



MEMO

TO: Scott Cosman, P Eng.
COMPANY: BC MOTI
FROM: Bob Forsyth, P Eng
DATE: 5 April 2024
CC: Zach Crippen, P Eng, Jenna Lee, P Eng.
PROJECT NO.: CA-EI-VG07796.A09
SUBJECT: Proposed Drainage Improvements, Hwy 9 near Miami Creek, Harrison Hot Springs, BC

1 INTRODUCTION

As requested, we attended the referenced site, on March 22, 2024, to visually assess ground conditions. We have been requested to provide our assessment and recommendations regarding retainment of the slopes of a proposed drainage ditch to be located adjacent to the west side of the north abutment of the Hwy 9 bridge over Miami Creek. Highway 9 crosses Miami Creek / Miami River twice in Harrison Hot Springs. The subject of this report is the southern crossing of Miami Creek. A proposed storm drain will outlet at the head of the ditch via a precast concrete headwall. From the headwall, the ditch leads down a distance of about 20m to the north bank of Miami Creek.

While on site we measured the bridge embankment slopes and vicinity using a measuring tape and inclinometer and took photographs of the site.

Prior to visiting the site, we reviewed background information which included drawings (plan and section) of the proposed ditch, headwall, and ditch slopes. The proposed drainage ditch must fit within the MOTI Right of way such that the private property on the west side of the ditch is not permanently altered. In order to do so, there will be a cut into the existing road embankment. For the most part, the ditch will fit into the Right of way with a 1.5H: 1V or flatter slope. However, for portions of the proposed ditch alignment, an approximately 1 H: 1V, 2m high cut slope will be required on the east side of the ditch. An approximately one metre high slope of similar inclination will be required on the west side of the ditch. A 1H: 1V slope, likely in granular embankment fill, is not expected to meet BCMOTI stability criteria, especially in wet conditions. Accordingly, an engineered retaining wall will be required for support of that portion of the slope that is steeper than 1.5H: 1V. We understand that the wall will continue from the storm drain outlet about 15m southward so that it extends past the existing bridge abutment wall. The drainage of the proposed retaining wall will be an important aspect of design and construction.

2 SITE DESCRIPTION

The embankment slope on the west side of Highway 9 on the north abutment of Miami Creek, is shown in Photos 1 and 2. The location of the site is shown in Figure 1. The embankment slope is about 2m high and inclined at approximately 40°. There is a relatively flat, 2.3m wide grassed strip between the paved shoulder of the highway and the embankment slope crest. The embankment slope appeared to be dry and stable and was vegetated with blackberries and a few small trees. A lawn area is present to the west of the shallow ditch at the toe of the embankment. A large deciduous tree, which dominates the lawn, is located about 7m west of the ditch. The property line is located close to the west side of the existing ditch.



Photo 1: *Looking south at the area west of the north abutment of the Highway 9 / Miami Creek Bridge, Harrison Hot Springs, BC.*



Photo 2: *Looking north at the area west of the north abutment of the bridge from the south bank of the river.*

No seepage was noted from the embankment during our site attendance and the creek was at about Elevation 10m, about 3.8m below the sidewalk level of the bridge. Soil exposed in the creek banks consists of non plastic silt and sand. Considering the existing slope angle and stable appearance of the embankment slope, we expect that the embankment is comprised of dense granular fill.

From west to east, the distance between the road and the property line increases, such that near the proposed storm drain outlet, there is less room to fit the drainage ditch and related banks than there is further to the south near the banks of the creek.

3 COMMENTS AND RECOMMENDATIONS

Immediately south of the proposed storm drain outlet location, 1H: 1V side slopes would be required to fit a 1.5m wide ditch between the existing paved shoulder of the highway and boundary of the adjacent property located to the west. Another 10m further south along the ditch alignment, the space increases such that the ditch will fit into the allotted space with 1.5H: 1V side slopes. BC MOTI Standards require that granular embankment slopes be inclined at a maximum of 1.5H: 1V or flatter. As well, it is desired that the retaining wall extend southward past the abutment wall of the bridge.

