TETRA TECH

TECHNICAL MEMO

ISSUED FOR USE

To:	Ben Campbell – Senior Project Manager	**Date:**	November 23, 2021
Client:	Government of Yukon – Land Dev. Branch	**Memo No.:**	001
From:	Myles Plaunt, CET	**File:**	704-ENG.WARC04113-01
Subject:	Geotechnical Support Infill Lot Development – Logan Subdivision – Whitehorse, Yukon		

1.0 INTRODUCTION

At the request of Mr. Ben Campbell, Senior Project Manager, Government of Yukon – Community Services – Land Development Branch, Tetra Tech Canada Inc. (Tetra Tech) has completed a geotechnical assessment for Lots 141, 142, 143 and 144 on Finch Crescent in the Logan Subdivision area of Whitehorse, Yukon.

This memorandum is subject to Tetra Tech's Limitations on the Use of this Document, which is attached in Appendix A.

2.0 SITE CONDITIONS

2.1 General Location & Work To Date

The infill area is located along Finch Crescent in the Logan Subdivision area of Whitehorse, Yukon. It is bordered by Magpie Road to the west and Lot 138 (which is a buffer between the infill area and Falcon Drive) to the east.

The lots are tree covered (moderately sparse lodgepole pines) and during the 2021 construction season, the lots were serviced, tying into the deep utility infrastructure on Finch.

2.2 Terrain

The infill area slopes downward towards the lot frontage along Finch Crescent. The slopes are considered gentle (between 4% and 6%). In general, there are no lot development constraints associated with the terrain throughout the subject site. Contour information is presented on the attached Site Survey Plan.

2.3 Geotechnical Conditions

No site specific testholes have been advanced throughout the infill area. However, geotechnical conditions were observed by Tetra Tech employees during the installation of the water and sewer services for each of the lots.

Conditions observed are consistent with what has been encountered on other projects completed throughout the Logan area and along Falcon Drive. Silt and sand till soils underly the entire site. The till soils become increasingly dense with depth (below the transition between the surficial ablation tills (brown in color) and the underlying basal tills (grey in color)). Cobble and boulder sized pieces are common within the till matrix. No shallow groundwater was observed while performing compaction testing during service trench backfill.

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The till soils are considered appropriate as a foundation soil, but it is considered frost susceptible and if allowed to become saturated, the soil consistency (soil strength) will decrease significantly.

2.4 Site Drainage

The site is sloped, so currently, positive site drainage across the four lots directs runoff towards Finch Crescent. However, residential development will interrupt surface water flow so steps (such as adequate site grading and functioning rain gutter and downspouts) must be taken to control the volume and direction of surface flow and roof runoff from rainfall and snow melt.

3.0 RESIDENTIAL FOUNDATION RECOMMENDATIONS

Residential foundation construction is considered feasible for this infill area. Shallow foundation systems which will be conducive to the conditions encountered include strip and spread footings with foundation walls or thickened monolithic slab-on-grade foundations constructed on an engineered fill.

Builders and developers must be aware of the Building Advisory that was issued by The City of Whitehorse, Planning and Development on October 25, 2010. This advisory relates to *Drainage Standards for Building Foundations*. The requirements for drain rock, perimeter drainage systems and sump construction presented in the advisory have to be followed for all foundations. The prescriptive measures are based on CSA and NBC specifications as summarized in the following sections.

3.1 Preserved Wood Foundations

For strip and spread footing systems, it is common for builders to use preserved wood for foundation wall construction. For this foundation system, if non-free draining soil exists throughout the base of the foundation excavation, a granular drainage layer will be required beneath all footings and basement slabs (in accordance with CAN-CSA S406).

The advisory also states that if areas of free draining material are encountered, it may be possible to remove the requirement for a gravel drainage layer (a geotechnical engineer must be consulted to verify free draining soils are present). However, due to the silt and clay content of till soils which underly the Logan infill site, along with the depositional history (deglaciation processes) of the Whitehorse area, soil conditions will not likely be considered free draining.

