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Project name:
Highway 8 Project E

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CC:
MDT, Highway 8

Technical Memorandum

Project E – Geotechnical Overview and Recommendations Issue for Tender (IFT), Highway 8

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1. Introduction

AECOM Canada Ltd. (AECOM) was selected by the BC Ministry of Transportation and Transit (formerly Infrastructure), to lead the Multi-Discipline Design Team (MDT) which included providing geotechnical input and Professional of Record services for the reinstatement phase of four sites along Highway 8, located between Merritt, BC and Spences Bridge, BC. The use of this technical memo is subject to AECOM's Statement of Qualifications and Limitations (Attachment 1).

The Sites are located approximately 8 km southeast of town of Spences Bridge on Highway 8. Project E includes the following locations: Site 16, Site 17, Site 18 and Site 19. These sites are locations where Highway 8 was washed out from the Nicola River's response to the November 2021 Atmospheric River event and subsequently repaired in the response phase to re-establish traffic flow.

The earlier response phase for Highway 8 included reconstructing the highway embankment (along with other works) and re-establishing the opening of Highway 8 to the public. The execution of this work was completed by others in 2021 and 2022. The proposed current work is to support the reinstatement / final phase of restoration works for Highway 8.

The scope of geotechnical work for this technical memo is to support the reinstatement phase, where Highway 8 is brought back up to pre-event highway design conditions with anticipated construction early to mid-2025. The scope of geotechnical work is described in the MDT Scope of Work (August 2024). A key design element of the geotechnical work scope is the Highway 8 Geotechnical Design Exception document, which allows the work to focus on meeting existing corridor standards where the alignment is in a similar location.

Based on the level of work completed (geotechnical and construction supervision) during the response phase, the geotechnical input for the reinstatement phase of work is largely based on pre-existing information (engineer memos and reports) from the response phase and limited but representative analyses (internally) and two site visits. Key items for geotechnical input include the expected performance of embankment fill slopes, cut slopes, pavement design (including ditching) and limited geohazard input (pre- and post-event comparison). Separately, a comprehensive Highway 8 corridor geohazard assessment was recently completed (Thurber, 2025) to provide guidance on site safety with respect to geohazards during construction.

2. Background and Existing Information

The response phase of work brought the highway back from a non-traversable state to near final design. It included embankment construction, riprap installation, a pavement structure with a high fines surface aggregate and placement of roadside barrier. For an overview of each site's lateral limits, the reader is referred to the MDT's Issued For Tender drawings and cross-sections for Project E.

For the response phase - geotechnical, pavement, and geohazard reports and related site visits were largely completed by Ecora Engineering & Environmental Ltd. (Ecora), and BGC Engineering. These reports were made available to the MDT by the BC Ministry of Transportation and Transit and the Owner's Engineer (OE) team. Ecora indicated the reconstruction of the highway embankments met the following: BC Ministry of Transportation and Infrastructure's Standard Specifications for Highway Construction SS 201.36 – Rock Embankments; SS 201.37 – Earth Embankments; SS 202 – Granular Surfacing, Base, and Sub-bases; and separately, Pavement Structure Design Guidelines, Technical Circular T-01/15 per Site completion reports.

Based on the significant geotechnical level of effort during the response phase, anticipated low risk and consequence of general embankment slope failures, sub-surface site investigations were not deemed necessary by the Ministry, OE and the MDT team for the reinstatement phase. Consequently, the above consultant reports were relied upon for the current reinstatement phase of work and are listed in the references. One exception was that AECOM completed an independent pavement design for Project D.

For clarity in reviewing construction drawings (plans and cross-sections) and engineering documentation for Project E, please note that the Sites count upwards(north-west) towards Spences Bridge but the Stations within each Site count upwards to the southeast, towards Merritt, BC. In addition, subsurface utilities are not anticipated for reinstatement works, but Call Before You Dig protocols are recommended for any excavation works. Project team

discussions have indicated some abandoned communication lines may be present in the corridor.

To clarify work scope exclusions – ML / ARD Testing, background geohazard level (pre-event) along with any impacts from the response or reinstatement phases of work on the opposite riverbank are excluded from this memo. The existing riprap and embankment fill has previously been assessed for Metal Leachate / Acid Rock Drainage during the response phase and there are no new rock cuts proposed in the reinstatement phase. Consequently, no additional ML/ARD testing work is required for existing materials. New riprap, where required in the reinstatement phase, is understood to be tested by others.

