



To:	Matt Ball/Susan Antpoehler	Date:	February 12, 2024
Client:	YG – EMR – Land Management Branch	Memo No.:	004
From:	Myles Plaunt, CET.	File:	704-ENG.WARC04348-01
Subject:	Granular Source Inventory Summary Whitehorse, Yukon		

1.0 INTRODUCTION

At the request of Matt Ball of the Government of Yukon – Energy Mines and Resources – Land Management Branch, Tetra Tech Canada Inc. (Tetra Tech) has been tasked with providing updated information regarding the status of the existing and potential granular borrow areas within the Whitehorse city limits.

Authorization to proceed was in the form of a signed contract (C00068892).

This memorandum includes the following:

- Figures 1 to 4 present granular resource polygons on Google Earth imagery for the granular borrow areas previously presented in the 1990/1991 Whitehorse Quarry Inventory study (File No. 0201-10539). Along with the previously delineated areas, additional areas within and close to the Whitehorse city limits have been included.
- Presented in this memo is an updated summary of the areas shown on the Figure set. Note that on Figures 1 and 3, there are red x's through some of the polygons where the material status has changed from anticipated good quality granular material to poor quality (frost susceptible) till material. Depleted sources have also been crossed out. The source numbers (WHSE-01 through to WHSE-19) have remained the same but the names of the borrow areas may have been changed to reflect current area development.
- This memo also includes past project references for the sources listed (as available) and a discussion addressing priority areas; areas with large scale quarry development potential; and suggestions regarding lease sizing and next steps to ensure good quality granular materials availability.
- Since the submission of Memo 2 on March 31, 2023, meetings with contractors actively seeking guidance on possible source locations has prompted a review of Sheets 8 (Surficial Geology) and 11 (Greater Whitehorse Aggregate Potential Map) from the Whitehorse Geohazard Report along with Maps 1 (Greenspace Network Plan and Parks), and 5 (Land Use Designations) from the new 2040 Official Community Plan. This was an interesting process as the Geohazard Report reinforces the findings from the work to date completed by this office and others. However, the current OCP, with expansive park boundaries and land use designations may preclude granular resource development.

2.0 GRANULAR RESOURCE INVENTORY SUMMARY

2.1 Figure 1 – North End of Whitehorse

Presented on Figure 1 is the following:

- Slightly north of the Takhini River Bridge on the right-hand side of the Klondike Highway is the Yukon Government's 3 Mile pit. This pit has long been a source of a variety of good quality granular materials and there are still significant reserves within the lease boundaries. Tetra Tech has not completed any geotechnical evaluation work in this pit, but this office has provided recent QC testing services to Transportation Engineering to ensure compliance with YG Gradation Limits For Granular Courses.
- The Stevens Quarry Area was originally labelled McPherson B in a 1978 study completed by R.M.Hardy and Associates. The R.M. Hardy work included 3 testpits and other source evaluation work included geophysical work (EM31 survey work) by R.M. Hardy in 1978 and an ES-1225 survey completed by Frontier Geosciences for Klohn Leonoff in 1980. Additional testpitting (8 testpits) was also completed by Klohn Leonoff in 1988 and this program included the drilling of a test well. There has been extensive delineation work completed by EBA/Tetra Tech throughout this area and the reserves are well documented in 2010 evaluation completed for the City of Whitehorse (File No W14101499-01) and the 2021 work completed for 3 Pikas (File No ENG.WARC03969-01). It should be noted that in the spring of 2023, Whitehorse City Council changed the zoning of the area to future planning.
- WHSE-01 (McPherson A was also included in the 1978 study completed by R.M. Hardy). Work completed to date includes 13 R.M. Hardy testpits (1978); 9 Klohn Leonoff testpits (1988), EM 31 and EM 34 geophysical surveys (1978) and a test well (Hydro. Cons. In 1976. In addition, 14 testpits were excavated throughout this area by EBA in 1991 (File No 0201-10721).
- Across from WHSE-01, a new source polygon has been added. This polygon includes the old PWC pit No. 1 (right along the Alaska Highway) and the Castle Rock Enterprises Haeckel Hill pit. The gravel reserves in Pit No. 1 are minimal and the reserves in the Castle Rock pit are dwindling. The Castle Rock lease is also being utilized for treating contaminated soil (LTF) and there is also potential for bedrock quarry development to produce various classes of rip rap and filter materials. For at least the last 5 years, Tetra Tech has provided Castle Rock with QC testing services to ensure aggregate compliance.
- WHSE-02, WHSE-04 and WHSE-05 have been removed from the inventory because WHSE-02 and WHSE04 are underlain by frost susceptible till soils and WHSE-05 (the old Charlie Friday pit behind the Kulan Subdivision) is considered depleted.
- WHSE-03 used to be designated as the Yukon – Alaska Truck Depot but the name has been changed to reflect current ownership by Cobalt Construction. There are still granular reserves on this site, but they are likely limited.
- The Cousins Airstrip (Cee and Cee Gravel) pit has been added to this inventory. Reserves within the lease boundaries are not known.
- WHSE-06 is a small pit along the entrance to the Ravens Ridge Subdivision. Additional work completed during the development of Ravens Ridge Ph 2 has determined that the gravel is surficial and underlain by till soils.
- The source polygon for WHSE-07 (McIntyre Creek Pumphouse) remains the same.
- WHSE-08 is located along Mountainview Drive. The polygon has been expanded to include the gravel reserves along both sides of Whistle Bend Way. A desktop level evaluation of this site was completed in 2022

(File No. ENG.WARC04318-01) and it included testhole data collected during the 2010 geotechnical evaluation of Whistle Bend Way (File No. W14101469).

