



THURBER ENGINEERING LTD.

August 5, 2022

File No.: 32121

Alberta Transportation
Provincial Building
9621 – 96 Avenue
Peace River, Alberta
T8S 1T4

Attention: Mr. Ed Szmata

**GEOHAZARD RISK MANAGEMENT PROGRAM (CON0022164)
PEACE REGION (PEACE RIVER DISTRICT)**

**SECTION D CALL-OUT REPORT
GRAVINA CREEK: HWY 692:02 km 3.13 – 3.30**

Dear Mr. Szmata:

This report presents the results of a call-out for the above-noted site located on Hwy 692:02 between km 3.13 and km 3.30. The legal description of this site is SW15-95-22-W5M. The AADT (average annual daily traffic) on the highway is 130 vehicles per day (verified in June 2022).

Mr. Ken Froese, P.Eng., of Thurber Engineering Ltd. (Thurber) undertook a call-out inspection on April 28, 2022, in the presence of Mr. Ed Szmata, Mr. Max Shannon, and Mr. Erwin Kurz of Alberta Transportation (AT).

It is a condition of this report that Thurber's performance of its professional services will be subject to the attached Statement of Limitations and Conditions.

1. BACKGROUND

The site is located on the north side of Highway 692 about 3 km east of the junction with Highway 35. At this location, there is a fill through the Gravina Creek valley approximately 11 m in height. There is an 87 m-long structural plate culvert (BF74654 at km 3.333) on the east side of the valley with a 3.5 m diameter. The culvert, and presumably the fill, was constructed in 1983.

The distress at this site started some time before 2015 and began as erosion along the highway in the northeast corner of the fill against the valley wall. The ongoing erosion had led to slumping of the highway embankment sideslope. The flow in this ditch also resulted in the approach culvert at km 2.845 washing out in 2018. The approach was rebuilt, paved, and additional riprap placed. It was repaired again in the fall of 2021 when the culvert became plugged with displaced riprap. As part of this repair, the riprap at the culvert inlet was grouted in place. Mr. Kurz, the Maintenance Contract Inspector (MCI) for the area, reported that the slumping of the highway embankment had not gotten worse since 2021.



A brief review of publicly available mapping indicates that the bedrock at this site is in the order of 80 m deep (Alberta Geological Survey DIG 2020 0023) and consists of marine clay shale of the Cretaceous Shaftesbury Formation (Alberta Geological Survey Map 236). The bedrock surface slopes southeast (DIG 2020 0022) toward pre-glacial valley thalwegs that approximately underly the present-day Meikle and Peace Rivers. Surficial geology maps indicate that the site is near a boundary between moraine (clay till) deposits to the northwest and glaciolacustrine deposits (silts and clays) of the Peace River Valley to the southeast (Alberta Geological Survey Map 601, 2013, and Map 205, 1987).

2. OBSERVATIONS

Observations made during the site visit are illustrated on the Drawing, attached. The observations were primarily confined to the erosion gully; however, brief observations were also made of the ditch leading upslope (west) to the approach culvert and of the bridge culvert to the east. Selected photographs from the site visit are also included at the end of this letter.

The upslope ditch is lined with a gabion mattress for much of the distance between the approach culvert and the valley. Close to the valley, the water had eroded through, or below the mattress such that it was sagging, to a depth of up to 0.9 m. The nick point of the gully was about 5 m west of the end of the guardrail where a smooth-wire fence crossed the bottom of the ditch. The nick point was almost as wide as the gabion mattress and had a vertical drop of about 2 m. There was a tension crack forming upslope of the nick point on the north side of the gabion mattress. The backslope side (north) of the gully was typically vertical except in a few locations where soil had slumped. The vertical face was up to 4.6 m in height tapering away toward the east. On the embankment side (south), the gully slopes were steep with numerous slump blocks partway down. The slumping was closest to the highway about 11 m east of the start of the guardrail where it was about 2.8 m from the back of the guardrail. The gully was approximately 15 m wide at this point. The gully angles away from the highway toward Gravina Creek.