The granular drainage layer should be constructed using a clean crushed stone or screened drain rock material of maximum particle size 40 mm and having less than 10% sand (passing the 5 mm sieve). This layer shall be at least 125 mm thick and shall extend at least 300 mm beyond the footing perimeter. The granular drainage layer shall drain to a sump which, in turn, will direct water to a point of final disposal beyond the building's footprint.

In accordance with CAN-CSA S406, the use of perimeter drainage (weeping) tile or pipe is not recommended with preserved wood foundations.

The design life of a preserved wood foundation system relies on keeping water away from the preserved wood foundation elements, so waterproofing of the foundation wall and the proper construction of the granular drainage layer is critical. As well, to provide additional protection of the waterproofing on the exterior face of the foundation walls, backfill material placed shall be free of deleterious debris, frozen materials, and large and/or angular pieces.

3.2 Concrete Foundation Recommendations

If the use of concrete foundations is desired, the drainage (weeping) tile and pipe, granular drainage layers, drainage disposal and surface drainage specifications as per NBC 2005, Section 9.14 “Drainage” must be followed.

Full depth concrete foundations with concrete footings are required to have perimeter drainage tile which terminates in a sump pit. A sump pit is to be installed to assist in the removal of water from the foundation area (should water accumulation in the sump pit warrant it).

3.3 Perimeter Insulation and Lot Grading

For frost heave to occur, there must be sub-zero temperatures and frost susceptible soils that have been allowed to become saturated. Since the Yukon experiences sub-zero temperatures through the fall winter months, and the subject site is underlain with frost susceptible till soils, the best way to mitigate potential for frost heave is to prevent surface water infiltration into the soils under the footings and to reduce seasonal frost penetration by installing adequate perimeter insulation around the foundation wall.

Tetra Tech typically recommends an equivalent of 2.5 m of equivalent frost protection. Therefore, additional perimeter insulation will be required where there is less than 2.5 m of foundation wall backfill. For example, if strip footings are constructed at 1.2 m below finished site elevations, additional perimeter insulation will be required. Tetra Tech uses a “rule of thumb” determination, where 25 mm (1”) of moisture resistant, backfillable, rigid insulation is the equivalent of 300 mm (1’) of soil cover; therefore, an additional 100 mm (4”) of insulation will be required to satisfy the 2.5 m minimum if the footings are founded at a depth of 1.2 m.

Attached or detached garages are often problematic, as they are typically constructed on near surface footings or a thickened monolithic slab-on-grade foundation. As well, temperatures in garage structures are often kept much cooler than the adjoining residence. Therefore, using a footing depth of 300 mm, along with 300 mm of non-frost susceptible granular structure beneath the footings, an additional 150 mm of perimeter would be required to mitigate potential for movement and damage caused by seasonal frost.

To ensure that the foundation is adequately protected, it is recommended that builders contact Tetra Tech so that site specific perimeter insulation solutions can be provided.

For the Logan infill site, it is recommended that perimeter insulation extend 1.8 m (6’) out from the building’s perimeter. To accommodate this recommendation, builders should be aware that this requirement may affect the setback distance from the foundation to the lot line.

The lot drainage requirements presented as STD DWG D2.0 and D2.1 in the City of Whitehorse Servicing Standards Manual must be enforced. This is particularly important for sites where residential structures are constructed along a slope and as presented on D2.0 and D2.1 (attached to this memo), “flows are to be carried around houses in defined shared or internal swales”.

Along with drainage control, it is important that the structure have functioning rain gutters and downspouts installed to minimize potential for water to make its way down along the foundation wall and under the footings.

4.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of the Government of Yukon and their agents. Tetra Tech Canada Inc. does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than the Government of Yukon, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this document is subject to the Limitations on the Use of this Document, attached in the Appendix A.

5.0 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.