- WHSE-09 is the Yukon College area. The granular materials throughout this area are usually poorly graded as they include gravel, cobbles and boulders suspended in a sand matrix.
- The Kopper King Bedrock Quarry site has been included in this inventory because the rip rap and filter materials produced by Alex Shamen have been used by YG in and along Yukon waterways.
- Much of the Fish Lake Road corridor is outside city limits but it warrants mentioning. In 2013, Tetra Tech completed a testpitting program along the south side of Fish Lake Road within 2 km of the Fish Lake boat launch area (File No. W14103235-01) and there appears to be glaciofluvial terrain features in the area between Jackson Lake and Franklin Lake.

2.2 Figure 2 – Central Portion of Whitehorse

There is a lot of overlap between Figure 1 and Figure 2. Included in this section are the following.

- WHSE-10 is the Hillcrest/Tank Farm area. The polygon could have been expanded to include the east side of the McIntyre Subdivision and the south half of the Valleyview Subdivision. Granular borrow potential exists throughout the Tank Farm area and historic use as a source of acceptable sub-base and basecourse materials has been successful. If extraction in this area continues, additional processing may be required to ensure acceptable quality.
- Across the Yukon River, WHSE-21 has been removed from the inventory as the deposit is unproven and is likely surficial with limited potential.
- Site reconnaissance during the completion of the 2013 North-East Urban Containment Boundary Area (File No. W14103296-01) observed an encouraging gravel exposure along the Marwell Forcemain access road on the east side of the Yukon River. The limits of the area will have to be determined once development on the other side of the river is proposed. For wide-spread use on all Whitehorse projects, a second bridge or significant upgrades to the Long Lake Road would be necessary.
- WHSE-20 is located along the Copper Haul Road south of the intersection with Fish Lake Road. Skookum Asphalt, and then Norcope Enterprises operated out of this pit for years, but their lease was terminated. There are still minimal reserves in this source, but there hasn't been approved extraction for numerous years.

2.3 Figure 3 – South of Robert Service Way

Again, there is a bit of overlap with Figure 2 but proceeding south from the Hamilton Boulevard/Robert Service Way intersection with the Alaska Highway, there is:

- WHSE-11 – Ear Lake Area. This granular source has been evaluated as far back as 1979 as part of the R.M. Hardy Whitehorse Gravel Survey - Alaska Highway and South Access Road project. It was also included in the 1990 EBA Whitehorse Quarry Inventory (File No. 0201-10539). There have been three operators working in this area for numerous years, including Skookum Asphalt, General Enterprises and Annie Lake Trucking. Ceasing extraction from this area has been considered since 1992 but extraction has continued until 2022. The main reason that aggregate processing and extraction has continued is that the Annie Lake lease and the General Enterprises Lease both had water sources that would allow the processing of concrete aggregate. However, it is understood that extraction from within the lease boundaries (this excludes the portions of the area privately owned by Skookum Asphalt and General Enterprises) has now been halted by the City of

Whitehorse. There are still limited gravel reserves throughout this area, but further extraction will not align with site reclamation and future land use.

