Hamilton

Aquafor Beech Limited

Highway 5 – Grindstone Creek Bridge Utility Relocation Class Environmental Assessment and Conceptual Design

Appendix E

Geotechnical Study

Terraprobe

Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

PRELIMINARY GEOTECHNICAL ASSESSMENT
HWY 5 & GRINDSTONE CREEK
WATERDOWN (HAMILTON),ONTARIO

Prepared For:

Aquafor Beech Ltd.
2600Skymark Avenue,
Building 6, Unit 202
Mississauga, Ontario
L4W 5B2

File No. 7-16-0106-01
August 16, 2016

Distribution:

Aquafor Beech
Terraprobe Inc., Stoney Creek

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1.0 INTRODUCTION

Terraprobe Inc. was retained by Aquafor Beech Ltd. to carry out a preliminary geotechnical engineering assessment in conjunction with the conceptual design and Class Environmental Assessment of the proposed Highway 5 – Grindstone Creek Bridge Utility Relocation project.

It is understood that the City of Hamilton proposes to build a utility bridge in advance of the reconstruction/rehabilitation of the Dundas Street (Hwy 5) bridge over Grindstone Creek and the CP Railway line. A number of utilities that are supported on the existing bridge will be transferred to the new bridge. A Class Environmental Assessment for the project is being undertaken and a geotechnical engineering assessment is required to provide information for conceptual design consideration as well as to provide clarification to some issues identified by Conservation Halton (CH) in their June 14, 2016 review letter (copy provided in Appendix A).

2.0 PROCEDURE

The geotechnical engineering assessment included the following tasks:

- A site inspection by a senior geotechnical engineer to obtain information on the nature and present condition of the valley slopes and creek banks in the area of the HWY 5 bridge ;
- A review of available reports, maps and other information to develop an understanding of the subsurface soil, rock and ground water conditions at the site;
- A review of available topographical mapping;
- The development of stratigraphic models for the site to be used in slope stability analyses;
- Analysis of the stability of the slopes using contemporary software ;
- Provision of information for the conceptual design of bridge foundations; and
- Preparation of a comprehensive report.

3.0 SITE DESCRIPTION

The following is a brief description of the conditions observed at the site during our inspection of August 9, 2016. Photos showing the conditions observed at the site are provided in the attached Appendix B.

The bridge at HWY 5 and Grindstone Creek is located on the east side of the Town of Waterdown (Hamilton), Ontario as shown on Figure 1. The existing bridge was constructed in 1966 and consists of three spans and two approach slabs with an overall length of about 65m. The bridge is supported on two abutments and two piers. The piers are situated near the toe of the valley wall slopes with a span of about 15m across the valley floor. The existing single rail track bed is situated on an

approximately 6 to7m wide bench located between the creek and the east valley wall. The toe of the west valley wall slope is exposed to creek flow. Low flow conditions were observed in the creek at the time of the inspection.

Some semblance of erosion protection in the way of rip rap and occasional large pieces of rock was observed along the west creek bank and between the piers and the bank. Some localized erosion has taken place along the west bank immediately downstream of the bridge. In addition, it appeared that a storm outlet on the downstream side of the bridge had been constructed, possibly several years ago. The remains of a corrugated steel pipe outlet were also observed at this location. Emergent vegetation was observed on the west valley wall slope in the area of the bridge and in the area of the storm outlet.

Clear crushed stone was exposed over a large portion of the east valley wall downstream of the bridge and there were some indications of slippage that may have previously occurred in this area. The exposed slope was dry at the time of the inspection.

4.0 SUBSURFACE CONDITIONS

Information on the subsurface conditions at the site was presented in a Foundation Investigation Report that was undertaken for the design of the existing Highway 5 bridge and is available from the MTO Foundation Library. [1]

The investigation included four boreholes with one borehole at each abutment and one borehole located in the flood plain on either side of the creek at each of the two piers. The following is our interpretation of the factual information presented in the report.

It was reported that the boreholes drilled at the site encountered fill overlying a deposit of generally stiff to hard clay and grey shale.

4.1 Tableland

The two boreholes drilled in the tableland area, penetrated about 3 to 4m of loose silty sand and gravel fill. The fill was underlain by a silty clay deposit that was penetrated to depths of about 10m. The silty clay was comprised of a generally firm to stiff upper zone and a harder lower zone. The boreholes penetrated bedrock at about elevations 212.5 and 213.4m. Ground water was encountered at depths of about 3m below the existing ground surface.

[1] Report on Foundation Investigation for Proposed Crossing C.P.R. Overhead and Grindstone Creek at Waterdown, Ontario -HWY # 5, District #4 – WP 272-60, Ontario Department of Highways Materials & Research Section, Downsview Ave., Toronto, (Dominion Soil Investigation Ltd.) August 19, 1960.

4.2 Flood Plain

Two boreholes were drilled in the flood plain on either side of the creek. These boreholes encountered fill overlying bedrock which was encountered at depths of about 2 to 3m or at about elevation 211.6 and 212.9m.

