Our File: McElhanney Project 2121-00924-00

TECHNICAL MEMO

To	From
Maurizio Ponzini, P.Eng. Design Manager, Cariboo Road Recovery Project R.F. Binnie and Associates Ltd.	Luc Harvey, P.Eng. Drainage Lead
Re	**Date**
Cottonwood Hill Slope Stabilization Project – Temporary Drainage Recommendations	March 13, 2024

1. Introduction

The Ministry of Transportation and Infrastructure (MoTI) retained McElhanney Ltd. (McElhanney) to provide drainage design services for a proposed highway realignment through the Cottonwood Hill Slope Stabilization project site, located along Hwy 97 approximately 14 km north of Quesnel, B.C.

1.1. BACKGROUND

A drainage report was prepared for the project which summarizes the drainage analysis and design recommendations for the highway realignment (Cottonwood Hill Slope Stabilization Project – Drainage Report – Final, February 23, 2024). The drainage report precedes this memorandum and should be referenced for a complete picture of the work. Except as required for the general cohesion of the text, this document does not repeat material from the drainage report.

The drainage report was used to inform the development of the detailed design drawings for the project, which are enclosed separate to this memorandum. This document refers to the stationing as specified on the IFT design drawings to identify the locations of key infrastructure.

During the detailed design phase of the project, it was identified that several temporary highway drainage configurations will be required to support interim highway conditions during construction. These are driven by the following construction phasing requirements:

1. Surcharging of the proposed fill area to the east of the existing highway, between stations 207+72 and 211+06, is required to reduce expected settlement of the final highway driving surface once the project is complete.

2. The southern portion of the project and the surcharge area to the north are expected to be installed over the summer and fall of 2024, with the surcharge being left in place over the winter of 2024/2025. Removal of the surcharge material and construction of the northern portion of the permanent highway works will occur over the summer of 2025. A temporary detour will be required to connect the constructed southern portion of the proposed highway works with the northern existing highway alignment while the proposed surcharge is in place.

These temporary conditions are shown in the highway detour and surcharge drawings which are included in **Appendix A**.

1.2. SCOPE OF WORK

Due to the extended duration that the proposed temporary highway works are expected to be in place, temporary drainage infrastructure needed to be sized to meet the MoTI design criteria for current climate conditions. This memorandum summarizes the analyses completed and the recommended drainage infrastructure that should be installed for the temporary highway works.

1.3. DESIGN CRITERIA

The BC Supplement to TAC Geometric Design Guide, 2019, 3rd edition, provided the primary design criteria for this project. Key guidelines are listed in Table 1.

Table 1: BC MoTI Design Guidelines

MoTI Section	Criteria	Value
1010 – General Design Guidelines	Design Return Period (Freeway) • Storm Water Inlets	 5-year
1050 – Pavement Drainage and Storm Sewers	Pavement Runoff • Runoff Coefficient • Time of Concentration • Minimum Pavement Grade • Maximum Ponding Width Grates / Spillway Spacing: • Depressed Bicycle Safe Grate Inlet Width • Spillway Width • Maximum Catchbasin / Spillway Spacing • Minimum Catchbasin / Spillway Spacing	 0.95 5 minutes 0.3% Maximum of 65% of paved shoulder or 1.2m 0.625m 0.600m 150m 20m

2. Hydrology

Historic rainfall IDF data is provided in the drainage report. The temporary roadway drainage calculations used the 5-year, 5-minute rainfall intensity for current climate conditions which is equal to 66.1 mm/h for the Quesnel Airport Auto climate station. Climate change was not considered for temporary drainage infrastructure.

3. Drainage Infrastructure Sizing

Concrete drainage barriers (CDB) / spillway and catchbasin locations required for the temporary drainage design along the detour road and surcharge area were calculated using the tabular method outlined in Section 1050 of the Supplement to TAC. Existing highway and temporary detour profiles, crossfalls and typical sections were taken from the 100% highway/detour drawings as input into the calculations (included in **Appendix A**).