An option for support of the ditch sidewalls is a retaining wall. In section 3.1 we provide recommendations for an MSE wall with a concrete lock block facing. Other types of retaining walls and reinforced slopes are possible and can be discussed in further detail if desired.

3.1 MSE WALL WITH LOCK BLOCK FACING

The following recommendations apply to an MSE retaining wall with a concrete lock block facing. A conceptual design of the wall is shown in Figures 2 and 3.

- Concrete lock blocks are 0.75m X 0.75m X 1.5m blocks cast with protrusions at the top that fit into matching depressions in the bottom of the overlying blocks.
- The lower row of blocks should be founded on dense native soil or structural fill placed on top of such. A minimum 150mm thick levelling course of 25 mm minus sand and gravel fill is typically placed below the first row of blocks. The levelling course is graded at an angle so that the wall face is battered at an inclination of 1H: 10V or flatter. The underside of the lower row of blocks should be embedded under the ground surface by at least 0.6m.
- A drain is required at the base of the wall backfill. The drain should consist of 100mm diameter perforated PVC pipe surrounded with about 150mm of drain rock all wrapped in nonwoven geotextile. The drain outlet should lead into the ditch downstream of the retaining wall.
- Wall backfill should consist of free draining 75mm minus sand and gravel (of the material that passes the 2mm sieve, only 5% should pass the .074mm sieve). A portion of the existing embankment may be suitable for re-use as wall backfill, provided that it meets the above criteria.
- Wall backfill and levelling course should be compacted to 98% of Standard Proctor Maximum Dry Density (SPD) within the reinforced zone of the wall. Backfill outside of the reinforcement should be compacted to 95% of SPD (as per Type D embankment fill)
- Where the wall is higher than 1.2m, it should be reinforced with uniaxial geogrid which extends a distance H from the wall face, equal to the wall height. Steel hooks, or equivalent, should be embedded into the back of the lock blocks so that the geogrid is attached to the block. The geogrid is not required for walls less than 1.2m high which is expected to be the case on the west side of the ditch.
- Geogrid should have a tensile strength of at least 67kN/m.
- There will be a temporary construction slope, up to about 2.5m high, on the east side of the ditch. The slope should be inclined as per WorkSafe BC regulations.

- The permanent slope at the crest of the retaining wall should be inclined at 2H: 1V or flatter.

4.0 FIELD REVIEW

It is recommended that field reviews be conducted by WSP during construction of the retaining wall. Of particular interest is:

- Review of subgrade, including the replacement of unsuitable material beneath the walls with structural fill.
- Installation of drains, drain rock and filter cloth.
- Installation of geogrid and compaction of wall backfill. We understand that the contractor will be responsible for Quality Control testing of the wall levelling course and backfill. We expect that each lift of fill beneath the wall and in the reinforced zone behind the wall will be tested by the QC representative. WSP, and/or BCMOTI representative, should be present on site on a periodic basis for QA observation and/or testing of the wall backfill.
- The compacted subgrade behind the reinforced zone supports the road and should likewise be tested on a full-time basis by the QC rep and observed periodically by WSP and/or a BC MOTI rep.

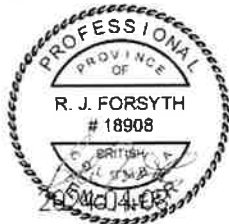
5.0 CLOSURE

This memo report was prepared for the exclusive use of the BC Ministry of Transportation and Infrastructure. Additional limitations are attached. If you have any questions concerning our geotechnical comments or require additional information, please do not hesitate to contact the undersigned.

