

SITE NUMBER AND NAME: NC111 – Hwy 16 Pembina River Bridge Erosion (BF75014)	HIGHWAY AND KM: 16:10, km 28.44	PREVIOUS INSPECTION: June 13, 2024	CURRENT INSPECTION: May 20, 2025
LEGAL DESCRIPTION: SW-20-53-7-W5	NAD83 COORDINATES: UTM11U 5939985 N, 632165 E		RISK ASSESSMENT: PF: 13 CF: 8 Total: 104
AVERAGE ANNUAL DAILY TRAFFIC (AADT): 7,800 (2024)		CONTRACTOR MAINTENANCE AREA (CMA): 508 / 509	

SUMMARY OF INSTRUMENTATION: N/A	INSPECTED BY: Stantec: Leslie Cho, Sonja Pharand TEC: Kristen Tappenden
PRIMARY SITE ISSUE: Erosion and gullying on and adjacent to the west and east bridge abutments.	
APPROXIMATE DIMENSIONS: West abutment: Max. gully size estimated to be about 4 m deep by 8 m wide. East abutment: Max. gully size estimated to be about 2 m deep by 4 m wide.	
DATE OF ANY REMEDIAL ACTION: In 1992 horizontal and vertical tie-backs (rock anchors) were installed on the east riverbank, at Pier 1. In 2003, a new stormwater culvert was installed on the west abutment, replacing the two parallel culverts, located adjacent to the NW and SW corners of Pier 5. A gabion mattress over geotextile was placed to backfill the gully that resulted from the failure of the original stormwater culvert adjacent to the NW corner of Pier 5.	

ITEM	CONDITIONS EXIST		DESCRIPTION AND LOCATION	NOTICEABLE CHANGE FROM LAST INSPECTION	
	YES	NO		YES	NO
Pavement Distress		X			X
Slope Movement		X			X
Erosion	X		Erosion gullies up to 4 m deep on the west abutment, north side of the bridge. Erosion gullies up to 2 m deep on the east abutment, north side of the bridge. Shallow gullies on the east and west abutments below the sandstone outcrops.		X
Seepage		X			X
Bridge/Culvert Distress	X		Erosion and rockfall at Piers 1 and 5, which are supported on footings. Erosion gully encroaching the north side of Pier 3.		X
Rockfall	X		The near vertical exposed rock mass below the east abutment generally contains horizontal bedding with near vertical joints/fractures creating blocks/wedges that detach from the rock face falling below and are undermining the abutment. The exposed rock mass below the west abutment is sloped at approximately 70 degrees and does not have as strong visible bedding/joint pattern as the east rock face. However, displaced blocks are visible on the slope surface.		X

COMMENTS

- Continued LiDAR change detection for the site did not indicate any obvious changes associated with ground movement between the 2024 and 2025 data sets. The Pembina River channel on the east bank shows lateral migration since 2014, while erosion at multiple locations on both embankments has resulted in material loss. Three potential landslides have been identified on the east slope, with movement identified between 2014 and 2023, and no further movement observed since.

East Abutment / Bank:

- Erosion is present along the east riverbank (Photos 1 to 4, 9 & 10).
 - A deep gully is present at the top of the bank, south from Pier 1. This gully is very close to existing power/telephone poles. The gully appears generally unchanged from the 2024 inspection.
 - Significant erosion is present below the sandstone outcropping near the top of the bank, both below the bridge and near the bridge on the north and south sides.
 - The erosion gullies below the east abutment appear to be in a similar state as seen during the previous inspection in 2024. The gullies appear to be about 0.5 m deep and extend downslope to the river.
- The sandstone outcrop was observed to be horizontally bedded and had near vertical joints closely parallel to the valley sides, which result in rockfall and further loosened slabs of rock potentially in unstable conditions below the abutment and potentially undermining the abutment (Photos 1, 2 & 3).
- Sandstone blocks fallen from the outcrop were observed between Piers 1 and 2 (Photo 3). The number of blocks on the slope appears similar to observations during the 2024 inspection.
- The pier within the river on the east side (Pier 2) does not appear to be affected by the erosion. Some sediment and rocks are collecting against the east side of the pier (Photo 4).
- The bridge was visited by Stantec's bridge team on November 14, 2024, where it was noted that the soil anchors on the east abutment were corroded, possibly impacting the stability of the retaining wall under the bridge (Photo 11).
- The anchors on the east abutment were inspected further on July 23, 2025 by Stantec and a contractor specializing in anchors. A total of 14 anchors were observed, with all showing wear and tear. Two of the 14 anchors have significant rust, however the metal still appears to be competent.

