MEMO

TO:	Scott Cosman, P Eng.
COMPANY:	BC MOTI
FROM:	Bob Forsyth, P Eng
DATE:	20 December 2024
CC:	Zach Crippen, P Eng, Jenna Lee, P Eng.
PROJECT NO.:	CA0039758.7070
SUBJECT:	Proposed Embankment/Drainage Ditch Slopes, Hwy 9 near Miami Creek, Harrison Hot Springs, BC

1 INTRODUCTION

As requested, we have reviewed your design details for the proposed embankment slopes on the west side of Hwy 9 on the north abutment of the Miami Creek bridge. There the embankment slope will be about 2.5 to 3.0m high and inclined at 1.5H: 1V with the lower 0.5m portion inclined at about 1H: 1V (horizontal: vertical). A drainage ditch, with an outlet to Miami Creek, will be present at the toe of the embankment slope. The embankment is believed to be composed of relatively dense granular fill. Portions of the embankment are presently inclined as steeply as 40°with no sign of instability.

At the road /bridge interface there is a concrete wing wall, about 0.6m wide, that protrudes onto the upper part of the slope. From the 1993 design drawings of the bridge, it is understood that this wall is actually a pile cap, that is underlain by pipe piles. The elevation of the bottom of the pile cap is unknown. Underneath the pile cap the upper parts of the piles are surrounded by treated wooden lagging. It is undesirable for the piles and lagging to be exposed by the new embankment slopes.

2 DISCUSSION

We have the following comments regarding the proposed embankment slopes in the vicinity of the wing wall. Conceptual plan and profile sketches are included with this memo.

- The lower 0.5m of the embankment slope will be surfaced with small boulders and inclined at about 1H: 1V. The base of the boulder slope should be 0.5m wide
- Above a height of 0.5m, (about elevation 10.8m) the slope will be inclined at 1.5H: 1V and planted with vegetation.
- The elevation of the bottom of the wing wall/pile cap should be determined at the time of construction or earlier if possible. The 1.5H: 1V slope may intersect the face of the wing wall 0.3m or more above the base of the concrete. In this case, the embankment should be sloped at 1.5H: 1V with no remedial action required.
- If this is not the case and there is less than 0.3m of cover above the bottom of the wing wall, remedial action, consisting of a mid slope buttress, could be considered as described below.

WSP Canada Limited
Suite 110 – 18568 96th Avenue
Surrey, BC V4N 3P9
T: +1 604-295-8657
wsp.com

- Concrete lock blocks, 1.5m X 0.75m X 0.75m in dimension, should be placed at the mid portion of the slope. There should be a set of blocks oriented lengthwise north to south and another to be placed on the south side of the pile cap oriented lengthwise west to east.
- The base of the lock blocks should be below/behind a 2H: 1V projection from the toe of the slope.
- The lock blocks should be placed on compacted granular fill, inclined so that the lock blocks will have a battered face inclination of 1H: 10V or flatter. We envisage that the lock block wall will be two blocks high.
- We envisage that the back of the lock blocks will be at least 300mm from the wing wall. The blocks will be backfilled with clean sand and gravel. The backfill should cover the lower 0.3m of the pile cap and not extend above the halfway point of the upper block.
- If desired, the buttress could consist of angular boulders instead of concrete lock blocks. Such are typically constructed by an experienced excavator operator. The boulders are typically fitted together so that that they are well interlocked. The batter angle is typically about 1H: 2V. The boulder supplier should provide test results showing that the boulders are not subject to metal leaching or acid rock drainage.

Good drainage practise on the road above the embankment is very important. The release of surface water onto the slope, with or without the mid slope buttress, should be avoided as it can lead to instability and erosion. This is especially important until vegetation takes hold on the embankment surface.

Photo 1: Looking north at the wing wall on the west side of the north abutment of the bridge. A drainage ditch with an outlet to the creek will be constructed at the toe of the embankment.