Yours sincerely,

WSP E&I Canada Limited

Prepared by:



Bob Forsyth, P Eng.
Principal Geotechnical Engineer

Reviewed by:

Randy Hillaby

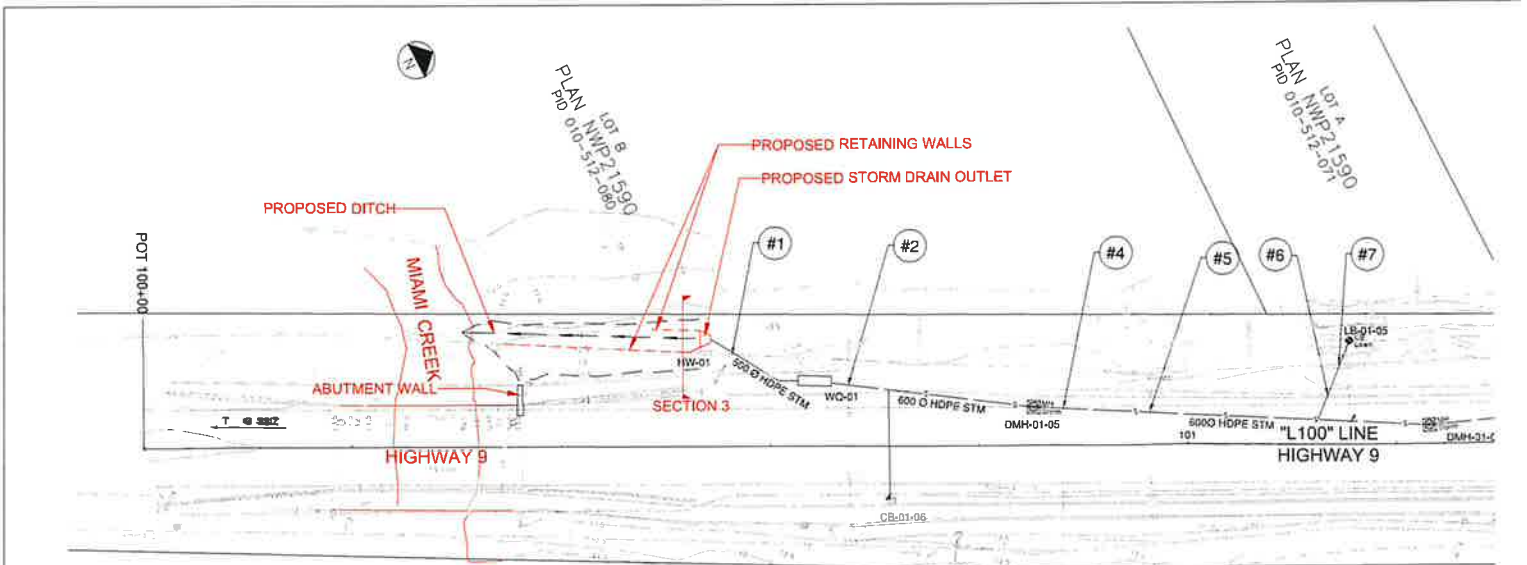
Randy Hillaby, P Eng.
Senior Principal Geotechnical Engineer

Attachments: Figures
Limitations

<p>PERMIT TO PRACTICE WSP E&I Canada Limited Authorized By: <u>James Brunswick</u> Signature: _____ Date: <u>2024-04-08</u></p> <p>PERMIT NUMBER: 1004452 Engineers and Geoscientists British Columbia</p>
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Attachment A

Figures




REF: DRAWING NO R1-1112-707 OF ROSEDALE-AGASSIZ HIGHWAY NO. 9 HARRISON HOT SPRINGS - DRAINAGE IMPROVEMENTS STORM SEWER 1, PARSONS, MARCH 15, 2024