704-ENG.WARC04113-01

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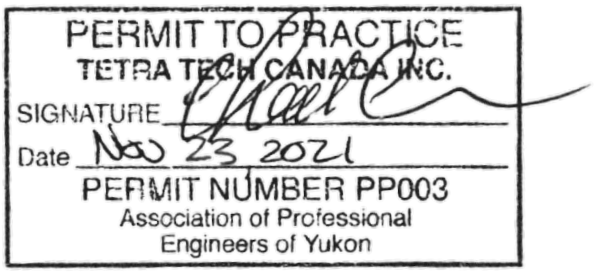
Attachments: Appendix A - Limitations on the Use of this Document
Site Survey Plan
Lot Drainage Standard Drawings D2.0 and D2.1



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.

1.2 ALTERNATIVE DOCUMENT FORMAT

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.

APPENDIX B

SITE SURVEY PLAN

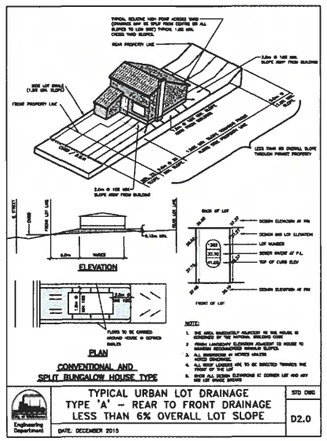
REVIEWED BY M.ABBOTT, CITY OF WHITEHORSE - JULY 16, 2020

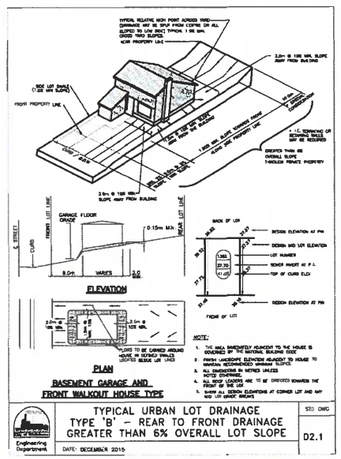
APPROVED.