Due to the presence of the surcharge, which will be built against and above the existing highway, catchbasins (CBs) are required to convey flow via pipes through the surcharge embankment to the floodplain on the other side. The limited crossfall and longitudinal slope along the existing highway adjacent to the surcharge area results in calculated maximum catchbasin spacing of between 10 and 20m. Therefore, we recommend that catchbasins be installed along the east side of the existing highway at a maximum spacing of 20m (matching the 20m minimum catchbasin spacing specified by the Supplement to TAC) along the entire surcharge area. Catchbasins inlet grates should be depressed below the road surface by 40mm.

The detour road deviates from the proposed highway alignment at approximately Sta. 205+60 and runs for approximately 300m before tying into the existing highway to the north. The proposed detour road geometry was used to calculate the required locations and spacing of the asphalt spillways and CDBs. A summary of the proposed spillway / CDB locations is included in Table 2.

Detailed spillway spacing calculations are also included in **Appendix B**.

Table 2: Concrete Drainage Barrier and Spillway Locations

Spillway ID	Station	Side of Road	Type	Maximum Spacing (m)	Actual Spacing (m)	Notes
T1	1006+25	East	CDB + Spillway	135	132	
T2	1007+70	East	CDB + Spillway	240	145	
T3	1007+90	East	CDB + Spillway	103	20	Reduced due to presence of high point
T4	1008+35	East	CDB + Spillway	46	45	
T5	1008+45	West	CDB + Spillway	20	20	
T6	1008+57	East		57	22	Terminus of barrier
T7	1008+57	West	CDB + Spillway	>20	12	Terminus of barrier

4. Conclusion

Surcharge loading is required to the east of the existing highway alignment at the north end of the project within the footprint of the new highway embankment to reduce settlement of the future road surface. As a result, the southern portion of the project will be built in 2024, while the northern portion is expected to be completed in the summer of 2025. A temporary detour road will therefore also be required to connect the southern portion of the new highway to the existing highway at the north end of the project while the surcharge is in place.

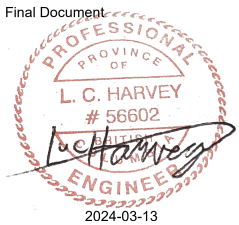
Temporary drainage infrastructure is required to manage drainage along the existing highway and the detour road in this temporary configuration. Roadway drainage calculations were completed to confirm the required CDB / spillway and catchbasin spacing. CDB and catchbasin location recommendations are included in *Table 2* above.

CLOSING

Sincerely,

Prepared by:

Final Document



2024-03-13

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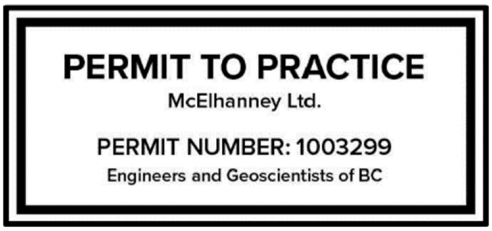
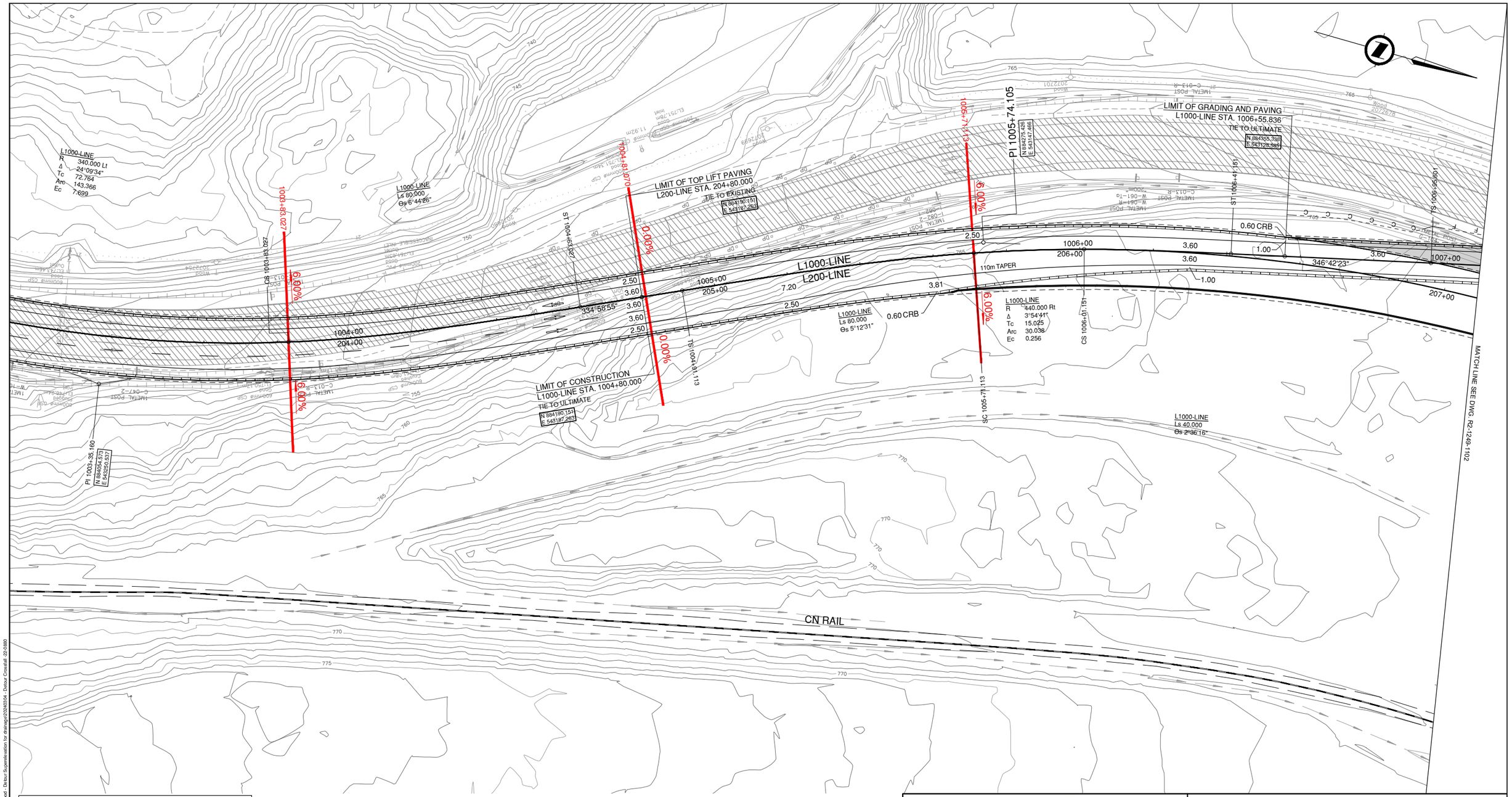


APPENDIX A

Temporary Highway Detour and Surcharge Drawings



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FOR TYPICAL SECTIONS SEE DWG. R2-1249-301 to 311	FOR CULVERT SECTIONS SEE DWG. R2-1249-751
FOR DISPOSAL SITE DETAILS SEE DWG. R2-1249-351 to 352	FOR CREST UNLOADING DETAILS SEE DWG. R2-1249-801 to 805
FOR GEOMETRICS AND LANING SEE DWG. R2-1249-401 to 404	FOR SURCHARGE DETOUR DETAILS SEE DWG. R2-1249-1101 to 1104

NOTES:
1. HOLLOW ARROWS INDICATE DIRECTION OF TRAVEL ONLY.
2. ALL CONSTRUCTION SIGNS TO BE ASTM LEVEL 9

LEGEND
- PAVEMENT REMOVAL
- SURCHARGE EXTENTS
- ADDITIONAL PAVEMENT AREA REQUIRED FOR DETOUR

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MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE
SOUTHERN INTERIOR REGION
HIGHWAY ENGINEERING AND GEOMATICS