4.3 Bedrock

The bedrock was described as being grey shale. A review of geological mapping[2] indicates that the bedrock in the area of the site probably consists of argillaceous dolostone and shale of the Lockport Formation.

5.0 DISCUSSION

5.1 General

It is understood that it is proposed to replace the existing HWY 5 Bridge over Grindstone Creek with a new single span structure. The City proposes to construct a new utility bridge in advance of the new highway bridge and to relocate all of the existing utilities from the existing highway bridge to the new bridge. It is anticipated that the utility bridge will also be a single span structure. A conceptual cross section of the utility bridge is shown on Figure 3.

Although the design of the new HWY 5 bridge is not specifically part of this project, it is considered that continuity in some aspects of the design would be desirable. It is anticipated the two bridges will have similar spans and foundation types. In addition it needs to be recognized that the design of the utility bridge may impact on the construction methodology of the new HWY 5 bridge. For this reason some aspects of the following discussion will relate to the conceptual design of both bridges although it is provided primarily to address the utility bridge. Consultants involved with the design of the new Highway 5 bridge will need to make their own assessment of the conditions and select the foundation type that best meets the design requirements.

The location of the new bridge abutments (and the resulting bridge spans) will need to be designed such that the foundation loading from the new bridges will not impact the stability of the valley wall slopes and the new foundations will need to be set back sufficiently from the slopes that they will not be affected by creek erosion and slope stability over the design life.

[2] Paleozoic Geology, Hamilton Area, Southern Ontario, Ontario Division of Mines; Map No. 2336; 1976.

5.2 Bridge Foundations

The following discussion regarding bridge foundations has been presented for conceptual design consideration only and with the understanding that a geotechnical investigation is required for the design of the foundations.

Consideration could be given to supporting the new bridge(s) on a shallow foundation system consisting of conventionally designed spread footings or on a deep foundation consisting of end bearing bored or driven piles.

5.2.1 Spread Footings

The MTO Foundation Investigation Report recommended that the existing bridge abutments be supported on spread footings located in the very stiff (hard) silty clay at elevation 214.6m (704ft) on the south side (west) side and at 217.0m (712 ft.) on the north (east) side. An allowable bearing resistance of 287 kPa (6000 psf) was recommended for the design of the abutment foundations. It had been recommended that the pier foundations be supported on bedrock. It is observed that the existing bridge foundations have apparently performed satisfactorily. It should be noted that the elevations noted above may not necessarily correspond to the as-built conditions.

Based on the subsurface conditions reported at the site and for conceptual design purposes, the spread footings for a new bridge would have to be constructed at or below the elevations noted above. Subject to subsurface exploration at the final design stage, higher bearing resistance values may be feasible for spread footings at these locations. The foundation loading resulting from single span bridges is anticipated to be greater than for a multi-span bridge and relatively large foundation units may therefore be needed.

It is considered that foundations constructed at the elevations noted above would be sufficiently deep that the zone of influence would not impact on the stability of the valley wall slopes and the foundations would not likely be impacted by the effects of creek bank erosion and resulting slope recession.

The depth of the excavations that would be needed to construct spread footings as outlined above would probably be in the range of about 8 to 9m below the existing ground surface. Depending on the sequence of construction, it is expected that shored excavations would be needed to preserve the integrity of the existing bridge foundations until such time as the bridge is taken out of service, as well as to minimize the impact on the slopes during construction. This will aspect will have to be addressed in the design and construction of both structures.

5.2.2 Deep Foundations

Deep foundations possibly consisting of HP sections driven to practical refusal in the bedrock that underlies the site, or end bearing caissons socketed into the bedrock; would provide relatively high resistance to the foundation loading.

Deep excavations would generally not be required and the excavation support systems are anticipated to be less onerous than would be needed for spread footings.

Finally, a deep foundation system will allow for a contemporary integral abutment design which is favoured for bridge design due to the reduced maintenance costs.

5.2.3 Summary

Based on the above considerations, we are of the opinion that a deep foundation system consisting of either end bearing driven or bored piles would be preferable to the spread footing alternative. This applies to both the new highway bridge and the proposed utility bridge.

5.3 Slope Stability Assessment

The discussion provided in section 5.2 of this report indicates that based on the overall height and inclination of the slopes, either of the two foundation design types under consideration will be sufficiently deep so as not to adversely impact on the stability of the valley wall slopes. The actual span of the structures will however be a function of the geometry of the valley wall slopes and the potential for creek bank erosion. Flatter slope inclinations will result in greater spans and the use of properly sized erosion protection will negate the need for additional setback for creek bank erosion.

An engineering analysis of slope stability was carried out for various cross sections utilizing a commercially available slope stability program Rocscience - Slide 6.0. The slope stability assessment was based on an effective stress limiting equilibrium analysis for long term slope stability. The method of analysis allows for the calculation of Factors of Safety for hypothetical or assumed failure surfaces through the slope. The analysis method is used to assess the potential for movements of large masses of soil over a specific failure surface which is often curved or circular.