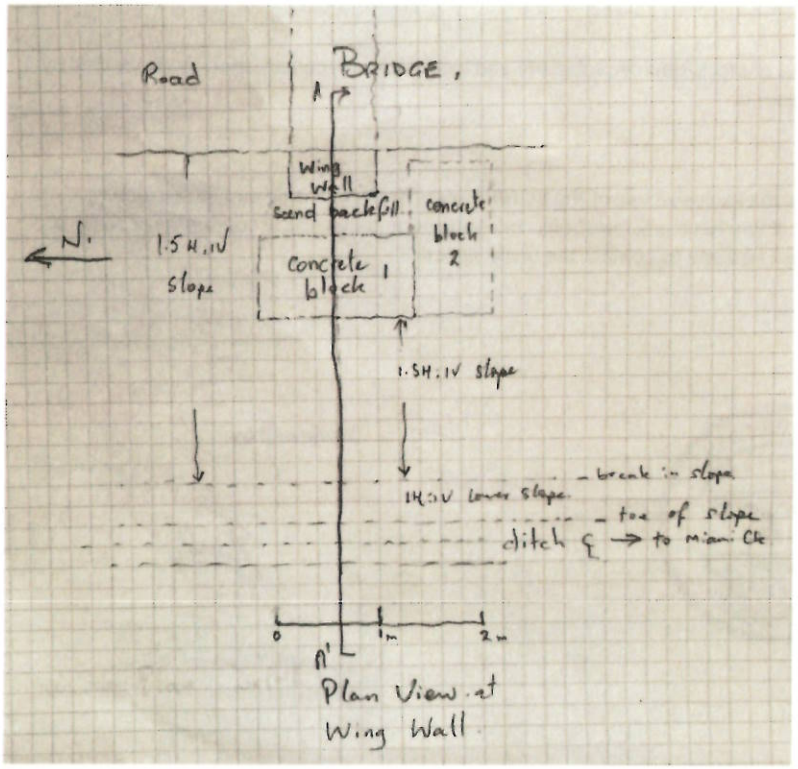


Figure 1: Conceptual Plan Sketch of the Wing Wall and Embankment with Mid Slope Buttress

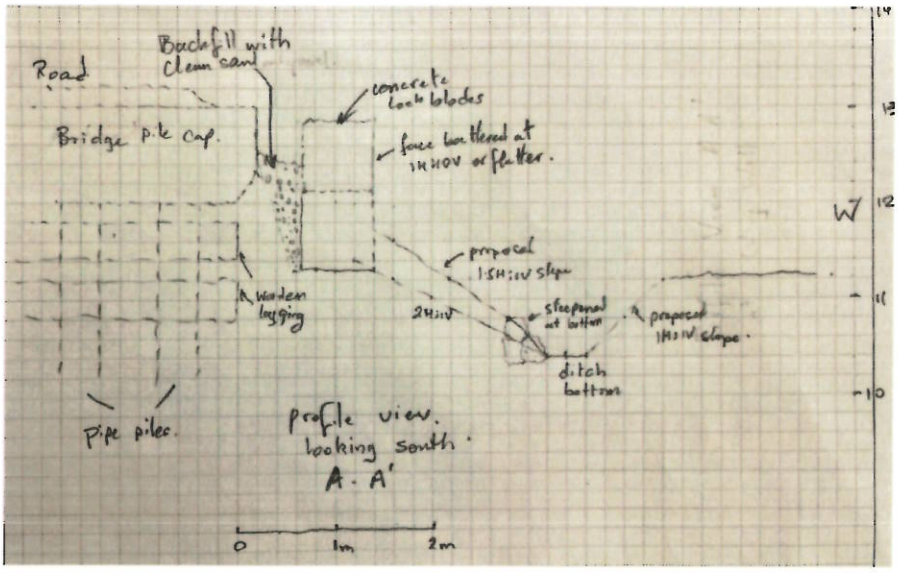


Figure 2: Conceptual Profile View with mid slope buttress

4.0 FIELD REVIEW

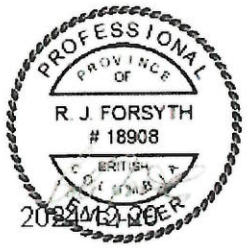
It is recommended that field reviews of block/boulder subgrade and lock block wall construction be conducted by WSP if the mid slope buttress is required.

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:

Surinder Garewal, P Eng.
Principal Geotechnical Engineer

Attachments: Limitations

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, wild life 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.