Site visits to Project D sites were completed by Hanh Hong, P.Eng. (AECOM) on September 5, 2024, and by Daryn Yonin, P.Eng. (AECOM) on November 20, 2024. The second site visit followed Ministry and OE feedback from the 50% Detailed Design. All photos in the memo were taken from the November 20, 2024 site visit.

3. Overview of the Four Sites Forming Project E

Road Surface / Pavement Structure

The reinstatement phase work is foremost a pavement structure replacement project based on a proposed 400mm of excavation of the existing High Fines Surface Aggregate (300mm) and SGSB-like material (100mm) and replacement with 300mm of WGB (25mm) and asphaltic concrete pavement (50mm x2). However, the project also includes riprap installation (KWL, 2024) some minor grading works (fills/cuts), subgrade improvements (compaction), conditional subgrade improvements (granular filter, non-woven geotextile and bi-axial geogrid) and some minor sliver cuts and fills.

Following the excavation of the existing HFSA and 100mm of SGSB-like materials, compaction of the subgrade is required (four passes with a 20-ton roller with vibration activated with provision for watering) as the excavation will cause some loosening of the underlying sand and gravel. In the event the road is widening is on insufficient SGSB-like material or the subgrade is determined to be at or near riprap elevation, then additional subgrade improvements will be required on a case-by-case basis. Conditional improvements may include the addition of granular filter material, non-woven geotextile and non-woven geogrid (below travel surface). Field reviews and discussions with the Ministry Representative are anticipated to assist with subgrade evaluation.

Minor Embankment Fills and Cut Slopes

Introduction

The reinstatement phase work for each site primarily involves the replacement of the travelling surface along with select installation of additional riprap (KWL,2024) however, there are some minor and infrequent additional grading elements to be completed before the new pavement structure is established at some locations such as minor fills and cuts to support the final geometric design of the highway.

The slope stability assessment process is viewed at these levels:

i) minor cuts and fills typically 2H:1V

ii) rare minor cuts and fills at 1.5H:1V
iii) overall embankment stability from non-shallow slope failures.

Pre-event slopes above the highway are addressed separately per Ministry guidance (2022).

Background

Typical embankment construction for the response phase is reported by Ecora (Hwy 8 Geotechnical Completion Memos for Sites 16-19, 2023) to have included rockfill embankment construction from the riverbed to the design flood elevation, provision for riprap along the outside fill-slope followed by Type D (sand and gravel) variable depth, overlain by SGSB- like material with approximately 300mm thickness and topped with 300mm of High Fines Surface Aggregate (HFSA). Construction methodology complied with the BC Ministry of Transportation and Infrastructure's Standard Specifications for Highway Construction (2020).

Existing embankment slope stability is generally favorable, low risk, low consequence, constructed to the BC Ministry of Transportation and Infrastructure's Standard Specifications for Highway Construction(2020) including geotechnical engineer field reviews and utilized high-quality materials (riprap buttress, rock fill embankment to design flood and compacted sand and gravel with field density testing).

The response phase geotechnical consultant (Hwy 8 Geotechnical Completion Memo for Site 11, Ecora, 2023) analyzed one cross-section that included a 'typical or representative' embankment that is not unlike of many embankments along Highway 8. Given the variety of slope geometries found in this corridor, this analysis provides a reasonable data point for this project as well.