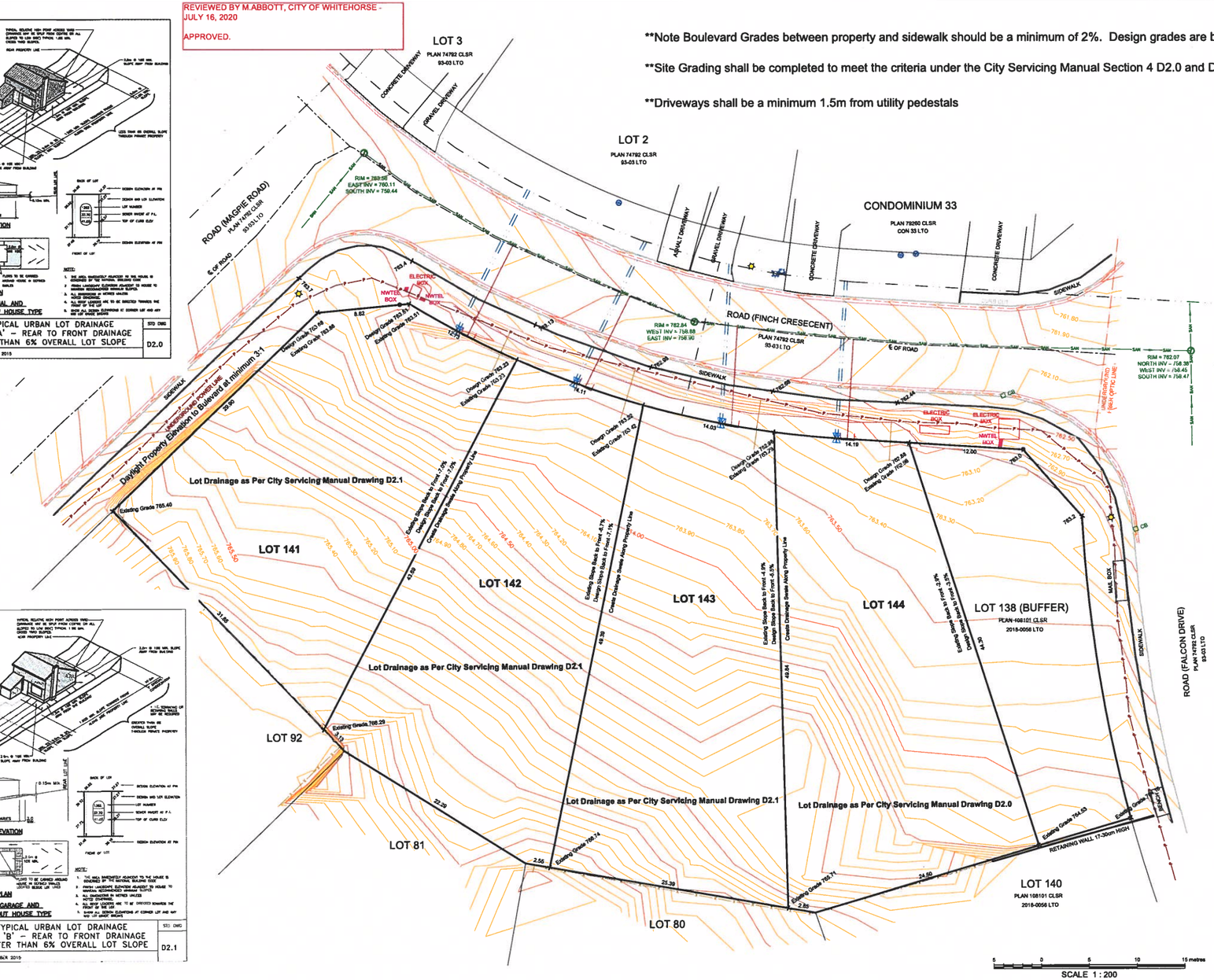
**Note Boulevard Grades between property and sidewalk should be a minimum of 2%. Design grades are between 5% and 10%

**Site Grading shall be completed to meet the criteria under the City Servicing Manual Section 4 D2.0 and D2.1

**Driveways shall be a minimum 1.5m from utility pedestals







LEGEND & NOTES :

ELEVATIONS ARE GEODETIC DERIVED FROM NRCAN PPP GPS OBSERVATION.
DISTANCES ARE IN METERS AND DECIMALS THEREOF.

- LOT BOUNDARY SHOWN THUS
- ELEVATIONS ARE SHOWN THUS
- LAMP POSTS SHOWN THUS
- SANITARY MANHOLES SHOWN THUS
- CATCH BASINS SHOWN THUS
- FIRE HYDRANTS SHOWN THUS
- WATER VALVES SHOWN THUS
- CURB COCK SHOWN THUS
- FENCE SHOWN THUS
- SANITARY LINE SHOWN THUS
- UNDERGROUND POWERLINE SHOWN THUS
- UNDERGROUND FIBRE OPTIC LINE SHOWN THUS
- 0.50m MAJOR CONTOURS SHOWN THUS
- 0.10m MINOR CONTOURS SHOWN THUS
- LIP OF GUTTER SHOWN THUS
- GUTTER LINE SHOWN THUS
- BACK OF CURBS SHOWN THUS
- BACK OF SIDEWALK SHOWN THUS
- TOP OF SLOPE SHOWN THUS
- TOE OF SLOPE SHOWN THUS
- NEW SEWER LINE SHOWN THUS
- NEW WATER LINE SHOWN THUS
- NEW WATER VALVE SHOWN THUS
- NEW ELECTRICAL AND COMMUNICATION LINE SHOWN THUS

SURVEY WAS PERFORMED ON THE 12th OF MAY, 2020.

FOR LOCATIONS OF UNDERGROUND UTILITIES, CONTACT THE UTILITY COMPANIES BEFORE EXCAVATING.