West Abutment / Bank:

- The separated culvert down the west riverbank, on the north side of the abutment, appears to be in similar condition as observed previously in 2024 (Photos 5 & 6). The erosion gully that has resulted from the water exiting the top piece of culvert appeared to be relatively unchanged, with a depth up to around 4 m and width up to around 8 m near the headslope. This gully continues down to the river, where it runs along the side of Pier 3 (Photo 7).
- A second erosion gully is roughly parallel to the gully that resulted from the culvert, and extends below the north corner of Pier 5 to approximately 5 m upslope from Pier 4 (Photo 6). The maximum size of the second gully on the west abutment is about 2.5 m deep and 6 m wide. Geotextiles can be seen in this erosion gully.
- The sandstone outcrop below the west abutment shows erosion and gullying, which continues down along the south side of the piers (Photo 6). These gullies begin at the abutment where they are beginning to undermine the concrete (Photo 8).
- Sandstone rock blocks fallen from the outcrop were observed between Piers 4 and 5 (Photos 6 & 8).
- No anchors were observed on the west abutment.

RECOMMENDATIONS

- Regular monitoring through visual inspection and LiDAR change detection at both abutments is recommended.
- In the short term, it is recommended that a topographic and/or LiDAR survey of both abutments and surrounding slopes is performed, including at least 200 m past both sides of the river along the highway to establish catchment areas. With this information, a surface water drainage study should be done to appropriately redesign the highway stormwater discharge on both riverbanks.
- A geotechnical investigation is recommended to characterize the compressive strength of the sandstone and complete rock discontinuity modelling to represent the rock joint patterns and identify wedges most likely to undermine the abutment.
- Long-term repairs may comprise the following:

- Repair/maintenance of the 14 corroded soil anchors on the east abutment. The high-level cost for a specialty subcontractor to mobilize to site, remove and install new grease caps, clean and remove the rust, and apply a spray-on galvanizing paint for corrosion protection is approximately \$15,000, excluding engineering costs.
- Repair of the erosion gullies under and adjacent to the bridge abutments. The loose material and debris may be excavated, and the area should be backfilled with compacted engineered fill. Given the inclination of the abutments, steep slope safety measures will be required. The high-level cost for repairing the erosion gullies is between \$350,000 and \$650,000, excluding engineering costs.
- Construction of a new stormwater discharge system on both abutments. Alternatives may comprise an above-ground CSP or HDPE pipe supported on a steel truss resting on footing, or reinforced concrete outfalls, or a system of long reinforced concrete drainage ditches descending the riverbank. The high-level cost for construction of a new stormwater discharge system is between \$1,000,000 and \$1,600,000, not including engineering and depending on the selected design.
- Site inspections should continue annually.

