscovite, chlorite, kaolinite, and vermiculite). In addition, minor amounts of sorosilicate (epidote), oxide (anatase), and pyroxene (diopside) are also present.

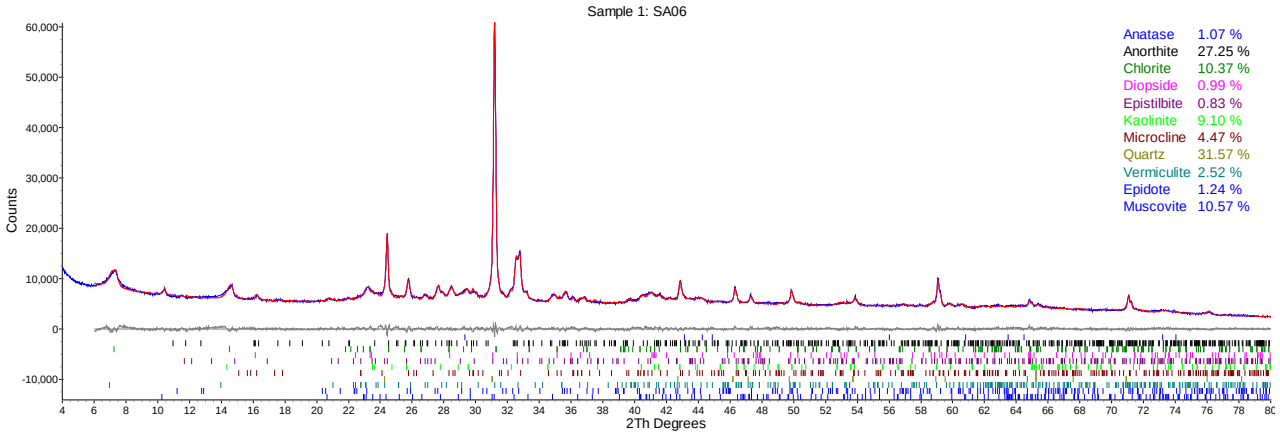


Figure 1: Powder X-ray Diffraction Pattern for Sample 1 [SA06] after Rietveld Refinement

Annexure-A

Experimental Setup for X-Ray Diffraction Data Collection and Analysis:

Diffractometer Name:	Bruker D4 Endeavor XRD with a Lynx-Eye detector
Instrumental Parameters:	Radiation Source – Cobalt (Co)
	Generator settings - 40 mA, 35 kV
	Start position [°2θ] - 4
	End position [°2θ] - 80
	Step size [°2θ] - 0.02
	Scan step time [s] - 1
Data Analysis:	ICDD PDF-4 Mineral 2022 powder diffraction database
	X'PERT HighScore Software for mineral identification
	TOPAS Software for quantitative phase analysis
Detection Limit:	0.5 – 1.0 % depending on the type, nature of sample, and crystallinity