YTG COMMUNITY SERVICES

PLAN SHOWING
SITE SURVEY
OF
LOGAN SUBDIVISION
LOTS 141 TO 144

CITY OF WHITEHORSE, YUKON

Drawn by:	KG	Scale: 1:500	Drawing: 37591-SiteSurvey-5	
Checked by:	RC	Date: 2020-06-21		
No.	Description:		Date:	By:
4	INITIAL ISSUE		2020-07-13	KG

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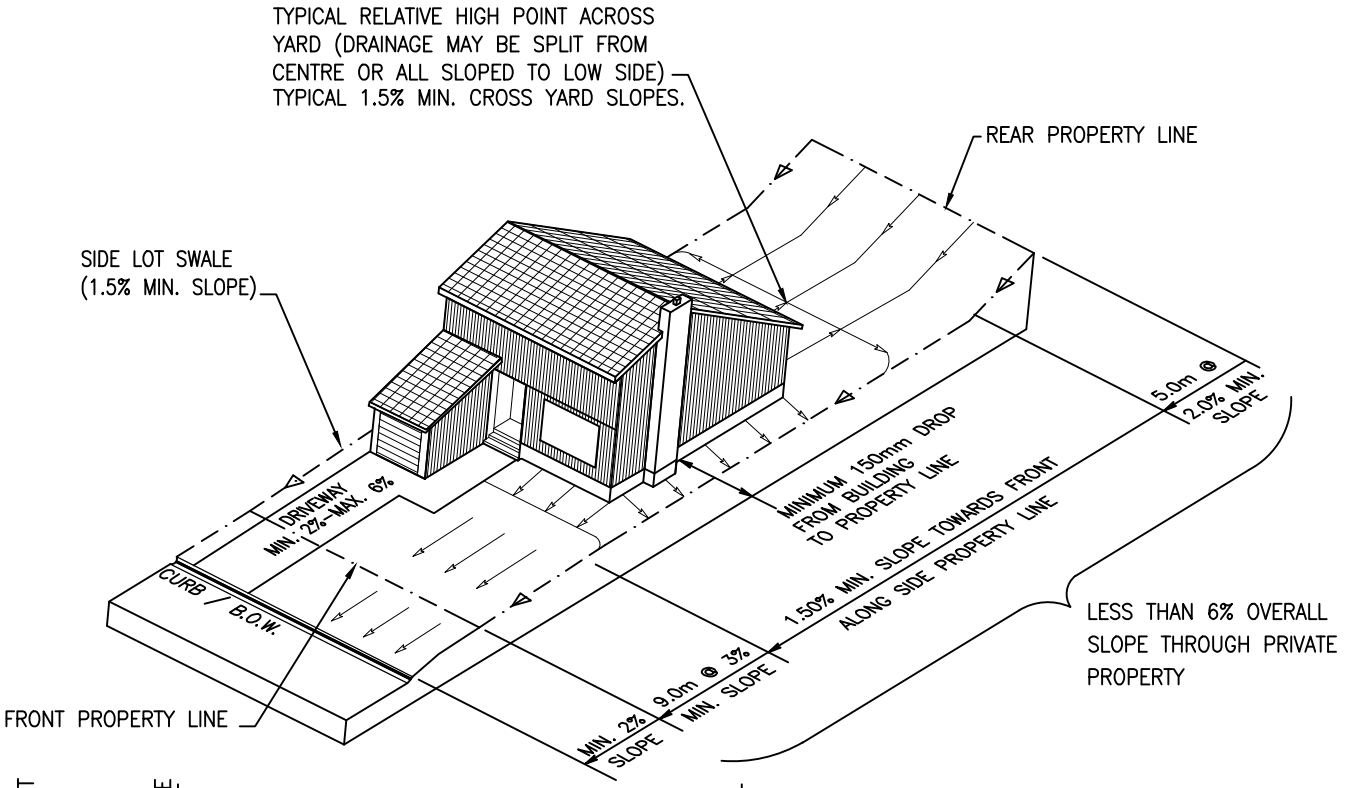
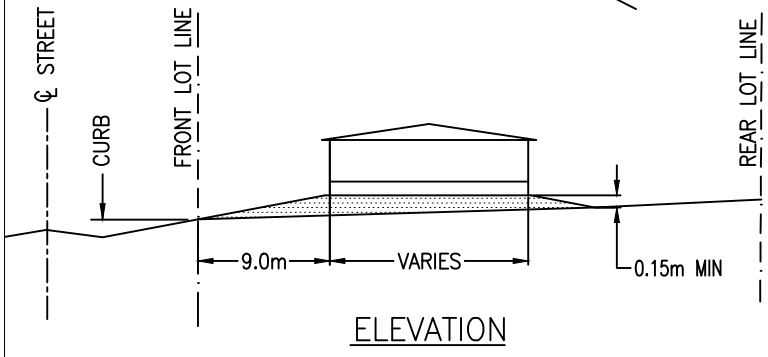
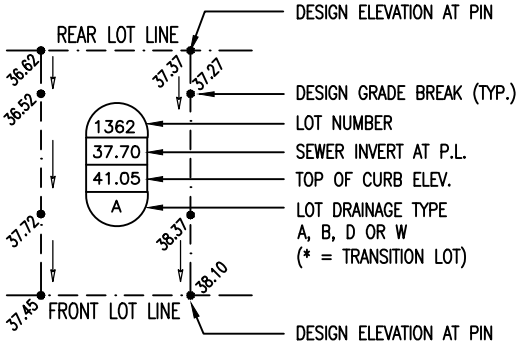
APPENDIX C