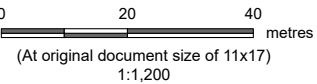
PREPARED BY: Sonja Pharand, P.Eng.	REVIEWED BY: Leslie Cho, M.Eng., P.Eng.	PERMIT TO PRACTICE:

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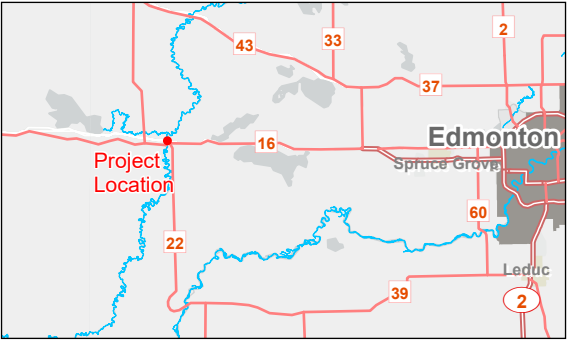


- Previous Observations
- 2025 Observations
- ① Photos and Direction
- Ground Elevation Contours (m AMSL)

m AMSL - metres above mean sea level



Notes
1. Coordinate System: NAD 1983 UTM Zone 11N
2. Data Sources: Geogratis, ©Department of Natural Resources Canada, All rights reserved.
3. Background: World Imagery: Parkland County
Light Gray Base: Esri Canada, Esri, TomTom, Garmin, FAO, NOAA, USGS, EPA, NRCan, Parks Canada.



Project Location
SW-20-053-07W5,
Entwistle, Alberta

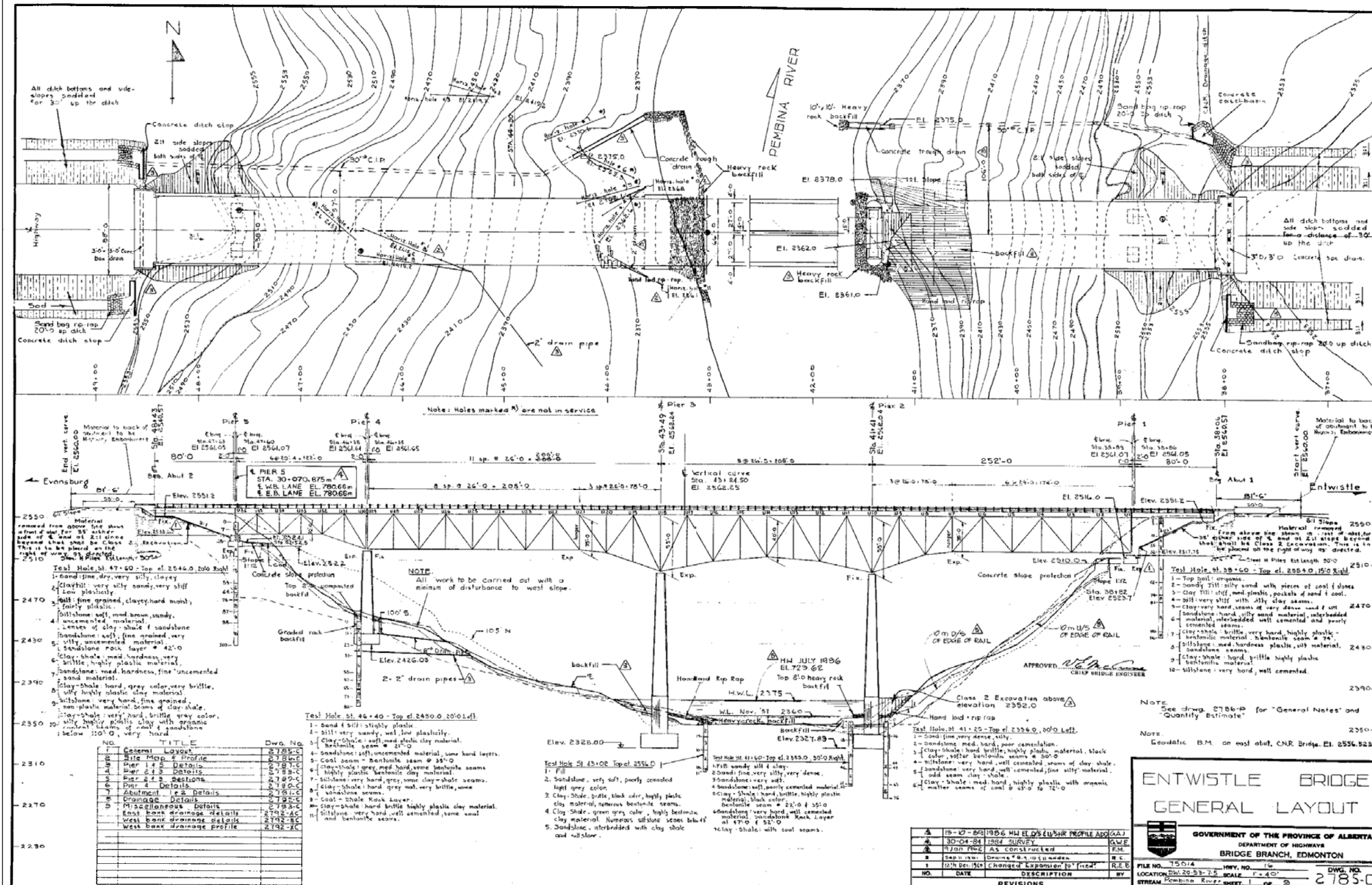
Prepared by MK on 2025-06-16
QR by SP on 2025-06-17
IR by LC on 2025-06-18