- WHSE-12 (Squatters Row Area) has been removed from the inventory as additional work completed throughout this polygon has noted frost susceptible till soils and shallow bedrock.
- WHSE-13 is the McLean Lake Quarry area. From 1982 to 1988, there was significant investigation and evaluation work completed throughout this granular borrow area, with numerous testpits advanced by JR Paine and Associates. Other studies include the 1992 IMC study (Phase 2 of the quarry area), 1998 McLean Lake Area Development (EBA File No. 0201-98-13408) which included updated volume projections and in 2014, detailed assessments were completed for all leases (File No. W14103498-01) and updated volume projections were again provided. This is the only borrow area in Whitehorse where quality and quantity assessments have been completed at regular intervals, which is important for future planning. Each of the leases in this area are still occupied, and most of them have a range of gravel reserves. However, there are currently issues with producing spec gravel products due to high silt contents. Other land uses in this area include the Land Treatment Facility (LTF) located on the Arctic Backhoe lease. Also on the Arctic Backhoe lease, testing has confirmed that various rip rap and filter products can be produced, and they are acceptable for placement along watercourses. Recently, a planning study was awarded to consider the potential for developing the Copper Haul Road south of the McLean Lake area into an industrial zoned lots.
- Newly added to the inventory are the two pits along the Copper Haul Road that are leased to Yellow Truck and Annie Lake Trucking. These borrow areas are included in the Copper Haul Road Industrial Subdivision project.
- Along the Mt Sima Road, the Travolion Borrow Area and the Sima Road Pit (operated by Justin Peterson) have also been added to the inventory. The Travolion area was first investigated by JR Paine in 1995 and in 2019, additional testpits were advanced by NuWay Crushing and assessment services were provided by Tetra Tech (File No. ENG.WARC03582-01). The Peterson pit has been in operation for numerous years and still has reserves, while the Travolion borrow area is currently undeveloped. There is a smaller terrain feature located north of the Travolion site that is being explored by a local contractor. It shows promise and is located in an area with the correct land use designation. These borrow areas are also included in the Copper Haul Road Industrial Subdivision project.
- WHSE-22 – Territorial Contracting. This area was evaluated by EBA in 1997 (File No. 0201-97-12712.1). Aggregates are produced for concrete production only and the lease has significant reserves along with a water supply for processing CSA A23.1 compliant concrete aggregates.
- On the east side of the Alaska Highway directly across from the intersection with Sima Road is the Utah Rail Yard. Running north of the rail yard site, an undeveloped gravel source exists, and on-site investigation work has been completed by CAP Engineering on behalf of Norcope Enterprises to assess quality and quantity. Unfortunately, this office doesn't have a copy of the report that CAP generated.
- The polygon for WHSE-14 used to be on the west side of the Alaska Highway across from MacRae. Extensive work in advance of the Whitehorse Copper Subdivision area development noted till soils so the polygon was removed and moved across the Highway to represent the glaciofluvial gravel deposits underlying the MacRae Subdivision area. The area between MacRae Subdivision and the Yukon River is also part of the planning study mentioned above and the area appears very compatible with the development of industrial lots.
- South of MacRae Subdivision to the entrance to the Fox Lake Golf Course (Wolf Creek North Subdivision is on the other side of the highway), WHSE 15 and WHSE 16 represent areas with unproven gravel extraction potential. This area was also evaluated by EBA (File Number 0201-97-12712

2.4 Figure 4 – Pineridge Subdivision to the Carcross Cut-Off

- Significant reserves of gravel exist under the Pineridge Subdivision (WHSE-17), the vicinity of the Cadet Camp (WHSE-18) and the Spruce Hill Subdivision (WHSE-19) areas.
- Added to the inventory is the Kookatsoon Pit located down the Carcross Road. This borrow area is a KDFN land selection and is significant because not only does Skookum Asphalt source their asphalt and BST aggregates from this pit, but the source is also currently the best choice for sourcing spec gravel products for Whitehorse projects. On the downside, the recent demand for materials from this source has been high and may impact long term extraction.

3.0 GENERAL DISCUSSION

Based on the data collected and reviewed for this inventory evaluation, along with the mapping presented in the 2040 OCP, it appears that although there is potential for the development of new borrow areas, jurisdictional hurdles are difficult to overcome. Excluding land tenure issues and the current zoning, the Stevens Subdivision and the area labeled as WHSE-01 (McPherson A) are still undeveloped with significant volumes of granular soils, which would service projects throughout the north end of Whitehorse.

The Northeast Urban Containment Boundary Area on the east side of the Yukon River is similar in size to the Whistle Bend Subdivision area and significant volumes of gravel will be required when development commences. The source identified as the Marwell Forcemain Source on Figure 2 will hopefully satisfy the needs of this future development area.

Throughout the central portion of Whitehorse, The Whistle Bend Way – Areas A and B (WHSE-08) and the Hillcrest Tank Farm Areas (WHSE-10) have significant reserves of non-frost susceptible gravel and the new OCP may leave the door open to gravel extraction from these sites.

Ongoing extraction of granular materials from the Ear Lake Area (WHSE-11) is winding down, but it should be noted that General Enterprises' Alaska Highway frontage and Skookum Asphalt's property are titled so asphalt production (Skookum) and concrete production (General Enterprises) can continue with on-site aggregate inventories and aggregates from other sources.

The Mclean Lake Quarry Area (WHSE 13 and WHSE 22) will continue to be one of the best potential sources of gravel throughout southern Whitehorse. There are still significant volumes of granular materials remaining, but additional processing may be required to produce compliant aggregates.

The report generated for the cursory investigation completed by CAP (for Norcope) throughout the area north of the Utah Yard could not be reviewed. Norcope was not granted permission to develop this area and land tenure has not been determined for this evaluation, but perhaps under the new OCP, future gravel extraction in this area can be considered.

Applications for borrow source development along the Copper Haul Road corridor warrants consideration. Yellow Truck and Annie Lake Trucking already have pits along the Copper Haul Road south of the Mclean Lake Quarry area and there may be additional areas with potential.