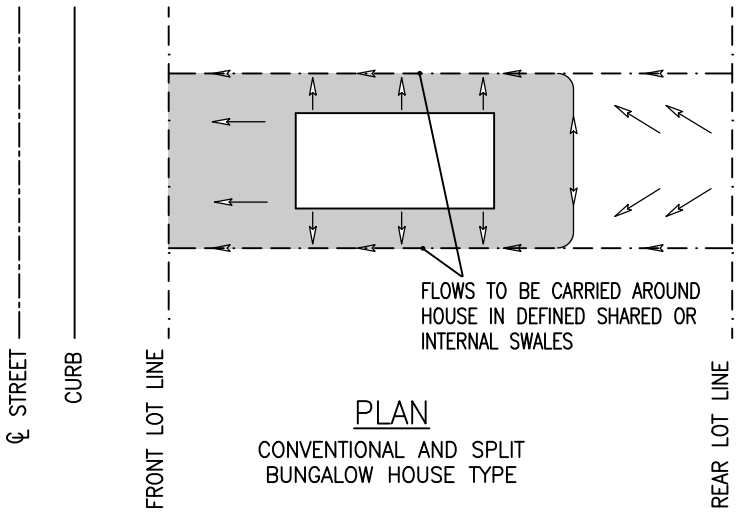
LOT DRAINAGE STANDARD DRAWINGS





ELEVATION





PLAN

CONVENTIONAL AND SPLIT BUNGALOW HOUSE TYPE

NOTES:

1. SITE GRADING TO BE CARRIED OUT AND MAINTAINED TO ENSURE WATER IS DIRECTED AWAY FROM ALL BUILDINGS TO PREVENT ACCUMULATION OF SURFACE WATER AT THE BUILDING STRUCTURE IN ACCORDANCE WITH THE NATIONAL BUILDING CODE OF CANADA.
2. LANDSCAPING TO BE INSTALLED IN A MANNER THAT MAINTAINS MINIMUM SITE GRADES.
3. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
4. ALL ROOF LEADERS ARE TO BE DIRECTED TOWARDS THE FRONT OF THE LOT.
5. ALL DESIGN ELEVATIONS ARE TO BE INDICATED AT LOT CORNERS AND GRADE BREAKS ALONG PROPERTY LINE.