For a specific failure surface, the Factor of Safety is defined as the ratio of available strength resisting movement, divided by the gravitational forces tending to cause movement. A Factor of Safety of 1.0 represents a ‘limiting equilibrium’ condition where the slope is at the point of pending failure since the soil resistance is equal to the forces tending to cause movement. The analysis involves dividing the sliding mass into many thin slices and calculating the forces on each slice. The normal and shear forces acting on the slides and base of each slice are calculated. It is an iterative

process that converges on a solution. CH policies are based on a minimum Factor of Safety of 1.5 for normal ground water conditions.

The following average soil properties were assumed for the soil strata in the slope stability analysis.

Stratigraphic Unit	Unit Weight (kN/cu.m)	Effective Shear Resistance, c' (kPa)	Effective Angle of Internal Friction ϕ' (degrees)
Fill – silty sand and gravel (loose)	18	0	30
Silty Clay - stiff to hard	19	5	32
Queenston Formation	24	Infinite Strength	

The boundary conditions for the phreatic surface were inferred based on a creek water level at about elevation 213.0m and a ground water elevation at 3m below the top of slope. Some distortion of the slope profile was observed in the available topographical mapping and for this reason cross sections downstream of the bridge were selected. The locations of the cross sections selected are shown on Figure 2.

The results of the slope stability analyses are presented in Appendix C and are summarized in the following table.

Location	Slope Inclination	Factor of Safety
East Slope	B-B 1.4H:1V	1.1
	2.1H:1V	1.5
West Slope	A-A 2.5H:1V	1.7
	2.1H:1V	1.5

It should be noted that indications of previous slope restoration work were observed on the east valley wall downstream of the existing bridge. A Factor of Safety of about 1.1 was indicated for this area of the slope (Section A-A). It was noted that the slopes in the immediate vicinity of the existing bridge are generally flatter than at the location selected for the analysis. The results of additional stability analyses indicated that an overall slope inclination of 2.1H:1V or flatter would be required to achieve a Factor of Safety of 1.5. Analyses of the west valley wall slopes indicated similar results.

It is apparent that the west valley wall slopes in the area of the bridge have been altered, probably when the existing bridge was constructed and then subsequently when the storm outlet was constructed. Fill was probably placed adjacent to the structure during its construction. Further analysis of the slopes in this area will be required at the final design stage.

5.4 Erosion

The east creek bank is separated from the east valley wall slope by a wide bench that supports the railway. The west east creek bank is coincident with the toe of slope. Although there is some rip rap along the west bank, localized bank erosion has been observed just downstream of the bridge near the storm outlet. It is expected that the existing storm outlet may need to be relocated further downstream when the utility bridge is constructed and the erosion protection along this section will need to be either upgraded or reconstructed.

It is considered that when the existing highway bridge is demolished the bases of the existing piers would be cut down to creek bed level and left in place. The erosion protection in the area of the new bridges will need to be upgraded and extended a sufficient distance downstream to maintain the slopes. Alternatively the abutments would have to be setback further to allow for the effects of unchecked erosion. It is noted that the conceptual design presently under consideration shows a toe wall along the west bank to provide erosion protection and to maintain the present extent of the existing bridge to the extent practicable. This is similar to the existing conditions.

6.0 SUMMARY

This report provides conceptual design information for the new utility bridge proposed for the site. Some aspects of the above discussion may also be applicable to the new highway bridge due to the close proximity of the bridges and the need for continuity with respect to such aspects as span length and also the design of creek bank erosion protection and the like.

Our analysis and discussion have been based on a site inspection, a review of background information on the subsurface soil, rock and ground water conditions at the site, a review of the draft Class EA report by Aquafor Beech Ltd. and a review comments from Conservation Halton.

The results of a preliminary analysis of conditions at the site indicated that while it may be feasible to support the new bridge on spread footing foundations, the deep foundation alternative consisting of end bearing driven piles or bored piles would be considered preferable from a geotechnical engineering perspective.

Our assessment indicated that with either of the two foundation types considered, the foundations would be sufficiently deep that the stability of the valley wall slopes will not be impacted by the foundations.

A long-term stable slope inclination of 2.1 horizontal to 1 vertical or flatter has been considered for the valley wall slopes based on preliminary slope stability analyses carried out using the stratigraphy inferred from the foundation investigation report and slope profiles inferred from topographical mapping.

For conceptual design and planning purposes, the bridge abutment locations can be determined based on a maximum 2.1H:1V stable slope inclination for the valley wall slopes. An additional erosion setback is not required provided that adequate creek bank erosion protection is provided and maintained.

A comprehensive geotechnical investigation will be required to provide parameters for the design of the bridges. The geotechnical investigation should be of sufficient scope to address both bridges to enhance continuity in the foundation design and as well as in the design approach to such issues as creek bank erosion protection.

7.0 LIMITATIONS AND USE OF REPORT

This assessment consisted of a site inspection, a review of background information and reports and slope stability analyses. The intent of the assessment was to provide comments on the geotechnical engineering aspects of the project primarily with respect to bridge foundations and slope stability and erosion.

The assessment is provided for conceptual design consideration only. The discussion and conclusions in this report are provided on the premise that a comprehensive geotechnical investigation will be undertaken for the design of the new bridges and that further analysis of the design aspects under consideration in this report will be within the scope of such future studies.