The gully makes a right-angle bend just before discharging into the creek. At this location, another slump is forming towards the highway which is about 19 m horizontal (23 m measured along the slope) from the guardrail. This smaller slump is about 2.2 m in height overall excluding intermediate slump blocks. At the bend in the gully, there was accumulated soil debris, riprap, and pieces of gabion mattress, nonwoven geotextile, and turf reinforcement mats. Some of the erosion control products might have been placed in those locations but most of the pieces appeared to have been transported from further upstream. There were two piles of riprap noted along this bend that appear to have also been deposited rather than placed there.

Although not shown on the Drawing, the creek curves way from the highway (about 60 m away) before curving back and through the bridge culvert. There did not appear to be any distress at the culvert inlet. There also did not appear to be any slope instability along the outside bend of the creek on the other side of the ridge from the highway ditch.

3. INSTRUMENTATION

There is no instrumentation at this site.



4. ASSESSMENT

Comparing with the site photographs provided by the MCI, it appears the erosion gully may have regressed up to 2 m since 2019 which is about 0.6 m to 0.7 m per year. With the erosion protection measures (gabion baskets and non-woven geotextile) already undermined, it is anticipated that the nick point will continue to erode upstream. While this will eventually reduce the flow gradient as the gully flattens out, high flows will continue to remove material from the highway embankment side.

5. RISK LEVEL

Based on the AT's Risk level rating system, the risk level for the slump closest to the highway at this site has been assessed as follows:

$$\text{Risk (20)} = \text{PF (10)} \times \text{CF (2)}.$$

This risk level was based on a Probability Factor (PF) of 10 (active with moderate but stable rate of movement) and a Consequence Factor (CF) of 2 (a moderate fill, the bridge culvert is not affected, and slide might affect use of the roadway and safety but not require closure).

Using AT's erosion risk rating system, the overall site has been assessed as:

$$\text{Risk (44)} = \text{PF (11)} \times \text{CF (4)}.$$

A Probability Factor (PF) of 11 was selected as there is likely erosion at all water levels and the gully is over 5 m wide and 2 m deep. The Consequence Factor (CF) of 4 was selected as the embankment is relatively high and partial closure could be a long-term consequence and the existing erosion control structures (gabion mattresses) have been, and are continuing to be, damaged. According to the 2006 Code of Practice Peace River Management Area Map (published by Alberta Environment), Gravina Creek is a Class C water body with a restricted activity period between April 16 and July 15. This implies that the creek is fish-bearing meaning the Risk Level of 44 is a minimum as the presence of a fish-bearing stream to which eroded material can flow (should be confirmed by aquatic expert) has a significantly high consequence factor (10).

6. RECOMMENDATIONS

It should be expected that the slump will eventually reach the highway surface. Although it is not possible to predict when this will happen, it seems probable within 5 to 10 years. In the short-term, routine observations of the site should continue. In the long-term, the site will need to be repaired. Thus, in the medium-term, preliminary engineering should be undertaken to design mitigation measures. Consultation with hydrotechnical experts will be required to assess the potential catchment area for that ditch to determine the probable water velocities that could be expected. Given the flow levels that have occurred in this ditch, hard armour will be necessary.

There are many products available; however, proper placement will be vital to prevent undermining by erosion such as has occurred with the gabion baskets. A dissipation structure



should be constructed to reduce velocities before discharging to the creek. It is recommended that regardless of the product used, that cut-off trenches be installed along the length of the ditch to limit seepage below the erosion protection and to prevent erosion below the lining. The gully will need to be built back up to the pre-erosion level with compacted clay fill and that work should take place in late fall or early winter when the ditch flow will be lower. The slumped embankment material will need to be removed and replaced. The north side could be left mostly intact, and the fill placed against the face which would avoid requiring additional right-of-way or removing of mature trees. Consideration should also be given to placing a subdrain at the base of the eroded ditch below the new fill to capture any groundwater seepage that may be present.

Based on the existing ditch gradient, gabion baskets should have been suitable. Thus, it is hypothesized that the erosion started at the downstream end (the termination details of the ditch protection are not known) where it undermined the gabion basket and then retrogressed up the ditch. The ditch could be lined again with gabion baskets tied into the intact ones further upstream provided that the termination is sufficiently robust. Consideration could be given to including gabion basket check dams to reduce velocities and step the ditch down toward the creek.