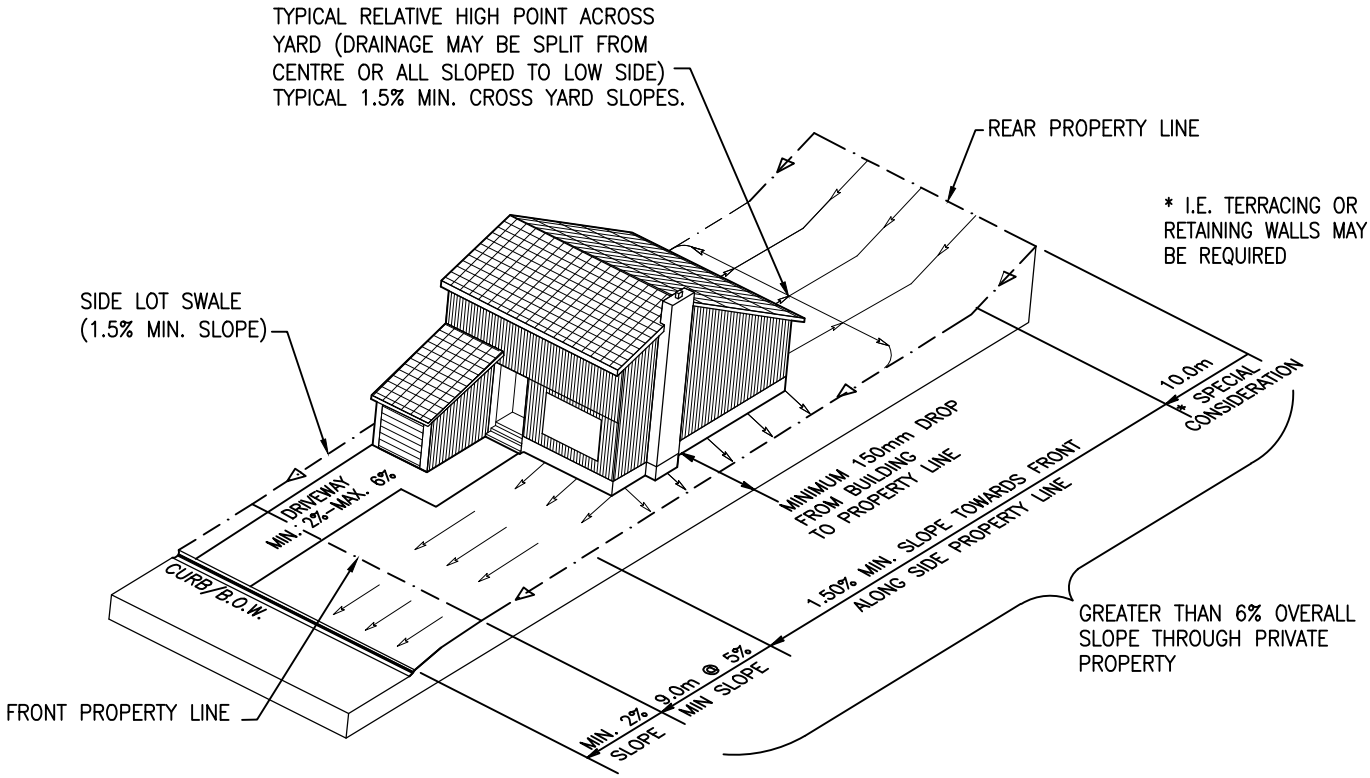
Whitehorse
THE WILDERNESS CITY
Engineering Department