APPENDIX D

PHOTOGRAPHS

Photo 1: Photo looking south at in-situ road cut of SA1 sample location

Photo 2: Photo looking southwest at in-situ road cut of SA2 sample location

Photo 3: Photo looking south at in-situ road cut of SA3 sample location

Photo 4: Photo looking south at in-situ road cut of SA4 sample location

Photo 5: Photo looking south at in-situ road cut of SA5 sample location

Photo 6: Photo looking south at in-situ road cut of SA6 sample location

Photo 7: Photo of TH22-03 Run 2. Sample taken at 2.1 m to 2.4 m

Photo 8: Photo of sample SA1

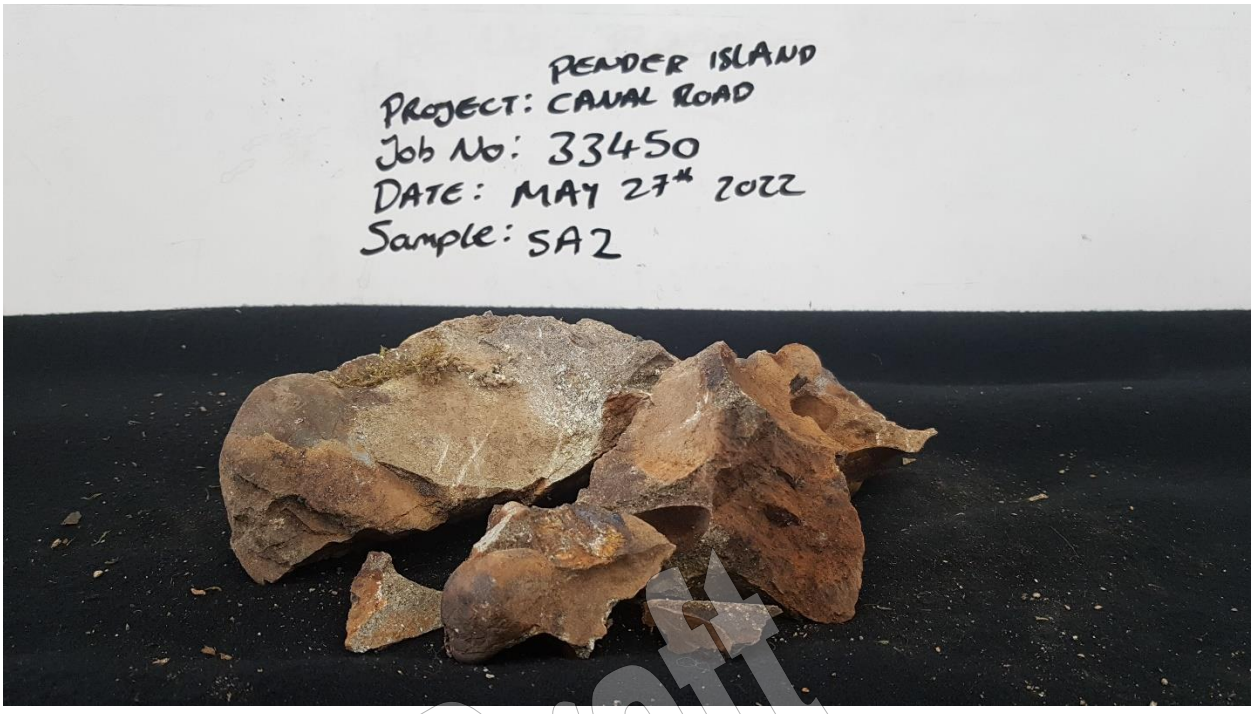


Photo 9: Photo of sample SA2

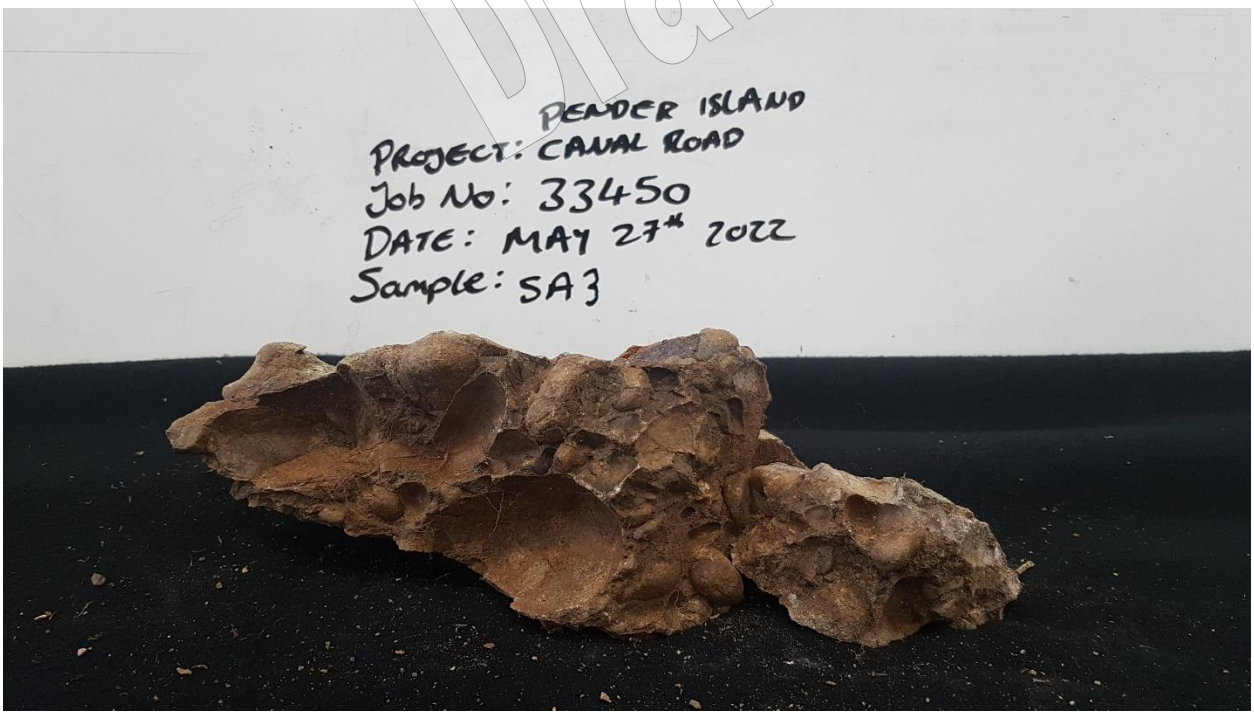


Photo 10: Photo of SA3

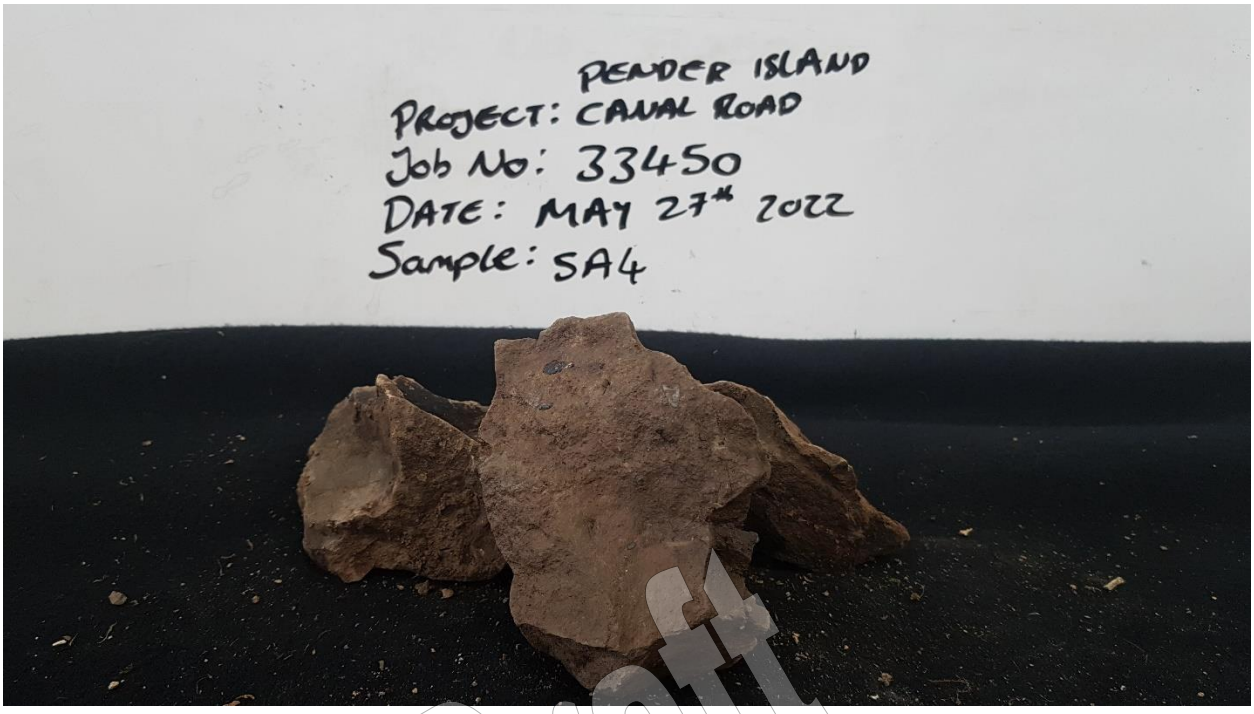