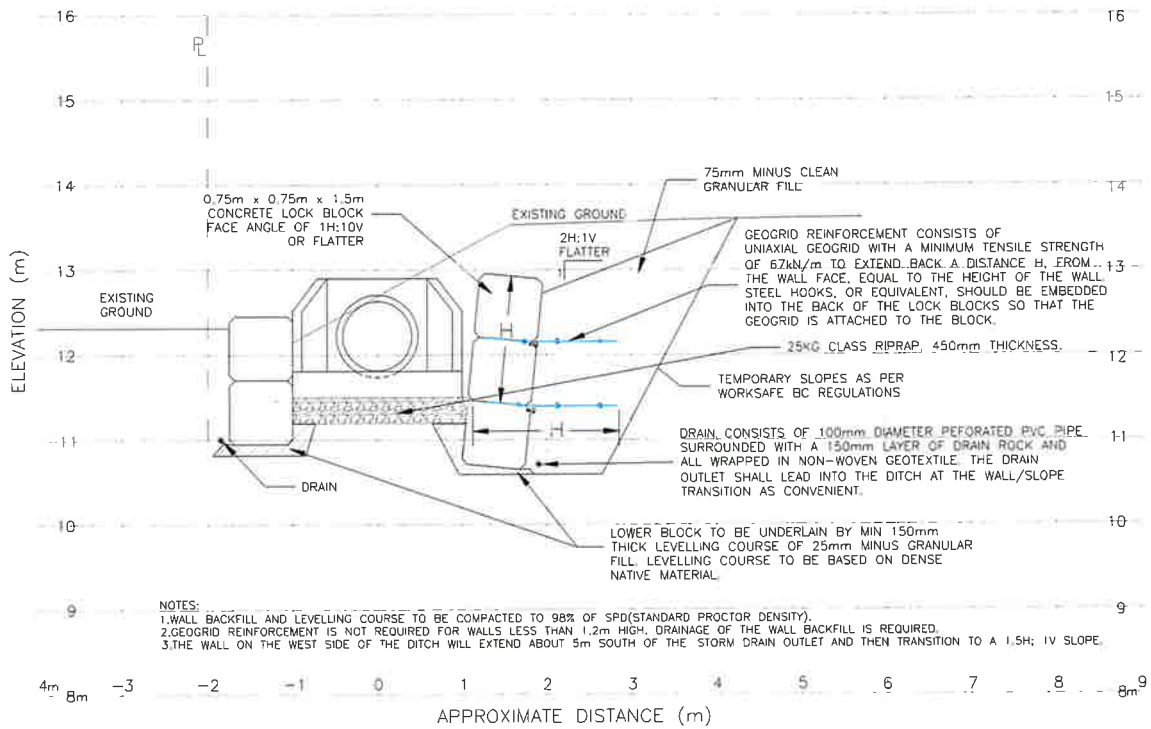
NOTE: WSP GEOTECHNICAL MARK-UPS ARE IN RED.