It has not been discussed whether KDFN or Ta'an Kwach'an have been contacted to determine if they have land selections which are being considered for gravel extraction. They should probably be included in all future discussions.

A comment regarding minimum lease size was requested. If local contractors are asked, they will always say that the lease size proposed is too small. The existing Mclean Lake Quarry lots are generally between 5 ha and 7 ha in size (the exception is Arctic Backhoe since they have expanded to accommodate their LTF. The most recent planning project completed by 3 Pikas for the Stevens Quarry Area had proposed lease sizes of 10-20 ha. Lease size can be variable and dependent upon the level of aggregate processing that will be required (more aggregate products produced require more room crushing and stockpiling. If leases can be at least 5 ha, that should be satisfactory for most small operators.

4.0 CONCLUSION

Based on information presented above, a review of the new OCP and recent meetings with contractors, it does not appear that there is much potential for large scale granular borrow extraction within Whitehorse city limits. However, smaller areas with potential for extraction can be considered and it would be ideal if all parties could accept this as a sustainable option for the near future.

It is understood that gravel extraction can possibly happen under the premise of site grading in advance of future development. For example, it is understood that Sidhu Trucking has plans to extract good quality gravel during the regrading of the tank farm area in order to satisfy their site grading plan. The regrading of the area on the south side of Whistle Bend Way also includes gravel extraction to accommodate urban density residential development.

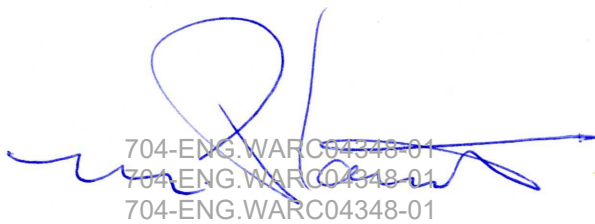
5.0 LIMITATIONS OF REPORT

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6.0 CLOSURE

We trust this technical memo meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech Canada Inc.



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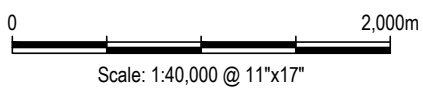
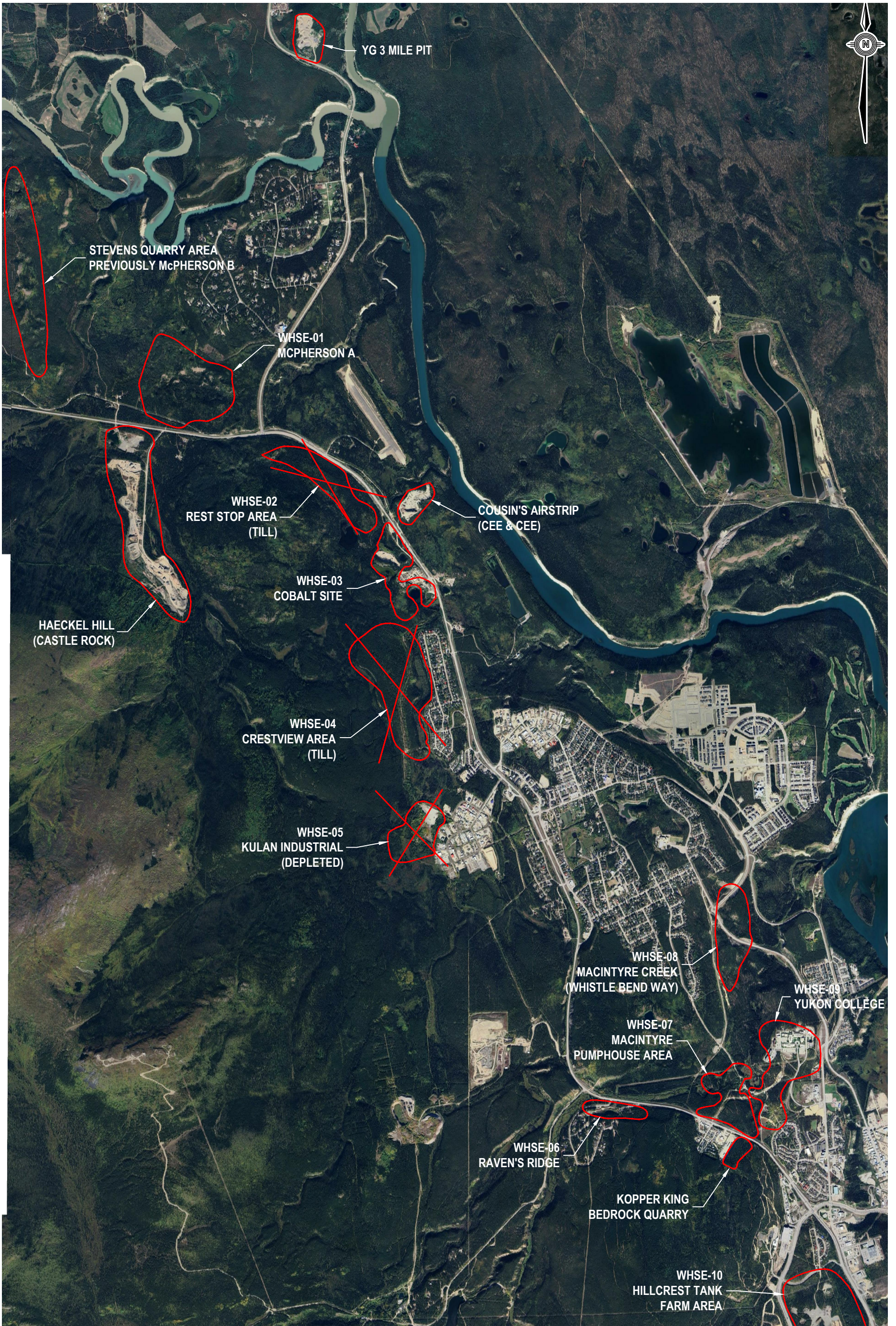
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Enclosed: Figures 1 - 4 – Area Maps Showing Granular Source Locations
 Appendix A – Tetra Tech’s Limitations on the Use of this Document