Client/Project
Transportation and Economic Corridors
Geohazard Monitoring Program
NC111 Hwy 16:10, 28.4 km Pembina River Bridge

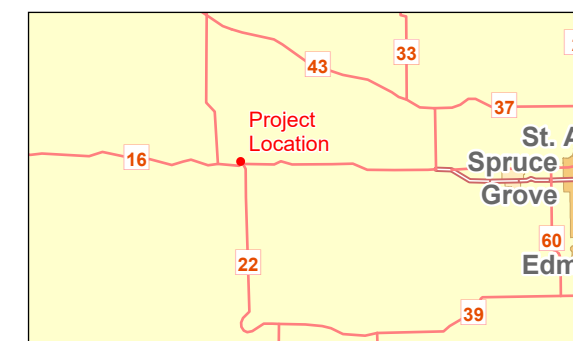
123315222

Figure No.
1

Title
Site Plan



Notes
 1. Coordinate System: NAD 1983 10TM AEP Forest
 2. Inset Data Sources: Geogratis, ©Department of Natural Resources Canada, All rights reserved.



Project Location Prepared by MK on 2025-06-16
SW-20-053-07W5, QR by SP on 2025-06-17
Entwistle, Alberta IR by LC on 2025-06-18

Client/Project	123315222
Transportation and Economic Corridors	
Geohazard Monitoring Program	
NC111 Hwy 16:10, 28.4 km Pembina River Bridge	

Figure No.

2

Title
**BF75014 Pembina River Bridge General
Layout**

2025 Site Inspection Photos at NC111



Photo 1: Gullies downslope of east abutment, facing north.



Photo 2: Gullies downslope of east abutment and broken culvert north of east embankment. Facing southeast.

2025 Site Inspection Photos at NC111



Photo 3: Sandstone outcrop and gullies downslope of east abutment, facing southeast.



Photo 4: Lower portion of east riverbank near Pier 2. Looking northwest.

2025 Site Inspection Photos at NC111



Photo 5: Overview of west slope and bridge surface, facing west.



Photo 6: Broken culvert and gully on the north side of the west abutment. Looking northwest.

2025 Site Inspection Photos at NC111



Photo 7: Erosion gully next to west pier at river level, facing west.



Photo 8: West abutment and riverbank, facing northwest.

2025 Site Inspection Photos at NC111



Photo 9: Broken culvert north from the east bridge abutment. Facing southeast.



Photo 10: Erosion of east bank, south from east abutment. Facing southeast.

2025 Site Inspection Photos at NC111



Photo 11: Corroded soil anchor on east abutment. Photo taken by Stantec bridge team, November 14, 2024.