

TECHNICAL MEMORANDUM

DATE 17 May 2019

Reference No. 1898696-004-TM-Rev0

TO Mike Sullivan, PEng
Ministry of Transportation and Infrastructure

CC Justin Bae, PEng (MoTI)

FROM W Daley Clohan, PEng

EMAIL dclohan@golder.com

**100% SUBMISSION DESIGN BRIEF
CONCRETE MAT EROSION PROTECTION
LILLOOET STATION BRIDGE**

ADDENDUM #1 – NORTH BANK CONCRETE MAT EROSION PROTECTION

1.0 INTRODUCTION

The intent of this document is to provide an addendum to the design brief pertaining to the 100% design submission to the Ministry of Transportation and Infrastructure (MoTI) for the concrete mat erosion protection for the Lillooet Station Bridge replacement project (Golder 2019). This addendum was submitted to the MoTI and it is understood that it will be included in a tender package being prepared by the MoTI.

This addendum should be read with the *Important Information and Limitations of this Report* that is included in Appendix A. The readers attention is specifically drawn to this information for the proper use and interpretation of this design brief.

This addendum provides information specifically for the hydrotechnical engineering design of the erosion protection along the north (i.e., left) bank of the bridge. Geotechnical, groundwater/hydrogeological, structural, and transportation engineering and archaeology, environmental, and bioscience services are all excluded.

2.0 BACKGROUND

Golder Associates Ltd. (Golder) submitted a hydrotechnical engineering assessment report on 10 October 2017 for the Lillooet Station Bridge (Golder 2017). This report provided review of the bridge site, watershed, and water management activities.

Golder's 100% design report was submitted on 01 February 2019. However, an opportunity to further minimize impacts to fish habitat was identified on 02 April 2019. This revised design is the result of this opportunity.

3.0 HYDROTECHNICAL DESIGN CRITERIA

Highway 99 is a provincial highway and the new bridge was assessed with a 200-year return period hydrological design criterion (Golder 2019). The following documents were considered in the hydrotechnical design addendum:

- Design Guideline 8 – Articulating Concrete Block Systems (HEC-23 Guideline):
 - US Department of Transportation, Federal Highway Administration. 2009. Bridge Scour and Stream Instability Countermeasures: Experience, Selection, and Design Guidance-Third Edition. Volume 2. Hydraulic Engineering Circular No.23. Publication No. FHWA-NHI-09-112.

4.0 HYDROTECHNICAL ASSESSMENT SUMMARY

A description of the site, design flow calculations, and hydraulic conditions is presented in Golder's 100% design brief (Golder 2019). The analysis in the following sections were based on the findings of this design brief and the Golder (2017) hydrotechnical engineering report.

5.0 NORTH BANK EROSION PROTECTION

Revised design information for the north (i.e., left) bank erosion protection works is summarized below. It should be noted that design specifications concerning anchors, edge treatments, filter(s), and the extents of the articulating concrete mat erosion protection is provided in Golder's 100% design submission (Golder 2019). The Assurance of Professional Design form (H1252) for the revised north (i.e., left) bank is attached to this addendum.

5.1 Articulating Concrete Mat

The articulating concrete mat erosion protection design is based on the HEC-23 Guideline and information provided by Cable Concrete® (International Erosion Control Systems Inc.). Cable Concrete is listed on the MoTI Recognized Product List (MoTI 2019). Cable Concrete provided their Block Selection Guide, Specifications, and Standard Drawings for review. It is Golder's understanding that the information provided by Cable Concrete can be relied upon and free of errors and omissions.

The Factor of Safety Design Method in the HEC-23 Guideline was followed. A summary of the design calculations for the CC70 block size are listed in Table 1. It is noted that this method follows the Imperial system of units as specified by the manufacturers. Parameters in Table 1 are converted for presentation in the Metric system of units.

The CC70 block size from Cable Concrete® meets the target factor of safety design for both banks. The parameters and calculations were reviewed with Cable Concrete® and the CC70 block size was confirmed. However, it should be noted that the stability of this product is largely dependent on how well it is installed (i.e., blocks are flush with one another within the specified tolerance) and the direction of flow across the surface of the block. The current alignment of Seton River is such that flow generally runs parallel along the north bank; however, based on aerial photography the reach proximal to the proposed Lillooet Station Bridge may develop a meander bend to the south, upstream from the bridge. If a bend in the river develops, flows would impinge upon the ACM on the north bank. In this scenario the stability of the CC70 may not conform with the design criteria under design flood conditions.