The information in the report relates only to the project described in the report and was presented in accordance with and subject to the scope of work agreed upon by Terraprobe Inc. and Aquafor Beech Ltd.

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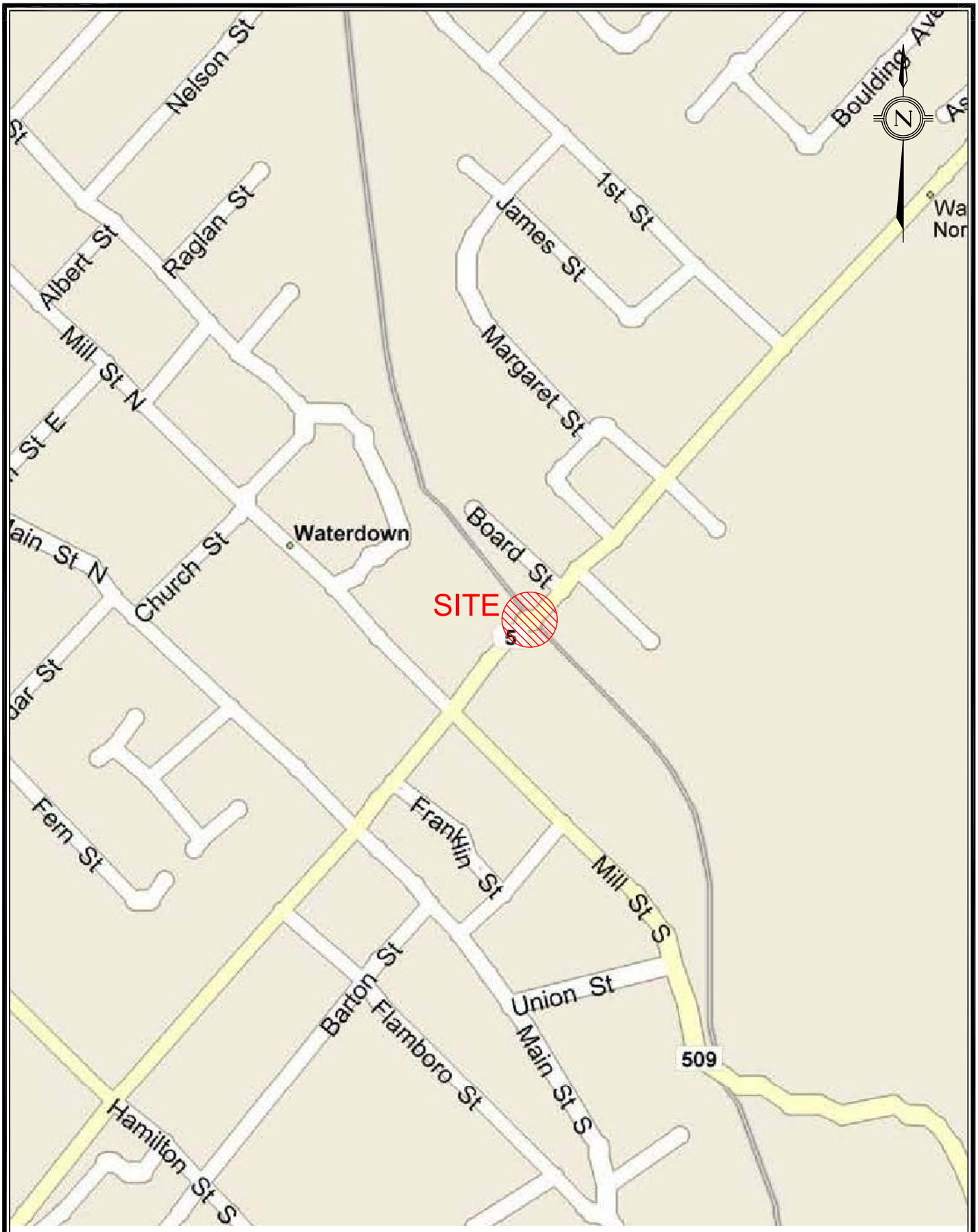
We trust this report is sufficient for your present requirements. If there is any point requiring further clarification, please do not hesitate to contact this office.

Yours truly;

Terraprobe Inc.