FIGURES

- Figure 1 Area Map Showing Existing and Potential Granular Resources (1 of 4)
- Figure 2 Area Map Showing Existing and Potential Granular Resources (2 of 4)
- Figure 3 Area Map Showing Existing and Potential Granular Resources (3 of 4)
- Figure 4 Area Map Showing Existing and Potential Granular Resources (4 of 4)



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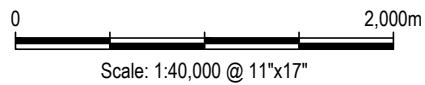
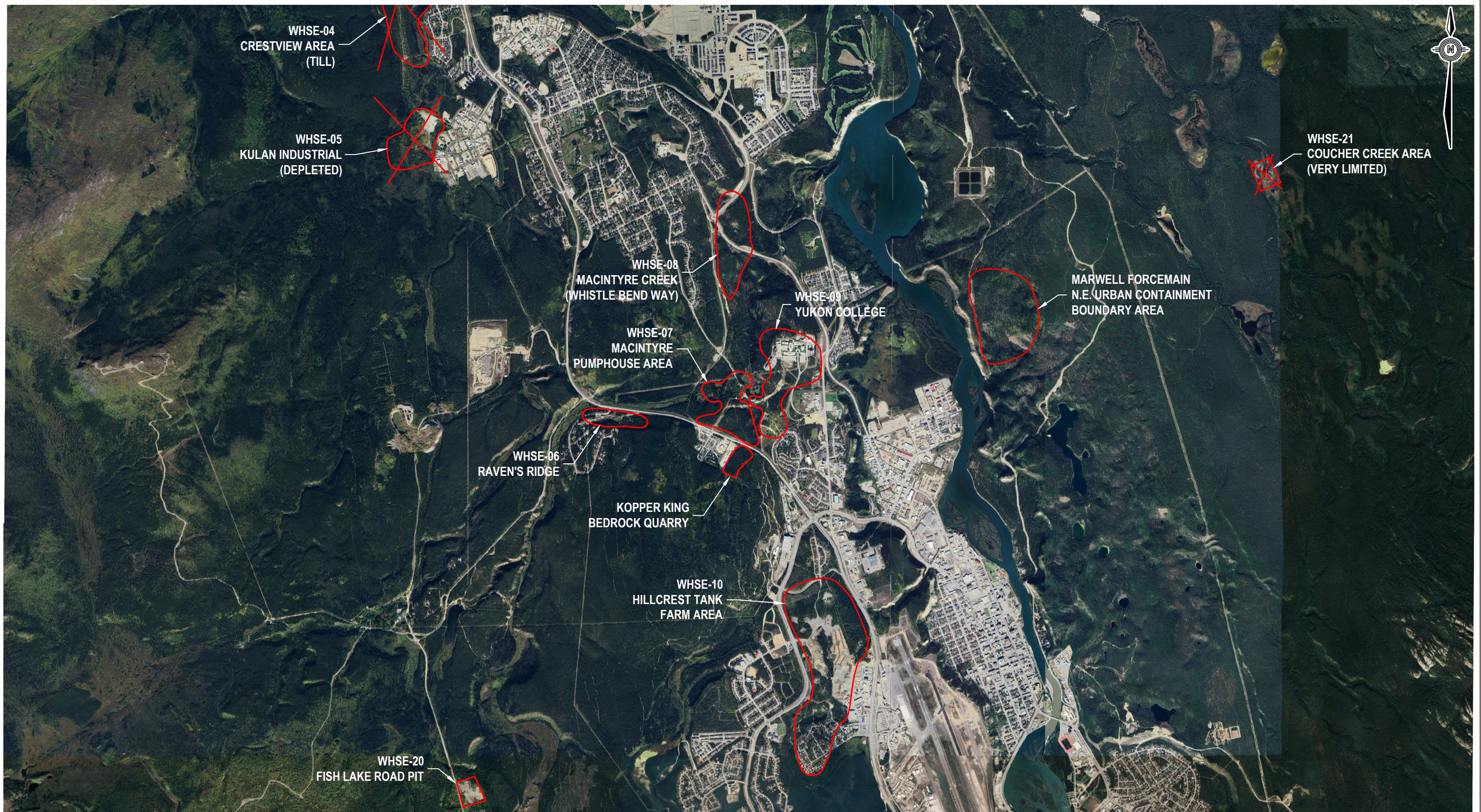
WHITEHORSE GRANULAR INVENTORY UPDATE