MIAMI RIVER



PART 54 - SECT
NO. 10 - PLAN
PID 013-107

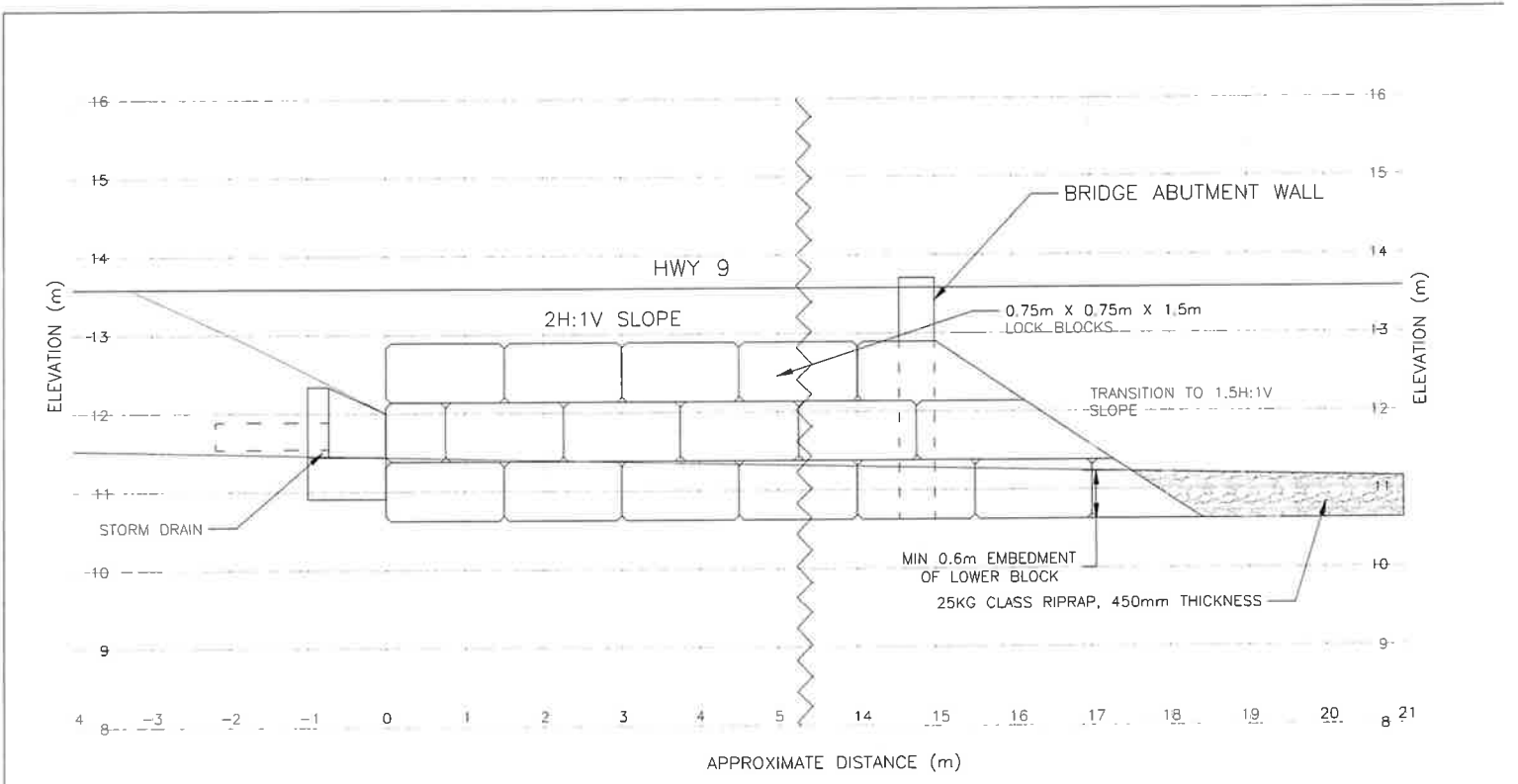
BC MOTI  <small>WSP (CA) Company Limited 20229 96 Ave Unit 100 Langley, BC</small>	DESIGNED BY: _____ CHECKED BY: _____ SCALE: _____ AS SHOWN	PROPOSED DRAINAGE IMPROVEMENT HWY 9 NEAR MIAMI CREEK, HARRISON HOT SPRINGS, BC	DATE: APR 2024 PROJECT NO: CA-EI-VG0779E REV. NO.: 0 FIGURE NO.: 1
	SITE PLAN		




BC MOTI



DRAWN BY: CHECK'D BY: SCALE: AS SHOWN	PROPOSED DRAINAGE IMPROVEMENT HWY 9 NEAR MIAMI CREEK, HARRISON HOT SPRINGS, BC	DATE: APR 2024 PROJECT NO: CHA/EI-VG0779E REV. NO.: 0 FIGURE NO.: 2
SECTION 3		



BC MOTI  <small>wsp (a) Canada Limited 20250 99 Ave Unit 100 Lethbridge, AB, BC</small>	DATE: APR 2024	PROPOSED DRAINAGE IMPROVEMENT HWY 9 NEAR MIAMI CREEK, HARRISON HOT SPRINGS, BC SIDE VIEW OF LOCK BLOCK WALL- LOOKING EAST	PROJECT NO: CA-EI-VG0779E
	DESIGNED BY: TL CHECKED BY: BF SCALE: AS SHOWN		REV. NO: 0 FIGURE NO: 3