J. G. Muckle, P. Eng., Associate

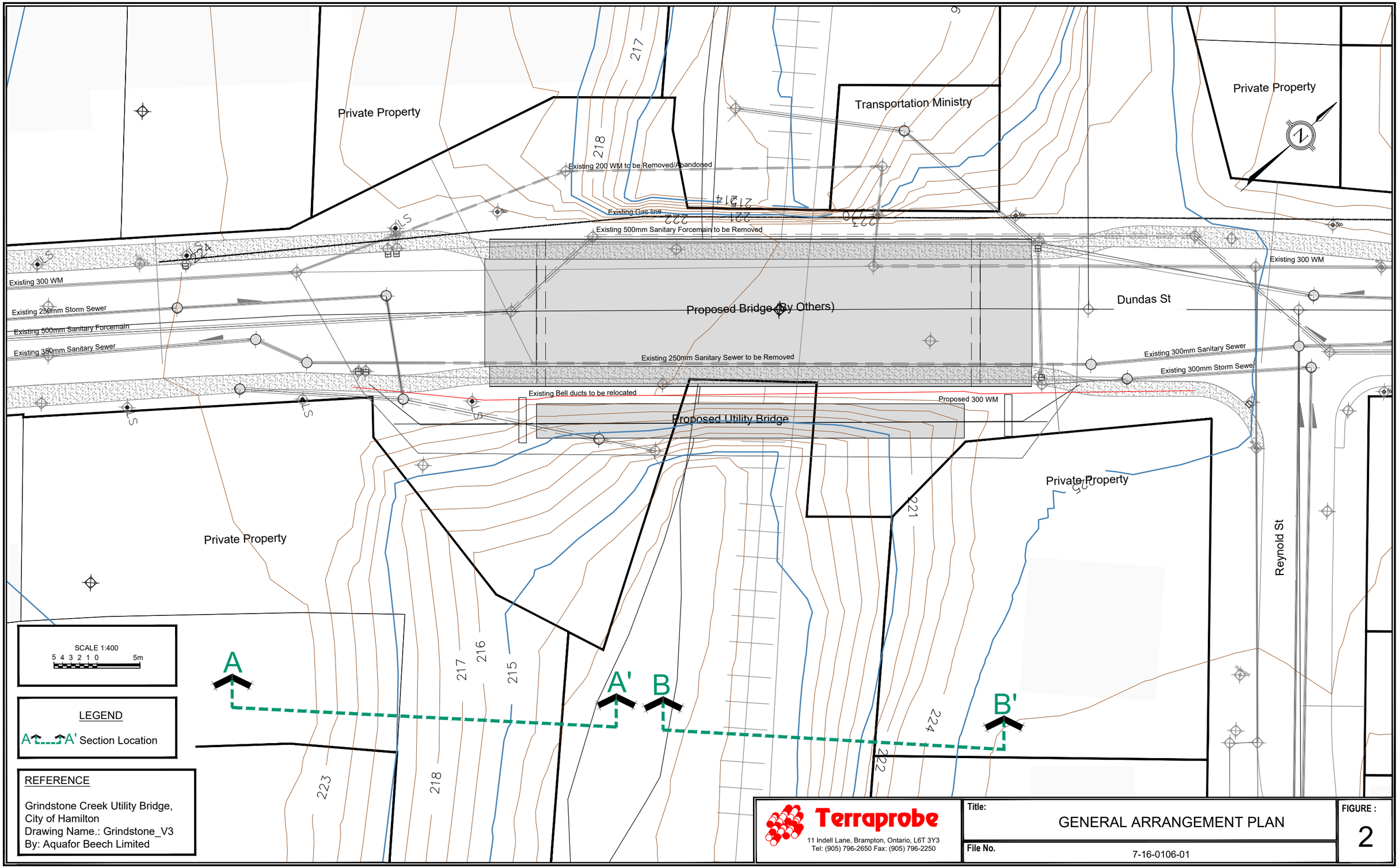
FIGURES



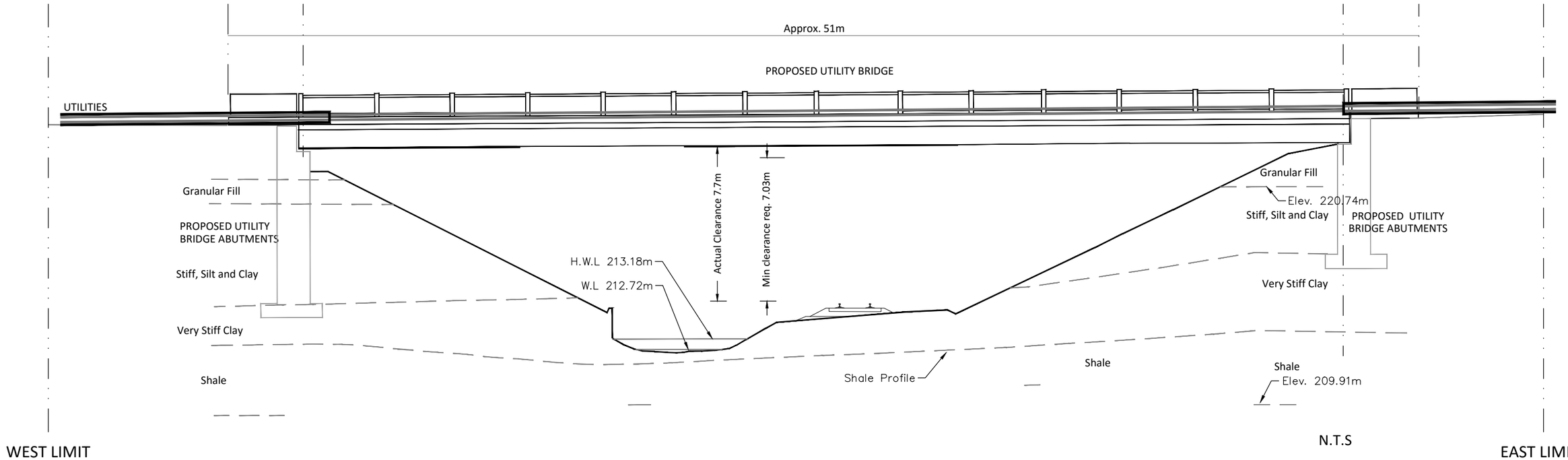
Terraprobe

903 Barton Street - Unit 22, Stoney Creek, Ontario, L8E 5R7
Tel: (905) 643-7560, Fax: (905) 643-7559

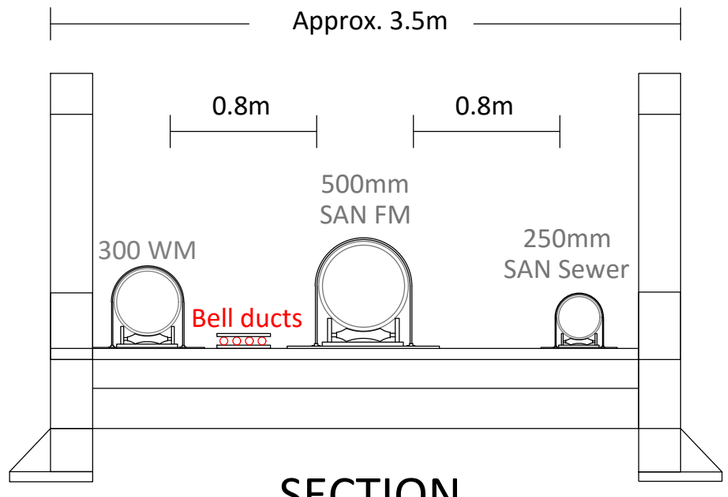
Title:	SITE LOCATION PLAN
File No.	7-16-0106-01
FIGURE :	1



Z:\1-Project Files\2016\Branch Folders\7-16-0106-01 Grindstone\A. Dwgs, Logs\AutoCAD\7-16-0106-01 FIG.dwg



ELEVATION



SECTION

N.T.S

REFERENCE

Section and Elevation, Grindstone Creek Utility Bridge, City of Hamilton
Drawing Name.: Grindstone_V4
By: Aquafor Beech Limited

N.T.S

Terraprobe
11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title: CONCEPTUAL DESIGN CROSS SECTION

File No. 7-16-0106-01

FIGURE : 3

REVIEW COMMENTS
BY
CONSERVATION HALTON

APPENDIX A

Terraprobe Inc.

Conservation Halton

905.336.1158
Fax: 905.336.7014
2596 Britannia Road West
Burlington, Ontario L7P 0G3
conservationhalton.ca

Protecting the Natural Environment from Lake to Escarpment

June 14, 2016

Mr. Winston Wang, M. A. Sc. P. Eng.
Water & Wastewater Planning
City of Hamilton
71 Main Street West
Hamilton, ON
L8P 4Y5

BY MAIL AND BY EMAIL

Dear. Mr. Wang:

Re: **Schedule 'B' Municipal Class Environmental Assessment (EA)**
Highway 5 Grindstone Creek Bridge Utility Relocation and Conceptual Design
Conservation Halton File: MPR 686

Conservation Halton's initial comments provided on November 2, 2015 noted that development within Conservation Halton's regulated area can be restricted and, in some cases, not permitted subject to Conservation Halton's regulatory policies as approved by the Board of Directors. Pursuant to Policy 3.51, Public Infrastructure, it is recognized that certain utilities and services such as watermains, storm and sanitary sewers, natural gas or