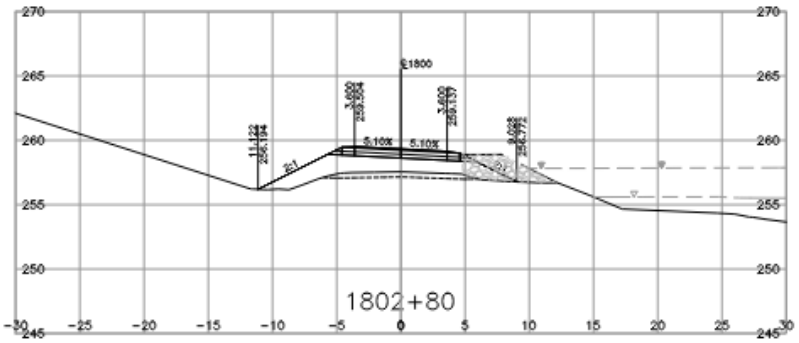
Discussion

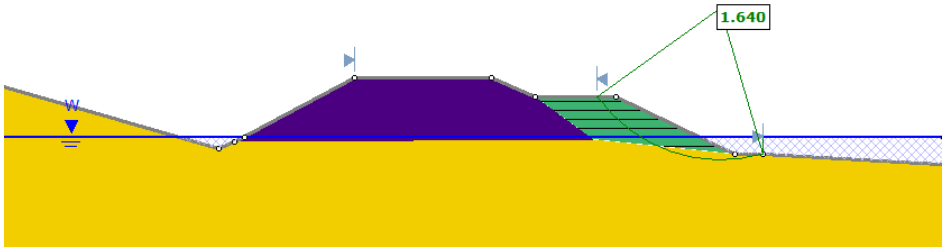
The analyses considered the BC MoTI Supplement to the CHBDC (2016) was in general agreement with AECOM's review and the updated CHBDC (2025). Degree of understanding for embankments – is judged to be low but given the high level of construction oversight, an argument can made the degree of understanding may approach typical. The representative stability analysis includes using rock fill / river gravel embankment friction angle of 38 degrees and compacted river gravel friction angle of 37 degrees for a 2H:1V (26.6 deg) embankment slope of less than 5m generating a Factor of Safety of approximately 1.5. This value related to consequence is between Low (FOS 1.45) and Typical (FOS 1.67) for Global Stability - Permanent. Furthermore, from a consequence perspective, Highway 8 has an unusually low traffic volume for a numbered route (see Section 4) and alternate roads and highways are available in the area.

Typical Project Section – Embankment Stability

An additional sample section, Site 18, Station 1802+80, was chosen for an embankment slope stability check and was evaluated with Rocscience's Slide2 software – with considerable engineering judgment and a focus on failure surfaces that can impact the road prism. Similar friction values were used from the response phase for rockfill/riprap with 38 deg, compacted sand and gravel at 37 degrees and river sand and gravels of 34 degrees. The Morgenstern-Price method was used and the section was evaluated for low water, high water and for the 2% in 50 years seismic condition for Merritt, B.C. (PGA of 0.16).

Although the embankment factor of safety is satisfactory given the presence of the riprap there is considerable geometric and material variability across each site and between sites which will generate a variety of safety factors that are beyond the work scope. The pseudo-seismic analysis was also above a factor of safety of 1.1. Riprap sloped at 2H:1V is shown to be very beneficial for the embankment stability.





Minor Grading in Reinstatement Phase

In general, proposed / new fill and cut slopes of 2H:1V meet slope stability requirements based on compacted granular materials (WGB, sand and gravel fill, rock fill) and expected cut materials of sand/gravel and rock fill. Project scope was reduced to focus on one typical section (no site investigation), however, with engineering judgement a friction angle of 37 degrees, typical 2H:1V dry cohesionless slopes have a FOS of approximately 1.5 (ratio of tan friction angle over tan slope angle).

Project Team discussions at 50% and 90% Detailed Design (with the Ministry and Owner's Engineers) supported the use of 1.5H:1V slopes to match existing conditions at a few select locations (typically no more than 10-20m road length) due to their limited extent (generally than 2-3m in height). Granular foundation, granular embankment materials present a lower risk (versus fine grained materials) and provide a benefit of minimizing site disturbance. These short sections will be slightly less than design code criteria (typical FOS of 1.3 – 1.4 for dry cohesionless soils) but meet pre-event conditions for slope stability and provide the benefit of minimizing additional sliver fills.

The proposed new 2H:1V slopes for cut and fill (2-3m high typically) will be slightly more resistant to erosion over time than the 1.5H:1V slopes. Embankment riprap is typically

installed at 2H:1V but due to site constraints with the Nicola River, a few short and isolated sections were constructed at and are proposed with a slope 1.5H:1V with the Ministry and OE Team's support. Given the angular nature and size of the riprap, and use of rock fill embankment, pre-event slope stability conditions are met with reinstatement phase works.

General Geotechnical / Geohazards Commentary

Geotechnical input was provided to the Project Team for 50% and 90% Detailed Design and IFT geometric plans / cross-sections that were prepared by AECOM as part of the MDT team. Geotechnical input was provided to support how the reinstated highway relates to the pre-flood highway condition in areas of fill slopes, cut slopes, ditches, pavement structure and upslope geohazards. As noted earlier, the intent of the combined response phase and reinstatement phase works is to address the cause of the highway washouts and reinstate the highway to previous conditions but to not expand the scope of work to address other pre-event geotechnical challenges on the corridor.