SURCHARGE DETOUR PLAN
HIGHWAY No. 97
COTTONWOOD HILL PHASE 2

R.F. BINNIE & ASSOCIATES LTD.
EGBC PERMIT TO PRACTICE
NUMBER 1001128

CALVIN LUI
ENGINEER OF RECORD
DATE FEBRUARY 28, 2024

DESIGNED	R. JONES	DATE	FEB. 2024
QUALITY CONTROL	R. JONES	DATE	FEB. 2024
QUALITY ASSURANCE	C. LUI	DATE	FEB. 2024
DRAWN	H. ITO	DATE	FEB. 2024

PROJECT NUMBER	REG	DRAWING NUMBER	REV
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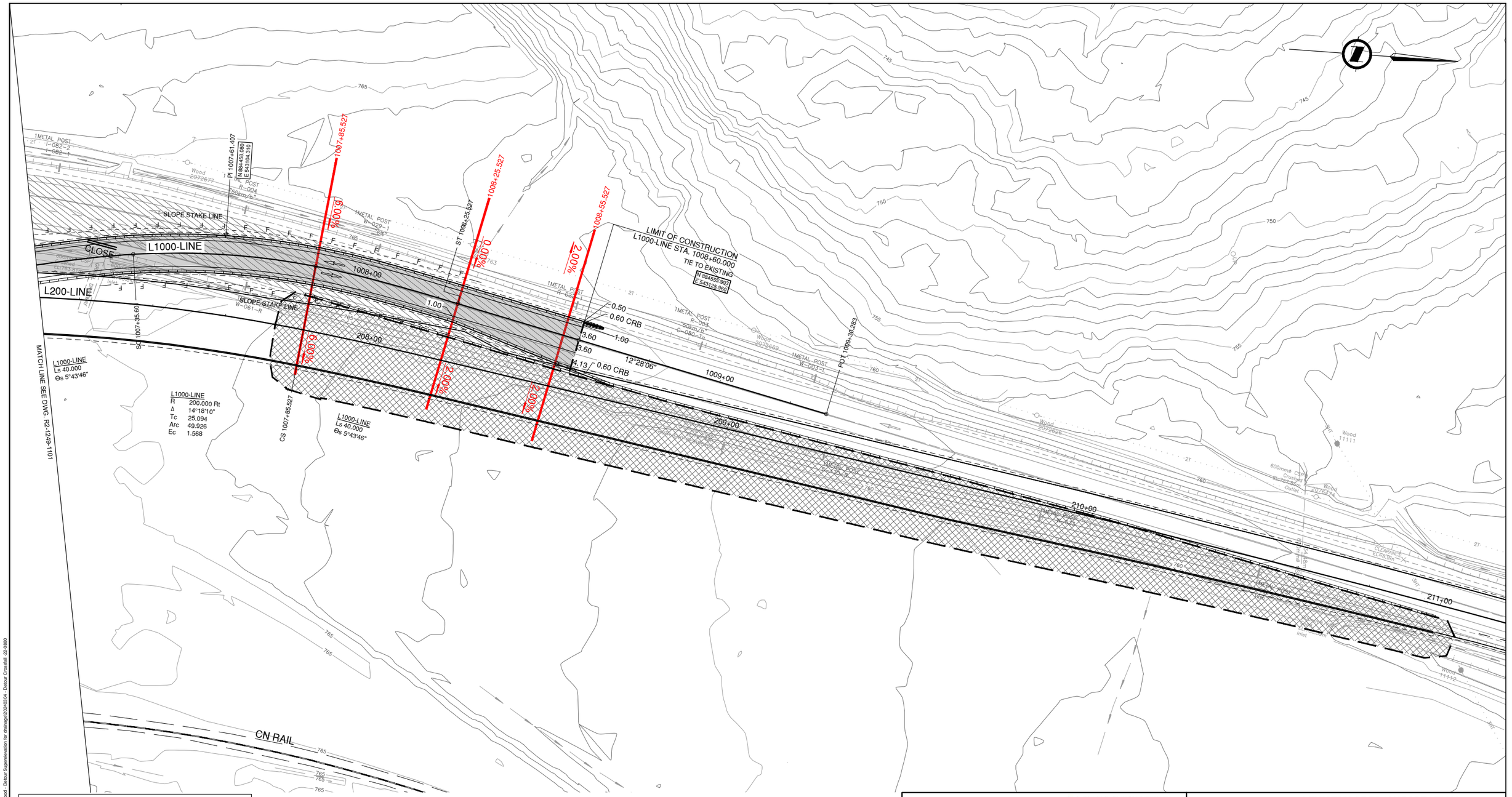