oil pipelines, hydro and communication corridors, footpaths/trails and transportation links will, from time to time, be required to cross hazardous lands, valleylands, wetlands or shorelines. As such, it must be demonstrated through the EA process that there are no reasonable alternatives.

Staff have reviewed the *Public Information Centre #2 Utility Relocation Schedule "B" Class Environmental Assessment Boards,* prepared by Aquafor Beech, dated May 3, 2016, as well as the *Bridge 451 – Highway 5 East, 120m east of Mill Street South, Ecological Characterization & Natural Heritage Assessment,* prepared by Dougan and Associates, dated September 2015, received May 10, 2015 and offer the following comments.

It is understood that the draft EA will be provided for review. The draft EA is to include technical study/studies in order to assess presented alternatives prior to selecting a preferred alternative.

Regulatory Comments under Ontario Regulation 162/06

Staff note that only limited information has been presented at this time, however please see the following comments as they pertain to Conservation Halton's regulatory requirements.

1) Staff note that a geotechnical assessment (study) is required for all alternatives to address slope stability and constructability.

2) In alternatives where a utility bridge is proposed, the span of the utility bridge is to be based on a geotechnical analysis of slope stability. This will impact bridge span and cost of construction, which may influence the evaluation matrix. The assessment is to consider the proposed utility bridge and future bridge reconstruction. Bridge abutments are to be placed outside of the slope hazard. If this is not feasible, the span is to be maximized to extent possible. Please ensure to provide supporting analysis in the draft EA.