An overview comparison of the net-change of the geohazards was made by reviewing LiDAR (2018-2021) information in Ecora's response phase completion reports and comments are provided for Sites below. In general, upslope changes from the event period were considered minimal and some steep slopes were left (above the highway) from Nicola River scour (ex. north end of Site 18). A key geohazard consideration is the size and location of the ditch area adjacent to Highway 8 which has been maintained or is slightly larger (creating more debris/rock catchment potential). For a few select sections, the project may consider using Site Modifications, as necessary, to re-establish any ditches that may have any irregularities in section to re-establish drainage and catchment for rock debris back to the pre-event condition and / or add material to the base of steep slopes left from the Nicola River flood event. At the Ministry's discretion, geohazard signage appropriate for the corridor should be considered, and separately near the near vertical eroded slopes (ex. Site 18) to prevent any people activity at the base or crest of those steep slopes.

A geotechnical overview is provided for each site in Section 3. Pavement design (including drainage and subgrade preparation) is presented for Project E in Section 4.

3.1 Sites 16 and 17

Sites 16 and 17 were combined for the reinstatement phase of work as a portion of the work involves a new alignment that connects the two sites. These combined sites account for approximately 737m of highway (approximately Station 1700+16 to 1707+53) noting the new alignment has a west shift (away from the pre-event alignment) approximately from Station 1702+20 to Station 1705+20.

Highway 8 response phase construction is detailed in Ecora's completion reports (Hwy 8 Geotechnical Completion Memos for Site 16 and Site 17, Ecora, 2023) and includes rockfill construction, overlain by sand and gravel fill, SGSB-like material and HFSA (300mm). As project design consideration, it is understood that the southeast end of Site 16 includes archeologically sensitive grounds, which requires minimizing cut-slopes and ditch depth to minimize excavation extents and it's associated impact.

Photo: Site 16 illustrates ditch depth in archeologically sensitive area of Site 16.

Proposed cuts and fills are to be 2H:1V unless a low risk topographic catch can be achieved on a short slope length (ex. 2-3m) then a short 1.5H:1V slope may be considered.

Contributing to the stability of the outer highway embankment is riprap. Riprap - ranging from Class 250 to 500 is present upstream to variable Class 50 riprap downstream. Riprap is not embedded in the riverbed but is reported to be thickened, and scour may occur up to 2.1m in the design flood events.

Highway 8 widening into and over the riprap may require the use of a granular filter and non-woven geotextile to reduce the risk of losing Type D embankment fill / pavement structure in to the riprap voids. Proposed conditional or provisional sum items to help the Ministry Representative and the Engineer of Record resolve subgrade issues over riprap or thin (less than 200mm thick) SGSB-like material include the conditional use of a granular filter, non-woven geotextile and / or possibly a biaxial geogrid in adverse situations. Details on these three proposed conditional sub-grade improvement tools are presented in Section 4.0

Photo: Site 16/17 transition illustrating riprap voids.

The highway embankment includes a lateral buffer (variable from 1m up to 5m) between the road and the top of the riprap slope, particularly from Station 1701+30 to 1703+90. Based on this buffer, the impact on the Highway 8 from riprap movement is expected to be restrained. Highway 8 could also be re-established temporarily to the east with reasonable construction effort should the current Highway 8 alignment be compromised. In general, the highway embankment materials and construction in the response phase provides embankment stability that is judged to meet pre-flood slope stability conditions.

The north end of Site 17 is noted to currently have less riprap (see photo) and this transition section will also have embankment stability similar to the pre-event condition.

Photo: Site 17 photo of northwest end, view upstream close to transition back to existing pavement

Based on the new alignment shift, geohazards for these Sites are considered to be similar or reduced from pre-event conditions, noting considerable work was involved in generating rock fill from this area and the highway alignment is shifted away from the rock-bluffs.

3.2 Site 18

Site 18 is approximately 731m long and extends from Station 1799+92 to 1807+23. This site was reconstructed in the response phase and included rockfill, sand and gravel, SGSB-like material and HFSA similar to the other sites. Additional details are located in Ecora's completion memo (Hwy 8 Geotechnical Completion Memo for Site 18, Ecora, 2023).

The slope stability of the Highway 8 response phase embankment is similarly judged to meet the pre-event condition and is further supported / buttressed by the addition of the designed riprap. New fills and cuts are recommended to be 2H:1V with minor, low risk and limited length exceptions at 1.5H:1V.

As with all the sites, the ability of the riprap to protect the highway embankment plays a role in the embankment slope stability. Scour beneath the riprap can lead to oversteepening at the toe of the slope which can make the riprap shift downwards. Fortunately, Site 18 was constructed with a reasonable lateral buffer (up to 5m horizontal distance in places) which favors highway embankment stability. Class 500 riprap is reported at this site and installed at a depth of approximately 1.5m below the riverbed. Scour during a design flood event is estimated to be approximately 2.5m. Overtopping would present potential instability to the pavement structure (WGB) slopes under a design flood event.