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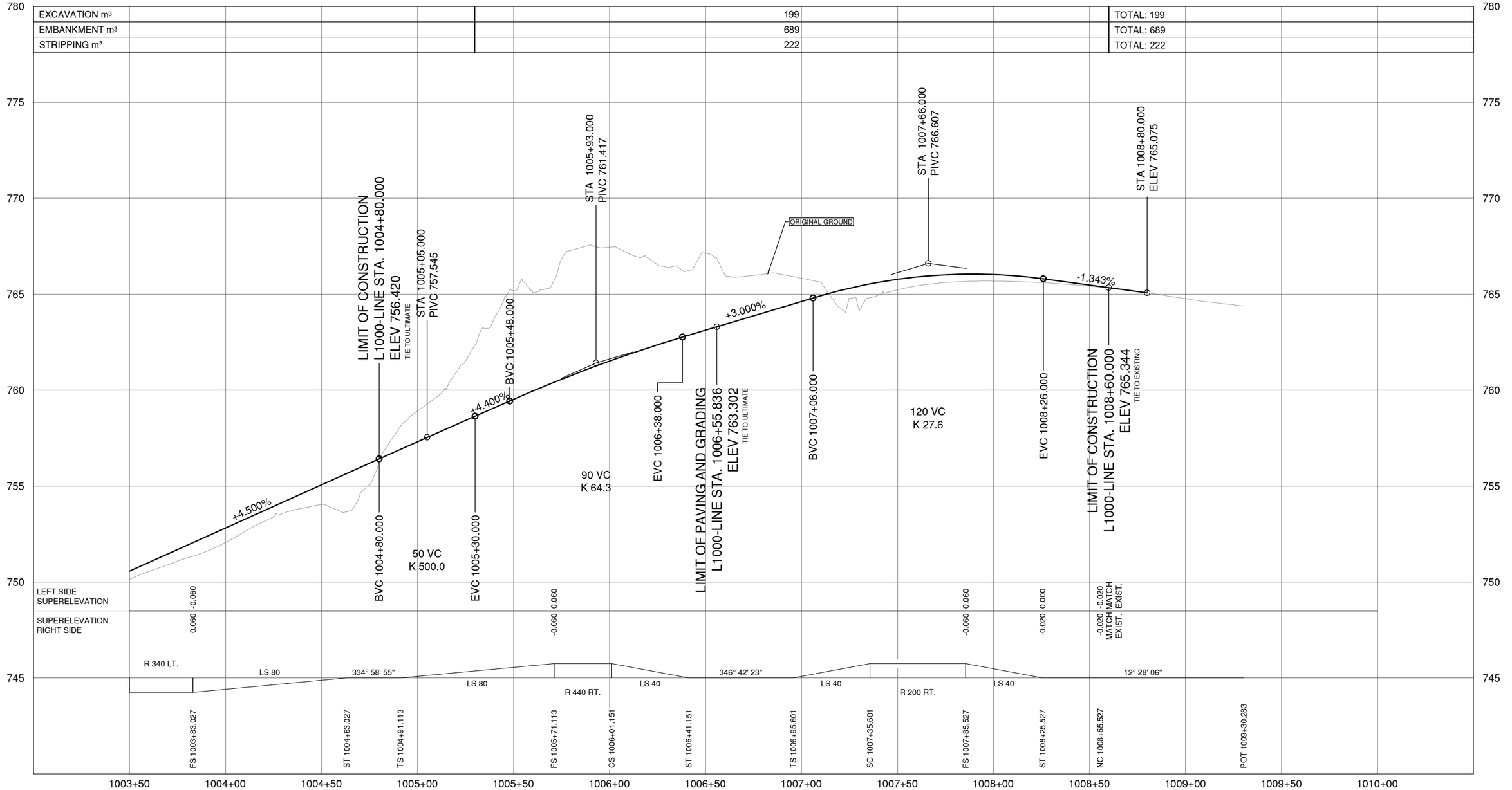
EMBANKMENT m³	689	TOTAL: 689	
STRIPPING m³	222	TOTAL: 222	