Table 1: Design Calculations Summary from HEC-23 Guideline (not all parameters are listed).

Parameter	North Bank Value (Unit)	Comment
SF _b	1.20	Base Factor of Safety
X _c	1.30	Consequence of Failure Coefficient
X _m	1.00	Uncertainty Coefficient
SF_t	1.56	Target Factor of Safety
R _c	300 m	Channel Radius
T	49 m	Top Width
K _b	1.39	Bend Coefficient
Y _{max}	5.2 m	Max Water Depth
S _f	0.005 m/m	Energy Grade Line Slope
T _{des}	376 N/m ²	Design Shear Stress
ΔZ	10 mm	Protrusion Height
V _{des}	4.57 m/s	Design Velocity
F _D and F _L	49.8 N	Drag and Lift Forces
Θ ₁	1.5H : 1V	Bank Slope (horizontal to vertical)
SF	1.87	Calculated Factor of Safety

6.0 DRAWINGS AND SPECIFICATIONS

Design drawings have been updated to reflect the changes presented in this design brief and have been submitted to MoTI separately. It is understood that these drawings will be included in the MoTI tender package. The drawings have not included in this design brief. The hydrotechnical design drawings numbers are:

- 1) 230-50: Bank Erosion Protection Plan
- 2) 230-51: Bank Erosion Protection Details
- 3) 230-52: North Bank, Bank Erosion Protection Cross Sections
- 4) 230-53: South Bank, Bank Erosion Protection Cross Sections

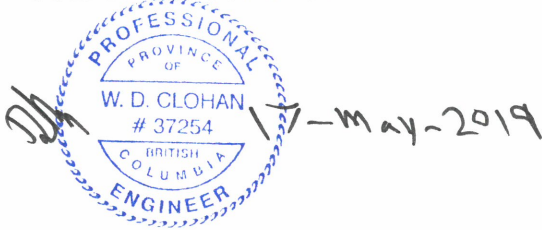
Technical specifications have been updated to reflect the changes presented in this design brief and have been submitted to MoTI separately. It is understood that these updated specifications will be included in the MoTI tender package (Special Provisions, Schedule 3). The technical specifications have not been included in this design brief.

7.0 CLOSURE

We trust this meets your current needs for a design brief and technical recommendations for the concrete mat erosion protection. Please contact the undersigned if there are any questions about this design brief.

Sincerely,

GOLDER ASSOCIATES LTD.



W Daley Clohan, MASc, PEng
Hydrotechnical Engineer

WDC/CC/syd

A handwritten signature in black ink that reads "CT Coles".

Chris Coles, MASc, PEng
Associate, Senior Hydrotechnical Engineer

Attachments: Attachment 1 – Important Information and Limitations of this Report

[https://golderassociates.sharepoint.com/sites/24046g/deliverables/issued to client_for wp/1898696-004-tm-rev0/1898696-004-tm-rev0-100% design-17may_19.docx](https://golderassociates.sharepoint.com/sites/24046g/deliverables/issued%20to%20client_for/wp/1898696-004-tm-rev0/1898696-004-tm-rev0-100%20design-17may_19.docx)

8.0 REFERENCES

Golder Associates Ltd. (Golder). 2017. Hydrotechnical Engineering Assessment – Lillooet Station Bridge No. 00230 Replacement. Prepared for Ministry of Transportation and Infrastructure. Vancouver BC: Golder Associates Ltd. Doc. No. 1412840-024-R-Rev0-2000-2007. 10 October 2017

Golder. 2019. 100% Submission Design Brief Concrete Mat Erosion Protection – Lillooet Station Bridge. Prepared for Ministry of Transportation and Infrastructure. Vancouver BC: Golder Associates Ltd. Doc. No. 1898696-002-TM-Rev0. 01 February 2019

Ministry of Transportation and Infrastructure (MoTI). 2019. Recognized Products List. 01 April 2019.

ATTACHMENT 1

**Important Information and
Limitations of this Report**

Important Information and Limitations of this Report

Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder can not be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without Golder's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, Golder may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to Golder. The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client cannot rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder can not be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

Soil, Rock and Groundwater Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions

that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. **The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report.** The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

Sample Disposal: Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

Follow-Up and Construction Services: All details of the design were not known at the time of submission of Golder's report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder's report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder's report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

Changed Conditions and Drainage: Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.