Limitations



Limitations

- 1 The work performed in the preparation of this report and the conclusions presented are subject to the following:
 - a) The contract between WSP and the Client, including any subsequent written amendment or Change Order duly signed by the parties (hereinafter together referred as the “Contract”);
 - b) Any and all time, budgetary, access and/or site disturbance, risk management preferences, constraints or restrictions as described in the contract, in this report, or in any subsequent communication sent by WSP to the Client in connection to the Contract; and
 - c) The limitations stated herein.
- 2 **Standard of care:** WSP has prepared this report in a manner consistent with the level of skill and are ordinarily exercised by reputable members of WSP’s profession, practicing in the same or similar locality at the time of performance, and subject to the time limits and physical constraints applicable to the scope of work, and terms and conditions for this assignment. No other warranty, guaranty, or representation, expressed or implied, is made or intended in this report, or in any other communication (oral or written) related to this project. The same are specifically disclaimed, including the implied warranties of merchantability and fitness for a particular purpose.
- 3 **Limited locations:** The information contained in this report is restricted to the site and structures evaluated by WSP and to the topics specifically discussed in it, and is not applicable to any other aspects, areas, or locations.
- 4 **Information utilized:** The information, conclusions and estimates contained in this report are based exclusively on: I) information available at the time of preparation, ii) the accuracy and completeness of data supplied by the Client or by third parties as instructed by the Client, and iii) the assumptions, conditions, and qualifications/limitations set forth in this report.
- 5 **Accuracy of information:** No attempt has been made to verify the accuracy of any information provided by the Client or third parties, except as specifically stated in this report (hereinafter “Supplied Data”). WSP cannot be held responsible for any loss or damage, of either contractual or extra-contractual nature, resulting from conclusions that are based upon reliance on the Supplied Data.
- 6 **Report interpretation:** This report must be read and interpreted in its entirety, as some sections could be inaccurately interpreted when taken individually or out-of-context. The contents of this report are based upon the conditions known and information provided as of the date of preparation. The text of the final version of this report supersedes any other previous versions produced by WSP.
- 7 **No legal representations:** WSP makes no representations whatsoever concerning the legal significance of its findings, or as to other legal matters touched on in this report, including but not limited to, ownership of any property, or the application of any law to the facts set forth herein. With respect to regulatory compliance issues, regulatory statutes are subject to interpretation and change. Such interpretations and regulatory changes should be reviewed with legal counsel.
- 8 **Decrease in property value:** WSP shall not be responsible for any decrease, real or perceived, of the property or site’s value or failure to complete a transaction, as a consequence of the information contained in this report.
- 9 **No third-party reliance:** This report is for the sole use of the party to whom it is addressed unless expressly stated otherwise in the report or Contract. Any use or reproduction which any third party makes of the report, in whole or in part, or any reliance thereon or decisions made based on any information or conclusions in the report is the sole responsibility of such third party. WSP does not represent or warrant the accuracy, completeness, merchantability, fitness for purpose or usefulness of this document, or any information contained in this document, for use or consideration by any third party. WSP accepts no responsibility whatsoever for damages or loss of any nature or kind suffered by any such third party as a result of actions taken or not taken or decisions made in reliance on this report, or anything set out therein. including without limitation, any indirect, special, incidental, punitive, or consequential loss, liability, or damage of any kind.

10 Assumptions: Where design recommendations are given in this report, they apply only if the project contemplated by the Client is constructed substantially in accordance with the details stated in this report. It is the sole responsibility of the Client to provide to WSP changes made in the project, including but not limited to, details in the design, conditions, engineering, or construction that could in any manner whatsoever impact the validity of the recommendations made in the report. WSP shall be entitled to additional compensation from Client to review and assess the effect of such changes to the project.

11 Time dependence: If the project contemplated by the Client is not undertaken within a period of 18 months following the submission of this report, or within the time frame understood by WSP to be contemplated by the Client at the commencement of WSP's assignment, and/or, if any changes are made, for example, to the elevation, design or nature of any development on the site, its size and configuration, the location of any development on the site and its orientation, the use of the site, performance criteria and the location of any physical infrastructure, the conclusions and recommendations presented herein should not be considered valid unless the impact of the said changes is evaluated by WSP, and the conclusions of the report are amended or are validated in writing accordingly.

Advancements in the practice of geotechnical engineering, engineering geology and hydrogeology and changes in applicable regulations, standards, codes, or criteria could impact the contents of the report, in which case, a supplementary report may be required. The requirements for such a review remain the sole responsibility of the Client or their agents.

WSP will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report.