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FOR GEOMETRICS AND LANING SEE DWG. R2-1249-401 to 404	FOR SURCHARGE DETOUR DETAILS SEE DWG. R2-1249-1101 to 1104

NOTES:

1. ELEVATIONS SHOWN ARE FINISHED GRADE.
2. EMBANKMENT FIGURES SHOWN ARE COMPACTED QUANTITIES.
3. EXCAVATION FIGURES SHOWN ARE NEAT LINE UNADJUSTED QUANTITIES.

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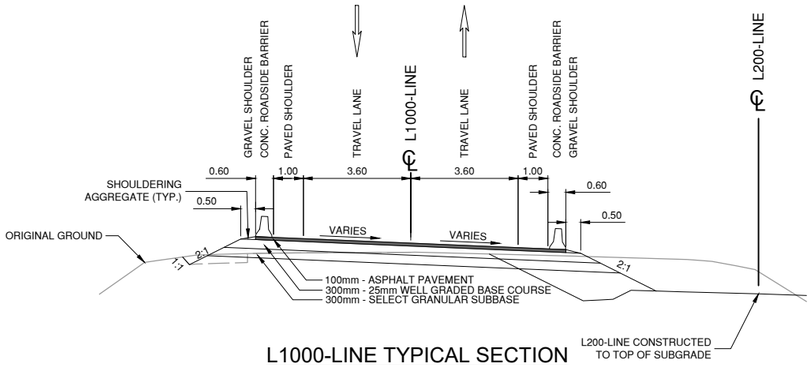

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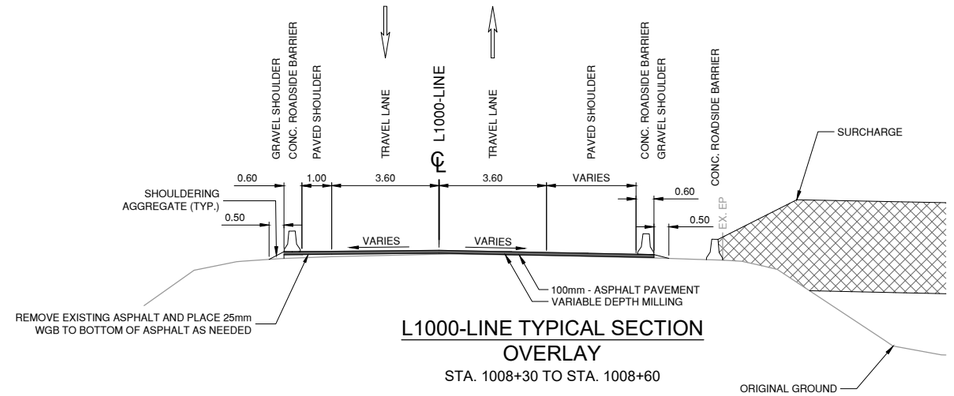
FULL PAVEMENT DETOUR
STA. 1007+25 TO 1007+80