AREA MAP SHOWING EXISTING AND POTENTIAL GRANULAR RESOURCES (1 OF 4)

PROJECT NO. ENG.WARC04348-01	DWN CB	CKD MCP	REV 0
OFFICE EBA-WHSE	DATE January 24, 2023		

Figure 1

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 Department of Energy Mines & Resources
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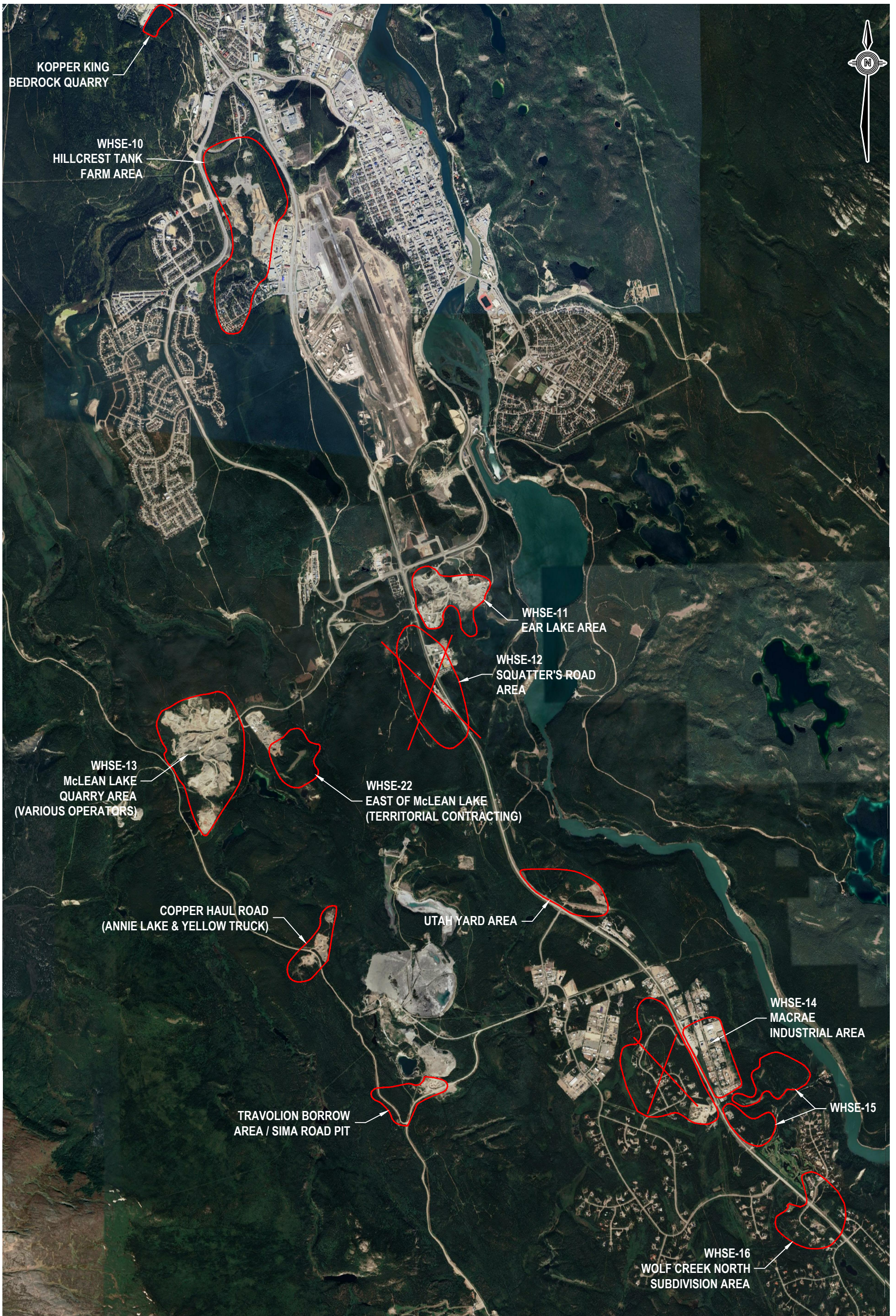
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WHITEHORSE GRANULAR INVENTORY UPDATE

AREA MAP SHOWING EXISTING AND POTENTIAL GRANULAR RESOURCES (2 OF 4)