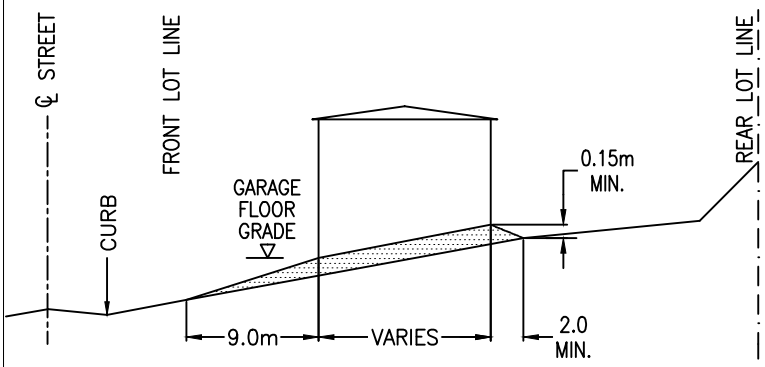
TYPICAL URBAN LOT DRAINAGE TYPE 'A' – REAR TO FRONT DRAINAGE LESS THAN 6% OVERALL LOT SLOPE

STD DWG

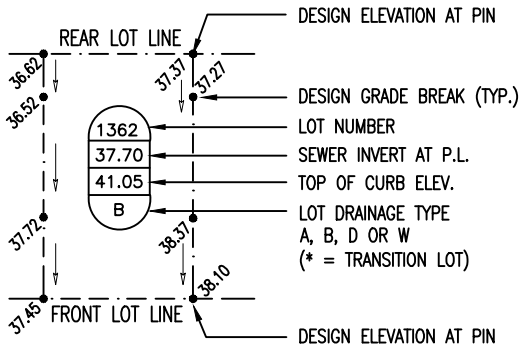
D2.0

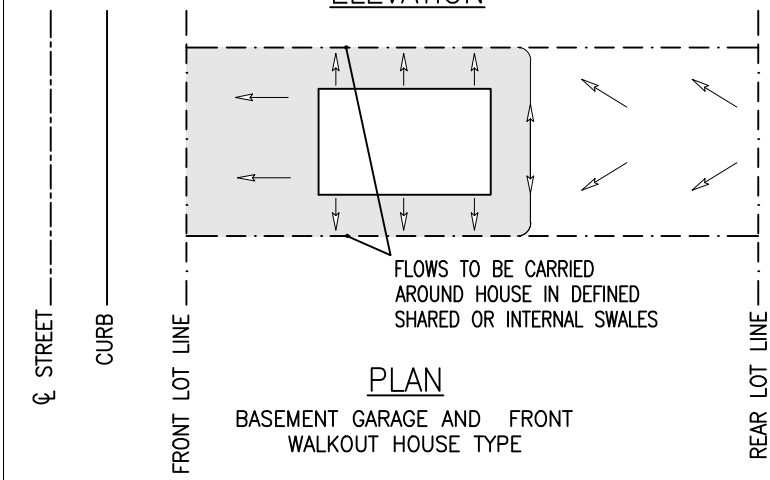
DATE: JANUARY, 2020





ELEVATION





PLAN

BASEMENT GARAGE AND FRONT WALKOUT HOUSE TYPE

NOTES:

1. SITE GRADING TO BE CARRIED OUT AND MAINTAINED TO ENSURE WATER IS DIRECTED AWAY FROM ALL BUILDINGS TO PREVENT ACCUMULATION OF SURFACE WATER AT THE BUILDING STRUCTURE IN ACCORDANCE WITH THE NATIONAL BUILDING CODE OF CANADA.
2. LANDSCAPING TO BE INSTALLED IN A MANNER THAT MAINTAINS MINIMUM SITE GRADES.
3. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
4. ALL ROOF LEADERS ARE TO BE DIRECTED TOWARDS THE FRONT OF THE LOT.
5. ALL DESIGN ELEVATIONS ARE TO BE INDICATED AT LOT CORNERS AND GRADE BREAKS ALONG PROPERTY LINE.

Whitehorse
THE WILDERNESS CITY
Engineering Department

TYPICAL URBAN LOT DRAINAGE TYPE 'B' – REAR TO FRONT DRAINAGE GREATER THAN 6% OVERALL LOT SLOPE

STD DWG

D2.1

DATE: JANUARY, 2020