Photo 11: Photo of sample SA4

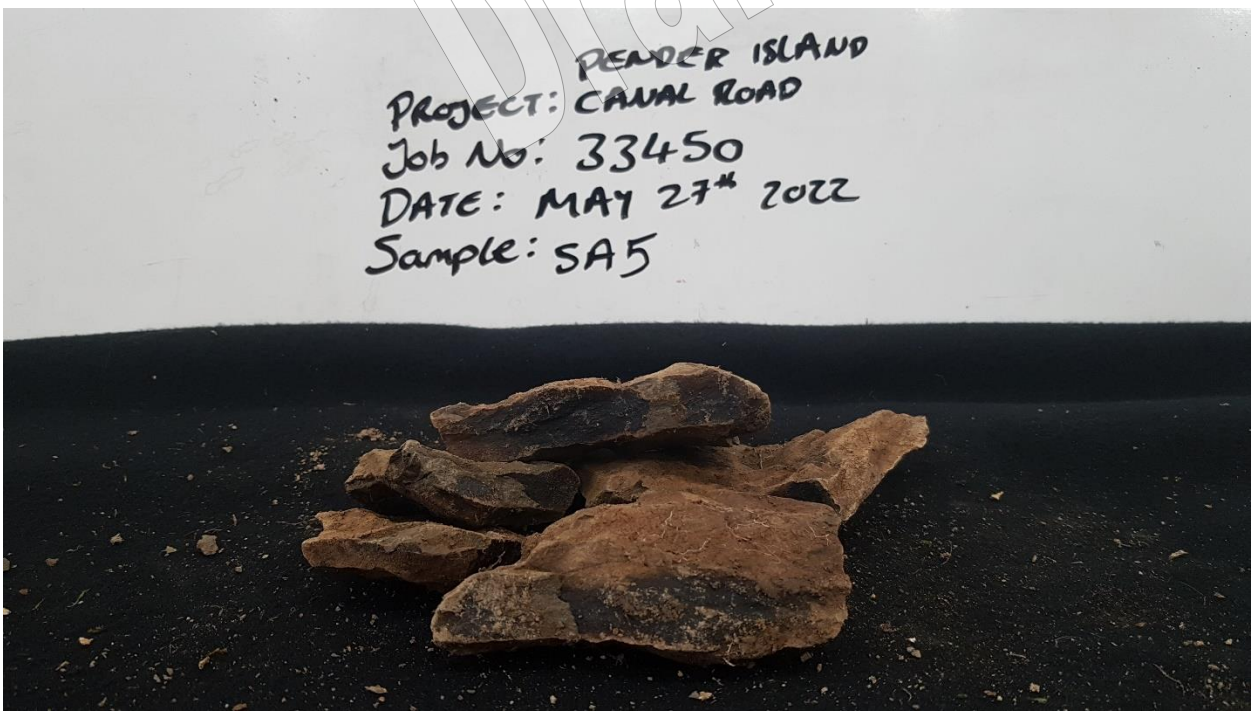


Photo 12: Photo of sample SA5

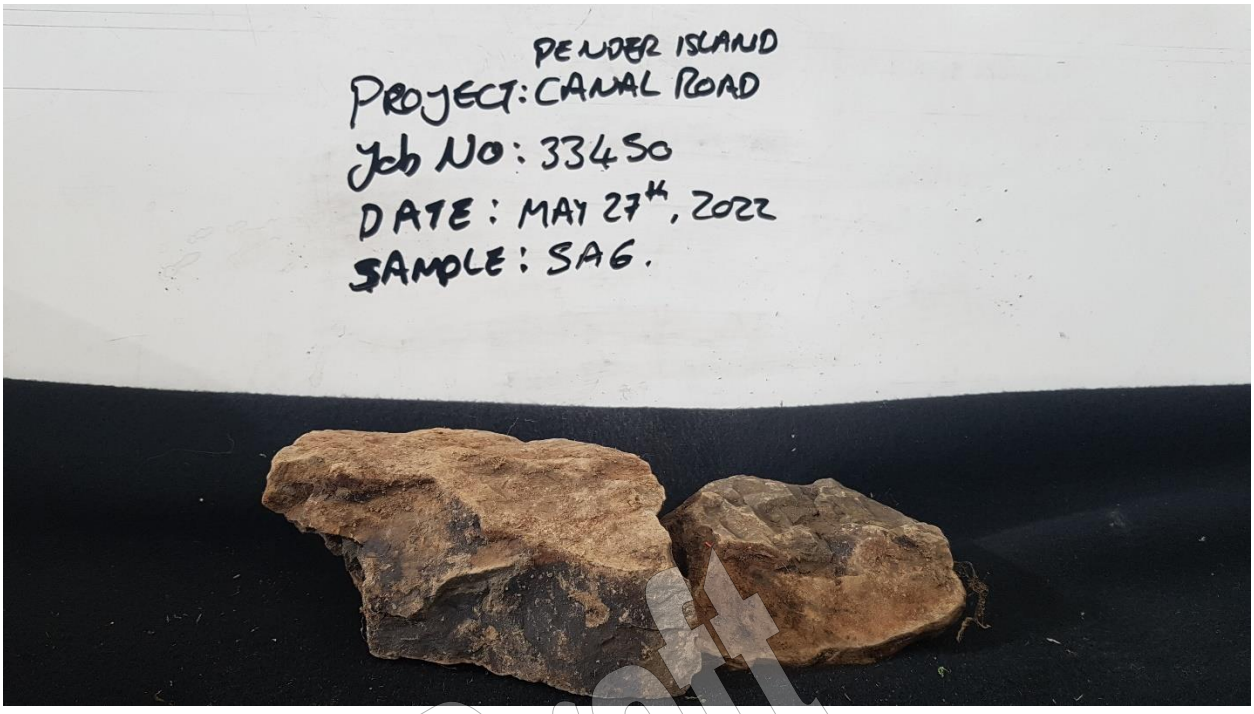


Photo 13: Photo of sample SA6

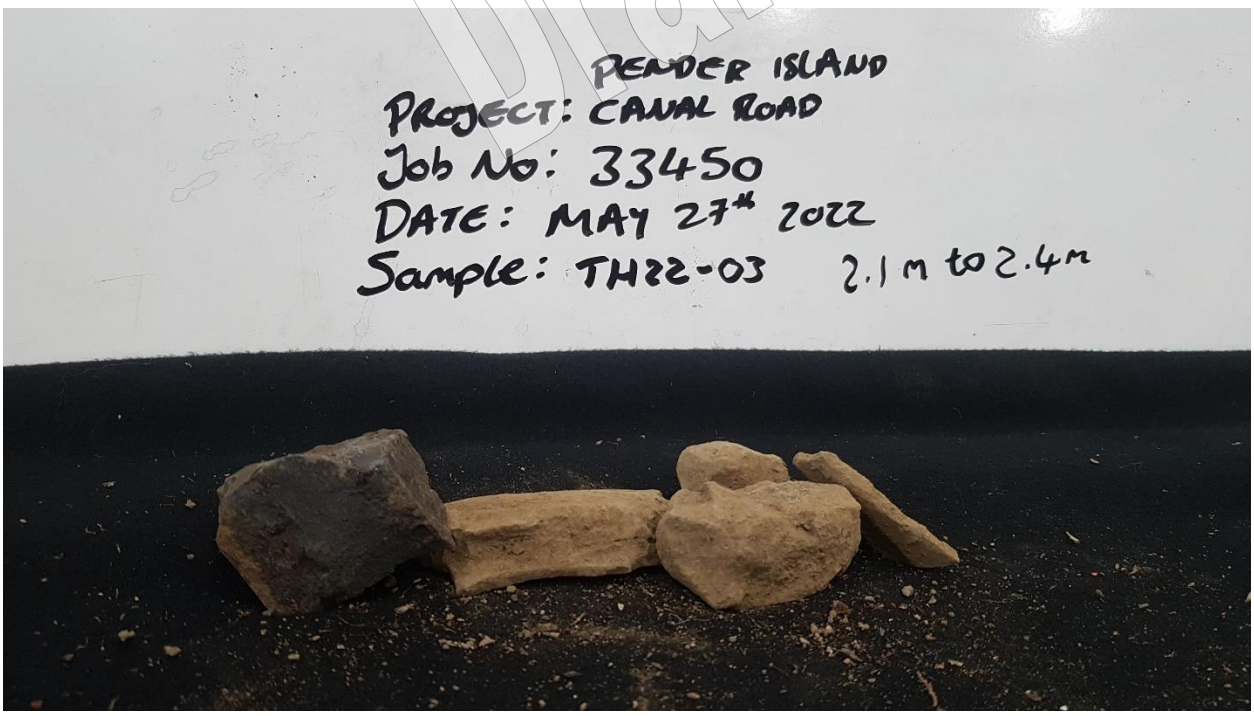


Photo 14: Photo of sample TH22-03