There appears to be a slight shift of the alignment to the west and this favors improved rock fall / debris ditch catchment and separation from upslope geohazards. However, this site contains a number of significantly over-steepened slopes above the highway (from the 2021

flood event) shown in the Site photo below. These near vertical slopes are set-back from the highway which will allow for a more stable long-term slope angle to develop with time, approximately to 1.5H:1V or possibly steeper, similar to many of the slopes in the corridor.

There is a rock / debris fall hazard with these steep faces (should anyone be near the base or crest of the steep slope) and consideration should by the Ministry to consider install corridor or localized geohazard signage to provide warning to stay away from these slopes (base and crest). Property owners should also consider set-back distances should they find themselves working/travelling near the steep slope crest.

Photo: Site 18 view north of the north end illustrating existing steep slopes from event and silty sand material in ditch.

Some limited widening on the inside / hillside from Station 1802+60 to 1804+30 may include minor sub-excavation and replacement (subgrade) and should be observed by the Ministry Representative during construction. Increased embankment height is not considered to present settlement issues for the embankment given the coarse-grained embankment and anticipated coarse grained underlying materials.

Should proposed riprap be brought to near the same elevation as Highway 8, it is recommended to ensure positive drainage away from road (ex. riprap voids near surface may get filled in with winter sand with time and cause pooling water near/on the highway). Constructability issues may also arise between establishing riprap elevation and the embankment construction for the highway pavement structure. Sequencing of work will be important to avoid work ‘redo’.

The geotechnical implications of raising the highway grade in this area are generally related to potential road embankment widening over riprap. As noted with other sites, three

conditional items are suggested for the construction to help mitigate the risk of losing Type D and pavement structure through riprap voids. The Ministry Representative and the Engineer of Record can, on a site-specific basis, utilize granular filter material, non-woven geotextile and/or biaxial geogrid for adverse sub-grade conditions. Adverse sub-grade conditions may be encountered where little to no SGSB-like material is present following the 400mm excavation of the existing HFSA and SGSB-like material.

Photo: Site 18 view upstream illustrating riprap voids and uphill slopes from the event.

3.3 Site 19

Site 19 extends for some 380m, from approximately Station 1900+05 to 1903+85. The alignment includes a slight shift towards the west and a riprap buffer (variable up to 5m horizontal distance).

Photo: Site 19 view to north illustrating riprap, slopes and localized road surface feature.

The dynamic element of the riprap buttress and its contribution to embankment stability is noteworthy at Site 19. Site 19 is reported to have some of the largest Class riprap on Project E, Class 500 to 1000. This riprap is reported (KWL) to be installed on the riverbed with no embedment while the scour is estimated to be up to 2.8m. This site includes some existing riprap failure from recent post-event floods. Embankment construction was robust given the coarse materials used, construction methodology and improved riprap protection.

From historical photos, some bedrock is present on the downstream portion of the Site which helps support the riprap and highway embankment stability. In addition, some of this Site has a lateral buffer (up to 5m horizontal distance) to from highway shoulder edge of riprap slope. There are localized areas where this is reduced to less than 2m, and the importance of an effective granular filter, possibly combined with a non-woven geotextile is recommended for any widening of the road embankment over the riprap.

Site 19 presents similar challenges as with other Sites when Type D is near or proposed on top of the riprap. Potential mitigation options include location specific and conditional subgrade improvements to be evaluated between the Ministry Representative and Engineer of Record. Suggested details of the conditional subgrade improvement options (granular filter, non-woven geotextile and / or biaxial geogrid) are detailed in Section 4.0. The photo below illustrates the loss of material into riprap voids where a granular filter was not present or effective.

Photo: Site 19 view upstream illustrating transition in granular filter.

Geohazard risk is assessed to be similar or lower based on the improved catchment area (road shifted away from hillslope above) for most of this Site - as established for Highway 8 during the response phase. It is further understood that select rock scaling was completed during the response phase as well as an update check on the long-term rock slope monitoring of a substantial rock bluff (Ecora). Consideration should be given, at the south end of Site 19 to use Site Modifications to ensure the ditches have adequate drainage and are shaped to pre-event geometry to help retain rockfall debris.