PROJECT NO. ENG.WARCO4348-01	DWN CB	CKD MCP	REV 0
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Figure 2



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Scale: 1:40,000 @ 11"x17"

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Department of Energy Mines & Resources
Lands Branch Division

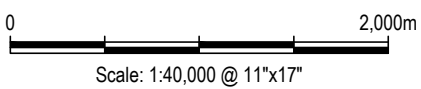
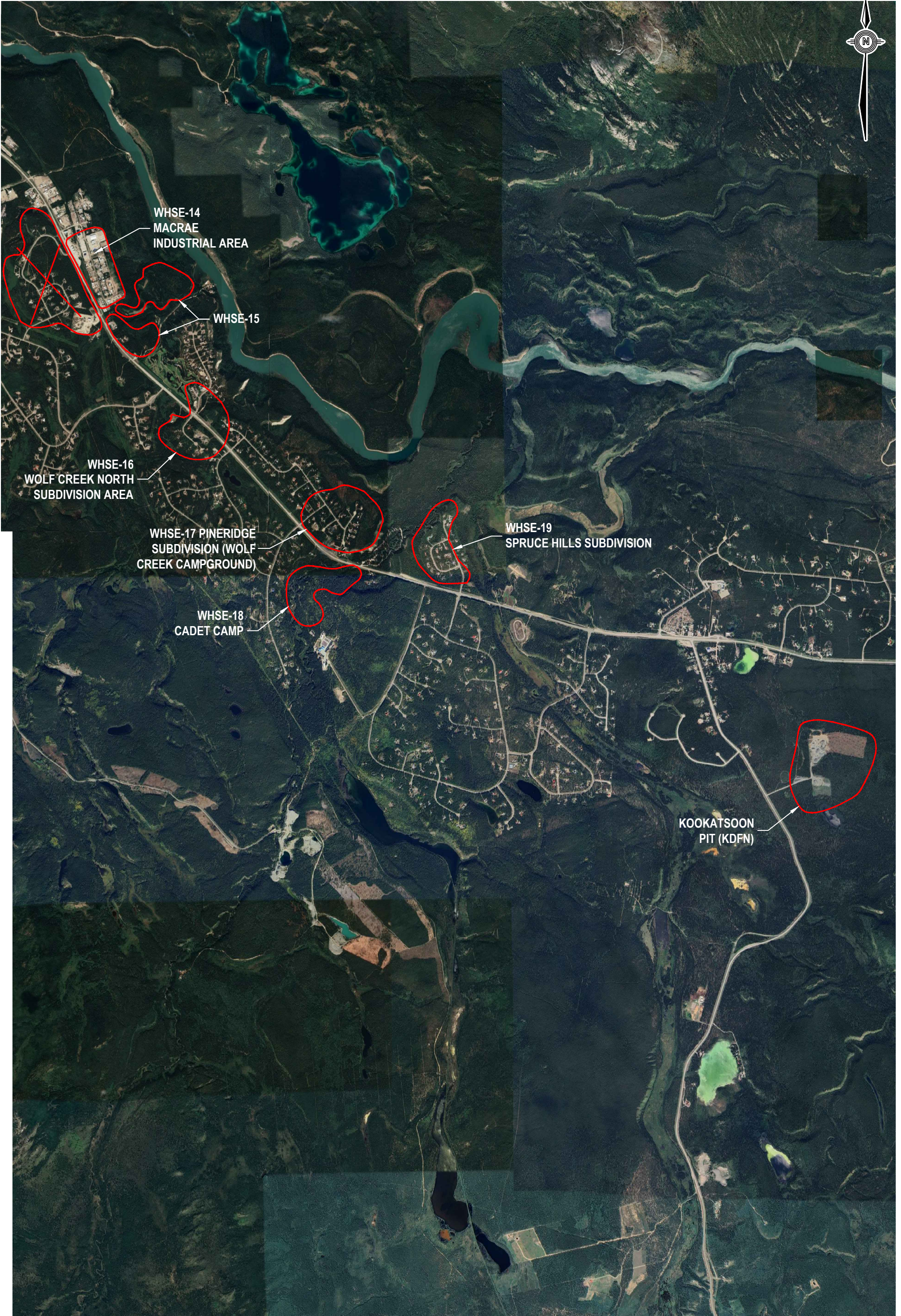
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WHITEHORSE GRANULAR INVENTORY UPDATE

AREA MAP SHOWING EXISTING AND
POTENTIAL GRANULAR RESOURCES (3 OF 4)

PROJECT NO. ENG.WARC04348-01	DWN CB	CKD MCP	REV 0
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Figure 3



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WHITEHORSE GRANULAR INVENTORY UPDATE

AREA MAP SHOWING EXISTING AND POTENTIAL GRANULAR RESOURCES (4 OF 4)

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Figure 4

APPENDIX A

TETRA TECH'S LIMITATIONS ON THE USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

GEOTECHNICAL – YUKON GOVERNMENT

1.1 USE OF DOCUMENT AND OWNERSHIP

This document pertains to a specific site, a specific development, and a specific scope of work. The document may include plans, drawings, profiles and other supporting documents that collectively constitute the document (the "Professional Document").