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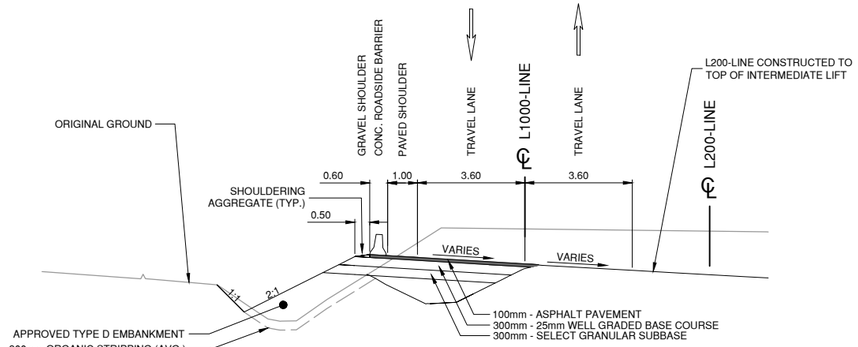
STA. 1008+30 TO STA. 1008+60



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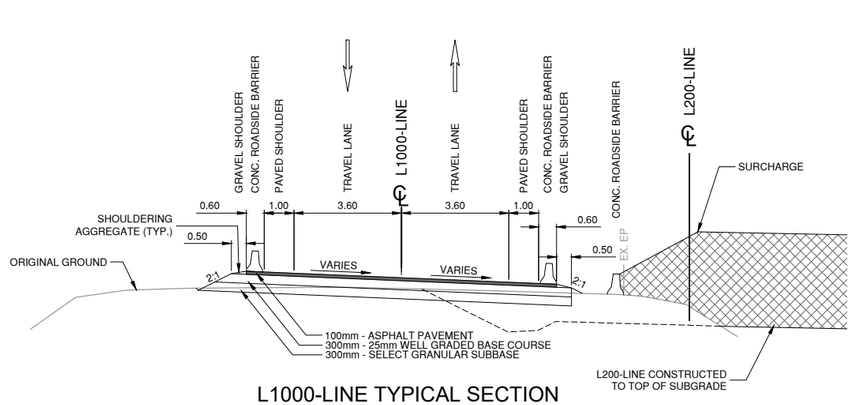
WIDENING ALONG ULTIMATE DESIGN
STA. 1006+55.836 TO STA. 1007+25