3) As discussed in the pre-consultation held on May 10, 2016, the draft EA is to include drawing(s) outlining top of bank, floodplain, and stable slope line (based on input from qualified Professional Geotechnical Engineer).

4) Please explain how risks such as spills (pollution) have been considered in the review. The only impact listed is during construction i.e. "construction risks (e.g. deep tunnels)."

5) *PIC Boards, pg. 7*: Please note that the condition of the riparian habitat in the vicinity of Bridge 451 is dense and offers excellent thermal mitigation and cover. Conservation Halton staff recommends minimizing any disturbance to the valley and riparian vegetation. The rating in the Evaluation of Alternatives table of "impact on existing vegetation" should be partly based on the estimated area of disturbance as well as any increased public access to the valley system which could degrade the riparian area.

6) *PIC Board, pg. 10, Alternative #2*: Verification is required to confirm there is no impact to hydraulics (conveyance and Regulatory flood elevations) at the EA stage.

7) *PIC Boards, pg. 10, Alternative #2*: When evaluating the options in the EA please quantify any intrusion into the valley that is required/possible. Additional concerns that should be discuss for each option in the EA include appropriate erosion and sediment control measures, how future maintenance could impact the creek, and staging of the proposed work.

   This option increases the number of valley crossings (two bridges) which is not desirable from an aquatic ecology perspective. One piece of infrastructure typically limits the potential area of impact.

8) *PIC Boards, pg. 11, Alternative #3*: The methods proposed to relocate the forcemain and watermain subsurface will need to be clearly stated in the EA and evaluated for potential impacts to the aquatic ecosystem. Any environmental mitigation methods recommended should also be defined.

This option increases the amount of infrastructure in the valley bottom which is not desirable from an aquatic ecology perspective. One piece of infrastructure typically limits the potential area of impact.

9) *PIC Boards, pg. 11, Alternative #3*: This alternative may require input from Fluvial Geomorphologist to support any utility crossing under Grindstone Creek, depending on depth of crossings considered.

10) *PIC Boards, pg. 12*: 'Impact on Erosion & Flooding' is ranked the same for all alternatives. Ranking should take into consideration:

    i. Likely relocation of existing storm sewer outfall for Alternative #2; and
    ii. Potential creek crossing of partial or all utilities for Alternative #3.

11) *PIC Boards, pg. 12*: The ranking of the alternatives based on impact on fish and aquatic habitat is expected to change based on the detailed evaluation in the EA. The factors to consider include:

- Number of separate valley crossings;
- Area of riparian disturbance;
- Potential impacts due to accessing the utilities to complete future work;
- Frequency and potential impact (valley or riparian area disturbance) of maintenance and emergency works;
- Public access to the valley; and,
- Mitigation measures recommended and the ease of their implementation.

12) *PIC Boards, page 13*: "Ease of Approvals/Potential for delays" is ranked the same for all alternatives. The basis is unclear. Ranking should take into consideration geotechnical requirements associated with each alternative.

Advisory Comments under Hamilton/CH Memorandum of Agreement

11) It is noted that a temporary redirection of traffic will be required as part of the proposed alternatives. Staff note with the relocation of traffic to a less urbanized road, there may be the potential for increased wildlife/vehicle collisions. Staff recommend that if mitigation measures are feasible to be implemented to reduce potential indirect impacts to the natural environment, they are considered.

12) *PIC Boards, pg. 7*: The Natural Heritage Assessment should also highlight that the bridge is located within the Grindstone Valley Environmentally Significant Area (ESA).

13) *PIC Boards, pg. 7*: Based on the review of the Ecological Characterization & Natural Heritage Assessment, staff recommend that bat habitat be assessed as per the Bat and Bat Habitat Surveys of Treed Habitats developed by Guelph District in May 2016.

14) *PIC Boards, pg.* 7: Based on the review of the Ecological Characterization & Natural Heritage Assessment, staff would like to know whether the bridge was assessed for nests such as those of cliff swallows?

15) Staff advise that mitigation measures to limit the spread of invasive species should be considered during the construction period.

Future Bridge 451 Replacement

Conservation Halton is of the understanding that in the future, the Highway 5 bridge that crosses Grindstone Creek in this location will be replaced. It is expected that at that time, the bridge replacement will be classified as a Schedule A+ EA.

As part of the current Schedule B EA, a geotechnical assessment is required for all alternatives to address slope stability and constructability. It is strongly recommended that during this geotechnical investigation, the future bridge replacement is incorporated into the geotechnical analysis to ensure that a like-for-like replacement is an acceptable approach and will not cause future risk to the structure and/or the public (i.e. stability, flooding, etc.).

Similarly, environmental characterization for this EA should evaluate the bridge and immediate vicinity, as the future bridge replacement has the potential to disturb wildlife using it as a nesting/roosting site, and access for replacement may also disturb habitat/vegetation that is sensitive to the future activities.

Conclusion

In summary, Conservation Halton looks forward to reviewing the Draft EA.

Staff trust the above is of assistance and would be pleased to meet with the Town to discuss our comments, should that be required.