This site contains a significant pre-existing rock cut and bedrock bluff that has been monitored by the Ministry for decades and is outside the reinstatement scope of work, It is understood that the Ministry is managing the monitoring of it in conjunction with other slope sites in the Province. As indicated earlier and by previous consultants, the rockfall source areas have significant elevation and corridor and / or location specific geohazard signage should be considered.

4.0 Subgrade Preparation and Flexible Pavement Design

4.1 Subgrade preparation

One of the most significant highway reinstatement activities throughout the four sites is the proposed removal of existing road surface which is comprised of 300mm of the HFSA. An additional 100mm of the SGSB-like material is also proposed to be removed, given the

potential for HFSA fines to have migrated into the SGSB-like material and negatively impact the new pavement structure drainage. It is understood that the HFSA/SGWB-like material will be used for shouldering on Highway 8 projects with any surplus stockpiled at Site 17. General grading of the subgrade should include 20H:1V slopes towards the outside of the embankment to allow for pavement structure drainage.

As the excavation process will loosen the subgrade, it is recommended that the new project subgrade be prepared through compaction performance criteria (4 passes of a 20 ton roller with vibration activated and provision for watering) to re-establish a suitable top of existing SGSB-like material surface. The Ministry Representative is required to witness this process to ensure there are no soft subgrade zones. Areas with soft subgrade and noticeable deflection from compaction should be excavated and replaced. Note: limited proctor information on the existing SGSB-like material precludes the use of accurate field density testing.

To help mitigate the unknown thickness of SGSB-like material that will remain (along with the potential to encounter riprap as a subgrade) – three conditional items (granular filter, non-woven geotextile and biaxial geogrid) are introduced as tools for the Ministry Representative and the EoR to address adverse sub-grade and / or thin (less than 200mm thickness remaining) of SGSB-like material.

The following conditional or provisional sum items may be considered by the Ministry Representative and the EoR for subgrade improvement (SGSB-like material or Type D embankment fills) and will besite specific (ex. riprap daylighted or thin, less than 200mm SGSB-like material present):

Conditional Item 1: Granular filter (well-graded angular rock fragments)

Background from the BC MoTT Standard Specifications for Highway Construction (2025), Vol 1, section on Riprap: "**205.06 Filter Layers –** Filter layers and placement, where required, shall be as per the Drawings and Special Provisions or as directed by the Ministry Representative."

General: provide granular filter material (Ministry ARD/ML acceptable source), place (and mechanically compact) a riprap void-filling material comprised of well-graded, angular rock fragments. This material will fill riprap voids that are daylighted during the initial HFSA / SGSB-like material excavation and selective use will also be for locations where new Type D embankment fill is projecting to extend overtop of riprap. As a conditional item, the decision to use granular filter and the extent of the granular filter placement will be with the Ministry Representative in consultation with the EoR. Note: the granular filter shall not increase the embankment height or thickness; the granular filter is to reduce voids present in the riprap subgrade projecting to be under the SGSB-like material or Type D embankment.

The Granular Filter gradation material shall be approved by the Ministry Representative utilising a well-graded angular rock fragment mix comprising: 100% less than 200mm diameter; 75% less than 125mm; 50% less than 75mm; and 25% less than 50mm with no fragments smaller than approximately 5mm diameter. Acceptance of granular filter material

gradation deviations will be at the discretion of the Ministry Representative to meet the objective of reducing riprap voids under the highway embankment.

Conditional Item 2: Geosynthetics, Non-Woven Geotextile (subgrade improvement)

General: This category of non-woven geotextile pertains to improvements to the subgrade and beneath new embankment fill (Type D) or WGB that overlies riprap and/or granular filter material and the use of this product will be at the Ministry Representative's discretion in consultation with the EoR. The Contractor shall supply and place geotextile as indicated by the Ministry Representative. Geotextile shall be from the BC MoTI Recognized Products List (2025) within the non-woven geosynthetics category and meet the requirements below (ASTM Test Method Value, D):

Grab Tensile Strength (D4632) of 712 N
Elongation (D4632) of 50%
CBR Puncture (D6241) of 1824 N
Trapezoidal Tear Strength (D4533) of 267 N
Water Flow Rate (D4491) of 4482 l/m/m2
Permittivity (D4491) of 1.5 s-1
Apparent Opening Size (AOS) (D4751) of 0.212 mm
UV Resistance (D4355) of 70% at 500 hours

- **Note:** All values are minimum average roll value except AOS which is the maximum average roll value.

The non-woven geotextile shall be used for the following applications: subgrade improvement overlying granular filter, Type D subgrade or as directed by the Ministry Representative (in consultation with the EOR).