Alternatively, Thurber has used grouted riprap in high flow scenarios which would also be appropriate here. It would have the disadvantage of increasing flow velocities (compared to ungrouted riprap) but would be more resistant to erosion. However, the resulting structure would be relatively inflexible and prone to cracking if undermined.

One potential solution is to rebuild the ditch higher than it was to reduce velocities over much of the length and then construct a drop structure near the creek. This will reduce the cost of the erosion protection required in the ditch but that might be offset by the cost of the drop structure. The drop structure could be constructed using cast-in-place concrete or stepped gabion baskets.

It should be noted that the sooner the site is repaired, the less the construction costs will be particularly if the roadway surface is not yet compromised. It is anticipated that investigation, design, and tender preparation is on the order of \$100,000 depending on the number of expert subconsultants (environmental, hydrotechnical, and land acquisition) necessary to assist with the design. Construction costs could be as high as \$500,000 depending on the increased extent of the erosion at the time of construction and the complexity of the repair (such as if reinforced concrete is required).



7. CLOSURE

We trust that this information is sufficient for your present requirements. We would be pleased to answer any questions that you may have regarding this letter report.

Yours very truly,
Thurber Engineering Ltd.
Don Proudfoot, M.Eng., P. Eng.
Review Principal

Ken Froese, M.Eng., P. Eng.
Geotechnical Engineer
/jf

Attachments:

- Statement of Limitations and Conditions
- Drawing 32121-H692:02-CALL-OUT-1
- Selected Photos (taken by Thurber in 2022 unless otherwise noted)



STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

5. INTERPRETATION OF THE REPORT

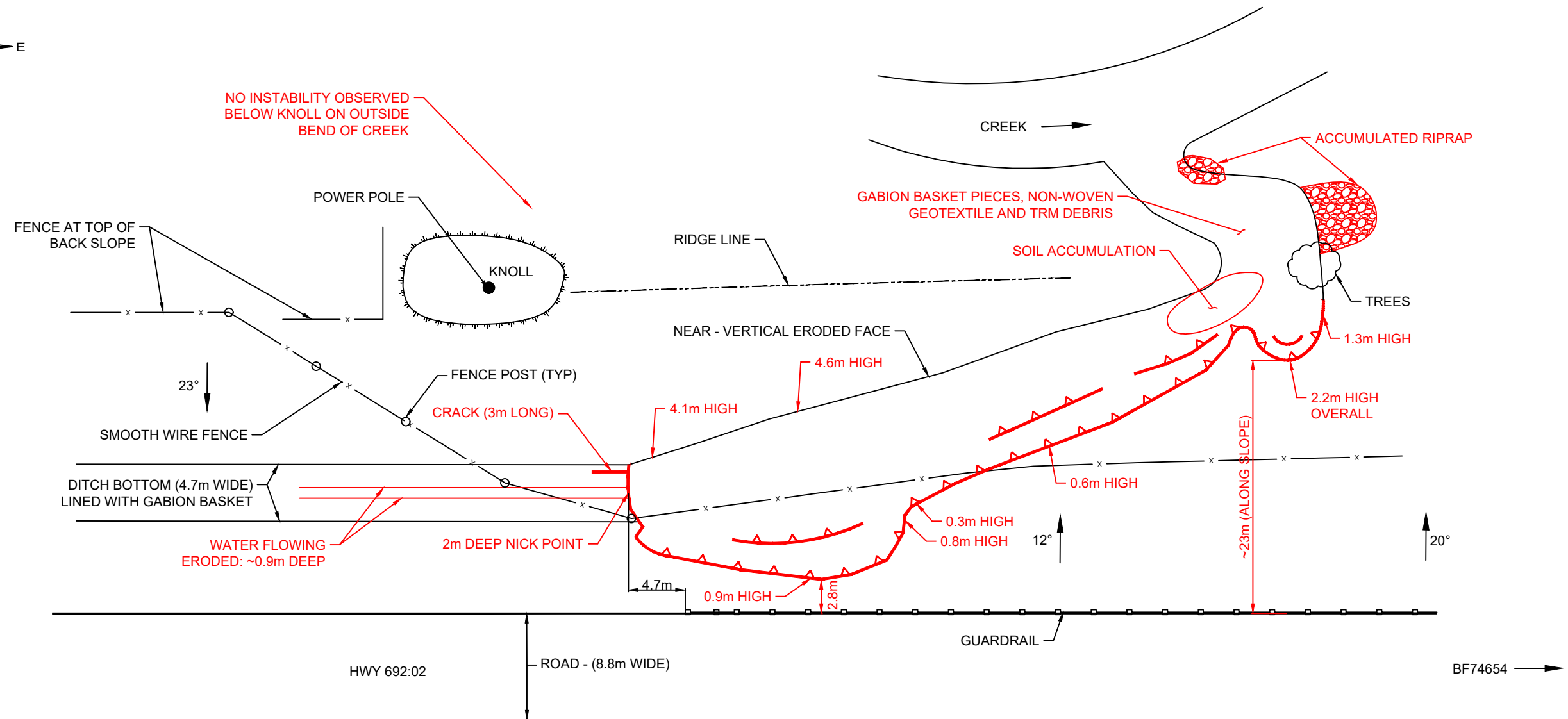
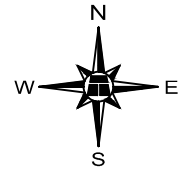
- a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.
- b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.
- c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.
- d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