12 Limitations of visual inspections: Where conclusions and recommendations are given based on a visual inspection conducted by WSP, they relate only to the natural or man-made structures, slopes, etc. inspected at the time the site visit was performed. These conclusions cannot and are not extended to include those portions of the site or structures, which were not reasonably available, in WSP's opinion, for direct observation.

13 Limitations of site investigations: Site exploration identifies specific subsurface conditions only at those points from which samples have been taken and only at the time of the site investigation. Site investigation programs are a professional estimate of the scope of investigation required to provide a general profile of subsurface conditions.

The data derived from the site investigation program and subsequent laboratory testing are interpreted by trained personnel and extrapolated across the site to form an inferred geological representation and an engineering opinion is rendered about overall subsurface conditions and their likely behaviour with regard to the proposed development. Despite this investigation, conditions between and beyond the borehole/test hole locations may differ from those encountered at the borehole/test hole locations and the actual conditions at the site might differ from those inferred to exist, since no subsurface exploration program, no matter how comprehensive, can reveal all subsurface details and anomalies.

Final sub-surface/bore/profile logs are developed by geotechnical engineers based upon their interpretation of field logs and laboratory evaluation of field samples. Customarily, only the final bore/profile logs are included in geotechnical engineering reports.

Bedrock, soil properties and groundwater conditions can be significantly altered by environmental remediation and/or construction activities such as the use of heavy equipment or machinery, excavation, blasting, pile-driving, or draining or other activities conducted either directly on site or on adjacent terrain. These properties can also be indirectly affected by exposure to unfavorable natural events or weather conditions, including freezing, drought, precipitation, and snowmelt.

During construction, excavation is frequently undertaken which exposes the actual subsurface and groundwater conditions between and beyond the test locations, which may differ from those encountered at the test locations. It is recommended that WSP be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered at the test locations, that construction work has no negative impact on the geotechnical aspects of the design, to adjust recommendations in accordance with conditions as additional site information is gained, and to deal quickly with geotechnical considerations if they arise.

Interpretations and recommendations presented herein may not be valid if an adequate level of review or inspection by WSP is not provided during construction.

- 14 Factors that may affect construction methods, costs, and scheduling:** The performance of rock and soil materials during construction is greatly influenced by the means and methods of construction. Where comments are made relating to possible methods of construction, construction costs, construction techniques, sequencing, equipment, or scheduling, they are intended only for the guidance of the project design professionals, and those responsible for construction monitoring. The number of test holes may not be sufficient to determine the local underground conditions between test locations that may affect construction costs, construction techniques, sequencing, equipment, scheduling, operational planning, etc. Any contractors bidding on or undertaking the works should draw their own conclusions as to how the subsurface and groundwater conditions may affect their work, based on their own investigations and interpretations of the factual soil data, groundwater observations, and other factual information.
- 15 Groundwater and Dewatering:** WSP will accept no responsibility for the effects of drainage and/or dewatering measures if WSP has not been specifically consulted and involved in the design and monitoring of the drainage and/or dewatering system.
- 16 Environmental and Hazardous Materials Aspects:** Unless otherwise stated, the information contained in this report in no way reflects on the environmental aspects of this project, since this aspect is beyond the Scope of Work and the Contract. Unless expressly included in the Scope of Work, this report specifically excludes the identification or interpretation of environmental conditions such as contamination, hazardous materials, wildlife conditions, rare plants or archeology conditions that may affect use or design at the site. This report specifically excludes the investigation, detection, prevention, or assessment of conditions that can contribute to moisture, mould, or other microbial contaminant growth and/or other moisture related deterioration, such as corrosion, decay, rot in buildings or their surroundings. Any statements in this report or on the boring logs regarding odours, colours, and unusual or suspicious items or conditions are strictly for informational purposes.
- 17 Sample Disposal:** WSP will dispose of all uncontaminated soil and rock samples after 30 days following the release of the final geotechnical report. Should the Client request that the samples be retained for a longer time, the Client will be billed for such storage at an agreed upon rate. Contaminated samples of soil, rock or groundwater are the property of the Client, and the Client will be responsible for the proper disposal of these samples, unless previously arranged for with WSP or a third party.