Placement and securing of the geotextile shall be in accordance with the manufacturer's recommendation, including overlap. Securing pins shall be supplied and installed by the Contractor. Securing pins shall be a minimum of 9 mm in diameter, of steel, pointed at one (1) end, and fabricated with a head to retain a washer having an outside diameter of no less than 100 mm. The length of the pins shall be no less than 300 mm. Securing pins with washers shall be inserted through both strips of overlapped fabric at not greater than 5.0 metre intervals, along a line through the midpoint of the 0.5-metre overlap. Securing pins with washers shall also be installed at 5m intervals along the outside edges of the Geotextiles. In the event the presence of riprap prevents the effective use of securing pins, the geotextile will need to be secured by other means (ex. hand placed rocks or Type D by shovel, in sufficient quantities, to keep the geotextile flush with the ground) to the satisfaction of the Ministry Representative.

The Contractor shall exercise care during fill and rock placement to avoid damage or displacement of the geotextile. Construction equipment shall not be permitted to operate directly on the surface of the geotextile. The Contractor shall at its own expense replace the geotextile that is damaged or displaced.

Conditional Item 3: Geosynthetics – Biaxial Geogrid (for subgrade improvement)

General: the sourcing, placing and installation of bi-axial geogrid will be as per site specific directions from the Ministry Representative in consultation with the EoR. The use of the bi-axial geogrid may be required below the travel surface (pavement) at locations where the existing SGSB-like material is either not present or deemed too thin (from the 200mm anticipated thickness). Installation of the biaxial geogrid will conform to the manufacturer's instructions. Where the biaxial geogrid is directed to be used with the non-woven geotextile, the biaxial geogrid will be placed directly on top of the non-woven geotextile.

The biaxial geogrid shall be from the BC MoTI Recognized Product List (2025) geosynthetics section and Geogrid (biaxial subsection) meeting the following criteria (ASTM Test Method Value, D):

Aperture size: 25mm x 33mm
Minimum rib thickness: 1.27mm
Wide Width Tensile (D6637) of 19.2 kN/m (machine direction) and 28.8 kN/m (cross-machine direction)
Strength at 5% Strain (D6637) of 11.8 kN/m (machine direction) and 19.6 kN/m (cross-machine direction)
Junction efficiency (D7737-11) of 93%
UV Resistance (D4355-05) of 100%
Flexural rigidity (D7748-12) of 750000 mg-cm

Note: All values are minimum average roll value.

Field Reviews

To assist with key field review work during construction, hold points are suggested for the first Site excavation (to approve subgrade) and for Site 18 where there is concern regarding riprap voids. Witness points are suggested for all subgrade exposed for both the pavement structure and Type D embankment fill and separately, for WGB prior to paving.

4.2 Pavement Design

The flexible pavement structure was designed according to the guidelines provided in the American Association of State Highway and Transportation Officials (AASHTO, 1993) Guide for Design of Pavement Structures. The following pavement design parameters were used in accordance with the Ministry's Pavement Structure Design Guidelines, Technical Circular T-01/15 and summarized in Table 1.

There is very limited information about the design subgrade elevation at this stage, however it is understood that select areas of Sites were inspected by a qualified geotechnical engineer (see Ecora individual site completion reports). In addition, a physical pavement site investigation (Ecora 2024) has indicated pavement thickness in the Highway 8 corridor ranges from 90mm to 290mm, with a greater average thickness noted in the westbound lane where the existing ditch depth is variable.

Table 1 - Design Parameters for Pavement Structure Analysis

Design Parameter	Design Values	Comments or Reference
California Bearing Ratio (CBR) of prepared subgrade	4.0%	Assumed soaked value based on subgrade conditions consisting of sands and gravels
Roadbed Resilient Modulus, M_R	41 MPa	M_R = 10.3 x CBR (based on AASHTO, 1993)
Traffic Loading (Equivalent Single Axle Load)	$4.0x10^5$ ESAL	Based on design traffic provided by AECOM Traffic Engineer
Design Life	20 years	Assumed
Reliability	85%	AASHTO, 1993
Standard Normal Deviate, Z_R	-1.037	AASHTO, 1993
Initial Serviceability, ρ_o	4.2	AASHTO, 1993
Terminal Serviceability, ρ_t	2.5	AASHTO, 1993
Allowable Serviceability Loss at end of Design Life, ΔPSI	1.4	AASHTO, 1993
Overall Standard Deviation, S_o	0.45	AASHTO, 1993
Asphalt Concrete Pavement (ACP) Structural Layer Coefficient, a_1	0.40	AASHTO, 1993
Crushed Base Course (CBC) Structural Layer Coefficient, a_2	0.14	AASHTO, 1993
Select Granular Sub-base (SGSB) Structural Layer Coefficient, a_3	0.10	AASHTO, 1993
High Quality Crushed Base Course (CBC, <5% fines) Drainage Coefficient, m_2	0.95	AASHTO, 1993
Poor Quality Select Granular Sub-base Course (SGSB, > 5% fines) Drainage Coefficient, m_3	0.80	AASHTO, 1993