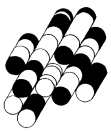
Best Regards,

Katie Jane Harris
Environmental Planner

cc: Dave Maunder, Aquafor Beech, via email

PHOTOGRAPHS

APPENDIX B



Terraprobe Inc.

View of slopes forward of east abutment

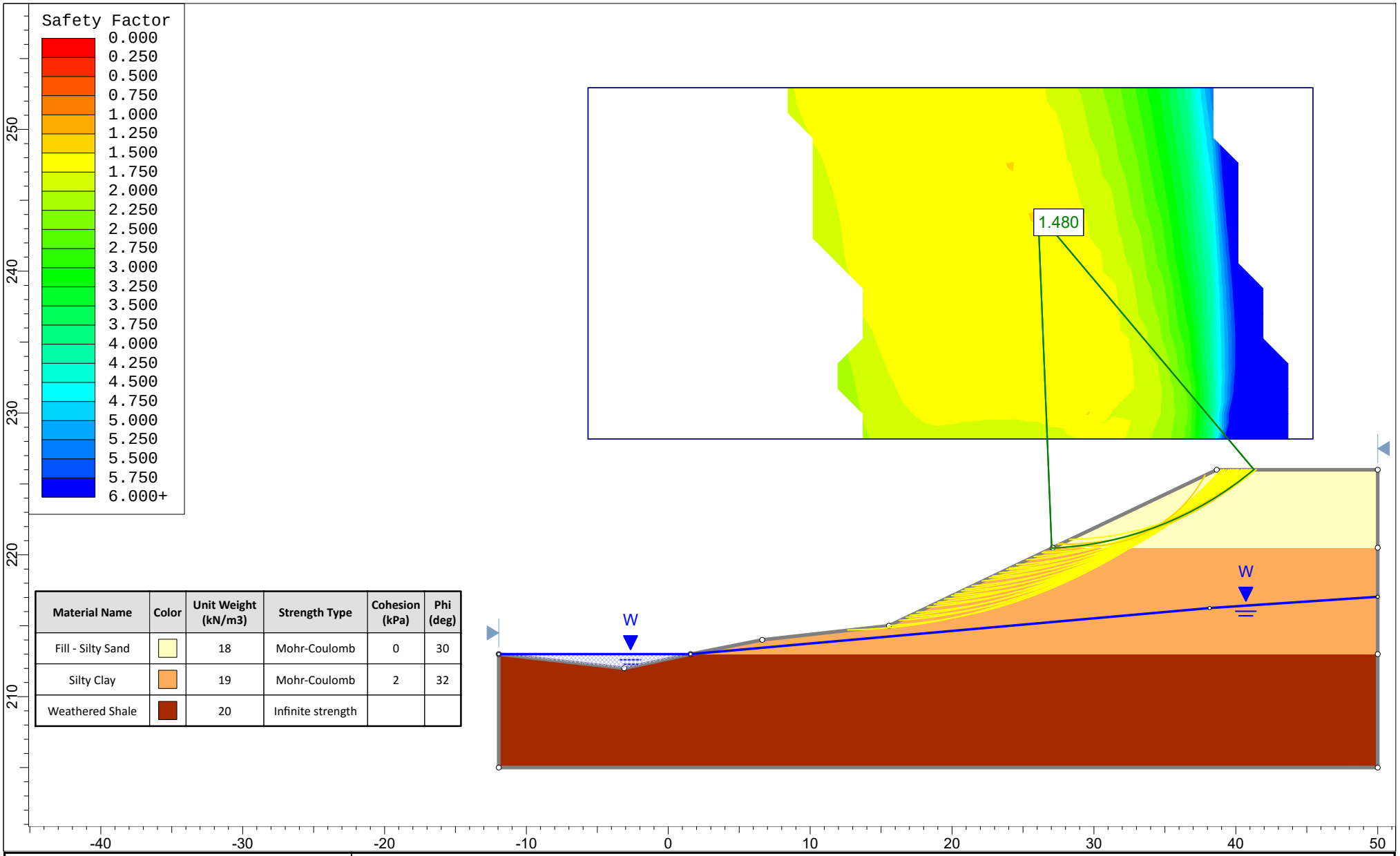
Apparent slope restoration work on east valley wall immediately downstream of existing bridge

Toe wall and rip rap in front of bridge piers on west side

Area of localized erosion and remnant of former storm outlet on west creek bank immediately downstream of existing bridge.

View from west abutment

View of slope forward of west abutment



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Fill - Silty Sand		18	Mohr-Coulomb	0	30
Silty Clay		19	Mohr-Coulomb	2	32
Weathered Shale		20	Infinite strength		

Terraprobe
Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

SLIDEINTERPRET 6.029

Project	**Grindstone Creek, Waterdown, Ontario**		
Analysis Description	East Side - Stable Slope Inclination at 2.1(H) :1(V)		
DB Kyle Byckalo	*Scale* 1:368	*Reference*	East Bank of Grindstone Creek
Date 8/15/2016		*File Name*	Grindstone East Side - Stable.slim