The Professional Document is intended for the use of TETRA TECH's Client, its officers, employees, agents, representatives, successors and assigns (the "Client") as specifically identified in the TETRA TECH Services Agreement or other Contractual Agreement entered into with the Client (either of which is termed the "Contract" herein). TETRA TECH does not accept any responsibility for the accuracy of any of the data, analyses, recommendations or other contents of the Professional Document when it is used or relied upon by any party other than the Client, unless authorized in writing by TETRA TECH. Any changes to the conclusions, opinions, and recommendations presented in TETRA TECH's Professional Document must be authorized by TETRA TECH.

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Where TETRA TECH submits electronic file and/or hard copy versions of the Professional Document or any drawings or other project-related documents and deliverables (collectively termed TETRA TECH's "Instruments of Professional Service"), only the signed and/or sealed versions shall be considered final. The original signed and/or sealed electronic file and/or hard copy version archived by TETRA TECH shall be deemed to be the original. TETRA TECH will archive a protected digital copy of the original signed and/or sealed version for a period of 10 years.

Electronic files submitted by TETRA TECH have been prepared and submitted using specific software and hardware systems, as per agreed project deliverable formats. TETRA TECH makes no representation about the compatibility of these files with the Client's future software and hardware systems.

1.3 STANDARD OF CARE

Services performed by TETRA TECH for the Professional Document have been conducted in accordance with the Contract, in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions in the jurisdiction in which the services are provided. Professional judgment has been applied in developing the conclusions and/or recommendations provided in this Professional Document.

If any error or omission is detected by the Client or an Authorized Party, the error or omission must be brought to the attention of TETRA TECH within a reasonable time.

1.4 DISCLOSURE OF INFORMATION BY CLIENT

The Client acknowledges that it has fully cooperated with TETRA TECH with respect to the provision of all available information on the past, present, and proposed conditions on the site, including historical information respecting the use of the site.

1.5 INFORMATION PROVIDED TO TETRA TECH BY OTHERS

During the performance of the work and the preparation of this Professional Document, TETRA TECH may have relied on information provided by third parties other than the Client.

While TETRA TECH endeavours to verify the accuracy of such information, and subject to the standard of care herein, TETRA TECH accepts no responsibility for the accuracy or the reliability of such information even where inaccurate or unreliable information impacts any recommendations, design or other deliverables and causes the Client or an Authorized Party loss or damage, except where TETRA TECH has subcontracted for such information.

1.6 GENERAL LIMITATIONS OF DOCUMENT

This Professional Document is based solely on the conditions presented and the data available to TETRA TECH at the time the data were collected in the field or gathered from available databases.

The Client, and any Authorized Party, acknowledges that the Professional Document is based on limited data and that the conclusions, opinions, and recommendations contained in the Professional Document are the result of the application of professional judgment to such limited data.

The Professional Document is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site conditions present, or variation in assumed conditions which might form the basis of design or recommendations as outlined in this report, at or on the development proposed as of the date of the Professional Document requires a supplementary exploration, investigation, and assessment.

TETRA TECH is neither qualified to make, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the Client.

1.7 NOTIFICATION OF AUTHORITIES

In certain instances, the discovery of hazardous substances or conditions and materials may require that regulatory agencies and other persons be informed and the Client agrees that notification to such bodies or persons as required may be done by TETRA TECH in its reasonably exercised discretion.

1.8 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, TETRA TECH has not been retained to explore, address or consider and has not explored, addressed or considered any environmental or regulatory issues associated with development on the subject site.

1.9 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems, methods and standards employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. TETRA TECH does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

1.10 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

1.11 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historical environment. TETRA TECH does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional exploration and review may be necessary.

1.12 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

1.13 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

1.14 INFLUENCE OF CONSTRUCTION ACTIVITY

Construction activity can impact structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques, and construction sequence are known.

1.15 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, and the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

1.16 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued satisfactory performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

1.17 DESIGN PARAMETERS

Bearing capacities for Limit States or Allowable Stress Design, strength/stiffness properties and similar geotechnical design parameters quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition used in this report. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions considered in this report in fact exist at the site.

1.18 SAMPLES

TETRA TECH will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

1.19 APPLICABLE CODES, STANDARDS, GUIDELINES & BEST PRACTICE

This document has been prepared based on the applicable codes, standards, guidelines or best practice as identified in the report. Some mandated codes, standards and guidelines (such as ASTM, AASHTO Bridge Design/Construction Codes, Canadian Highway Bridge Design Code, National/Provincial Building Codes) are routinely updated and corrections made. TETRA TECH cannot predict nor be held liable for any such future changes, amendments, errors or omissions in these documents that may have a bearing on the assessment, design or analyses included in this report.