The result of this pavement design and information review indicates that the subgrade conditions are expected to be suitable for proposed pavement structures provided proper subgrade preparation and proof-rolling is performed as discussed in Section 4.1 The recommended pavement structure is provided in Table 2.

It is understood that one of the project constraints is to minimize impacts on cut-slopes. To meet this objective, several sections of Highway 8 ditches will be re-established and closely mirror pre-event ditch dimensions. These ditches will not provide optimum drainage below the pavement structure (typically 300mm below pavement structure) and may result in earlier than expected pavement maintenance due to frost action during spring (freeze-thaw cycles) given the expected frost depth of approximately 1.3m (Ministry of Agriculture and Land, 2006). This trade-off (cut slope impact vs pavement performance) matches the pre-event Highway 8 conditions and prevents other geotechnical challenges that may be generated from new and larger slope cuts.

Table 2: Pavement Structure Design Recommendations

Pavement Structure Material	Pavement Structure Thickness	Comments
Asphalt Concrete Pavement (ACP)	100 mm	Two layers 50 mm thickness each (Class 1 Medium Mix)
Crushed Base Course (WGB)	300 mm	25 mm-minus well-graded base per MOTI for Pavement Structure Type B
Select Granular Sub-base Course (SGSB)* *Prepared Subgrade	200 mm anticipated existing / in-place; SGSB like material to be compacted at surface with potential improvements	SGSB-like material for this project is the pre-existing / in-place material to be utilized as sub-base. Estimated to be 75 mm-minus sand and gravel mixture per embankment construction.
		Excavation surface to be compacted by 4 passes with a 20 ton roller (with water) to the Ministry Representative's satisfaction; site specific subgrade improvement recommendations to be considered when SGSB less than 200mm thick following excavation or at Ministry Representative's request.

*Note: the foundation for the WGB on this project will generally include the existing / in-place 200mm of remaining SGSB-like material from the response phase which are underlain by embankment of sand and gravel, rock embankment or possibly riprap. Before placement of WGB material, the sub-grade (SGSB-like material) shall be compacted to the satisfaction of the Ministry Representative and will include a minimum of 4 passes over all areas of the subgrade with a 20 ton roller with vibration activated (with provision for watering). At the Ministry Representative's discretion (with consultation of the Engineer of Record) sub-grade improvements (granular filter, non-woven geotextile and / or biaxial geogrid may be prescribed on a site specific basis).

The pavement transitions at the beginning and end of each Site will mirror other projects in the Highway 8 corridor for consistency – this is a transition between the new pavement and the existing pavement. Pavement transition details include the following: i) pavement cut to be 2m (laterally) into the existing pavement; ii) pavement cut to be perpendicular to the centerline; iii) only the asphalt concrete pavement (ACP) to be removed for 0.5m towards the Site then a transition slope of 5H:1V from the edge of the 0.5m lateral offset to the 400mm excavation depth. A typical image of the pavement transition is provided in the Project drawing set.

Note: the existing pavement thickness is variable and may require a 'top-up' or minor excavation to account for the new pavement thickness. A typical detail of the pavement transitions between the start and end of a Site is illustrated on the IFT Drawings. The following pavement thickness ranges were provided by the (Hwy 8 Pavement Assessment, Ecora, 2024), noting the thickness in west bound lane was often greater than what was found in the east bound lane.

Site 16/17: 90mm to 210mm

Site 18: 90mm to 210mm

Site 19: 65mm to 210mm

Site 17 Storage Area

Site 17 includes a material storage area and an access is proposed to it from Highway 8. The surface treatment for this access road is recommended to be 300mm of HFSA on top of the Type D fill based on a low-volume road comparison and existing Type D fill from Site 17.

5.0 Closure

We trust that the information provided in this memo meets and supports the project's requirements. Should you require any additional information, or further clarification regarding any of the above, please do not hesitate to contact the undersigned.

Prepared by

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ATTACHMENT 1:

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