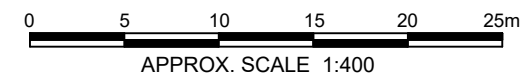
The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.



LEGEND

- SCARP CRACK (APPROXIMATE)
- CRACK
- GUARD RAIL
- FENCE LINE

NOTE:
FEATURES WERE MEASURED IN FIELD USING APPROXIMATE METHODS
(PACING, MEASURING WHEEL, TAPE MEASURE, AND CLINOMETER)



PEACE REGION (PEACE RIVER DISTRICT)

**HWY 692:02 km 3.13 - km 3.30 GRAVINA CREEK
SW 15-95-22-W5M
2022 CALLOUT**

DWG No. 32121-HWY 692:02-CALLOUT-1

DRAWN BY	ML
DESIGNED BY	KEF
APPROVED BY	DWP
SCALE	APPROX. 1:400
DATE	JULY 2022
FILE No.	32121





Photo 1 (MCI, July 20, 2015) – Looking west at erosion gully forming.



Photo 2 (MCI, July 20, 2015) – Looking east at erosion gully.



Photo 3 (MCI, May 2, 2018) – Looking east at the approach culvert wash-out.



Photo 4 (MCI, May 22, 2018) – Looking northeast at restored approach and culvert inlet riprap.



Photo 5 (MCI, March 28, 2019) – Approach culvert inlet under high flow. Approach was paved.



Photo 6 (MCI, March 20, 2019) – Looking east at widening erosion gully.



Photo 7 (MCI, March 20, 2019) – Looking west at growing erosion gully.



Photo 8 (MCI, March 20, 2019) – Looking north at remnants of the erosion protection.



Photo 9 (MCI, April 20, 2021) – Looking east at the erosion gully which has slumped toward the road.



Photo 10 (MCI, April 20, 2021) – Looking north where the ditch discharges to Gravina Creek. A slump has formed at the bend.



Photo 11 (April 28, 2022) – Grouted riprap at the approach culvert inlet.



Photo 12 (April 28, 2022) – Looking downstream (east) from approach culvert outlet (riprap also grouted).



Photo 13 (April 28, 2022) – Looking west at the nick point of the gully.



Photo 14 (April 28, 2022) – Looking east at the regression of the slump.



Photo 15 (April 28, 2022) – Looking south at the main slump in the highway embankment.



Photo 16 (April 28, 2022) – Looking south downstream of the bend in the erosion gully.



Photo 17 (April 28, 2022) – Looking west at the end of the erosion gully. Pieces of gabion basket are visible.



Photo 18 (April 28, 2022) – Looking east along the erosion gully at the east flank of the embankment slump and the undercut north side.