L1000-LINE TYPICAL SECTION
FULL DEPTH TIE-IN TO EXISTING HIGHWAY
STA. 1007+80 TO 1008+30

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DRAWN	H. ITO	DATE FEB. 2024

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UNSURVEYED CROWN LAND

SRW PLAN CG2154

SAWCUT LINE FOR SURCHARGE

R/W PLAN H-593

L100-LINE 114+00

HIGHWAY No. 97

SURCHARGE EXTENTS

BRITISH COLUMBIA RAILWAY

PLAN CG243

PID: 015-288-838

DL 11268

UNSURVEYED CROWN LAND

SRW PLAN CG2154

LEGEND

PROPOSED ULTIMATE GEOMETRY

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SURCHARGE DRAINAGE

HIGHWAY No. 97

COTTONWOOD HILL

DATE : Mar. 04, 2024

DWG. No. : SK-01

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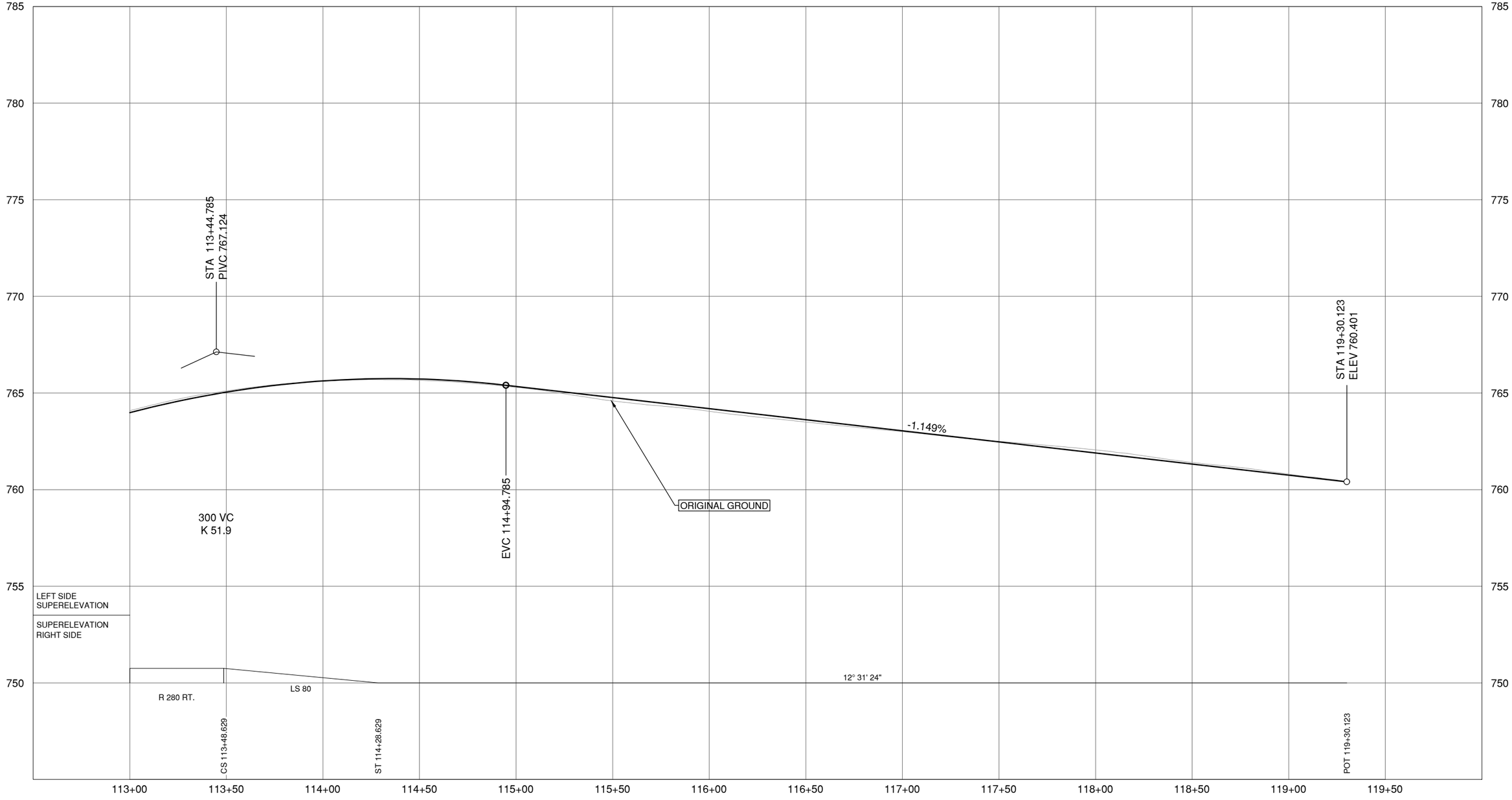

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L100-LINE PROFILE
HIGHWAY No. 97
COTTONWOOD HILL

DATE : Mar. 04, 2024
DWG. No. : SK-02
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APPENDIX B

Spillway Spacing Calculations

CDB / Spillway Spacing Calculations

Notes:

NOTE: CDB STATIONS REPRESENT THE RECOMMENDED STATIONS IN THE 100% DESIGN

CDB spacing is based on Figure 1050.I in Section 1050 of the MoTI Supplement to TAC Geometric Design Guide

Design Inputs are from **100% DD Drawings R2-1249-100, -200, -300, -400, -XS**

Inlet width (w) based on typical spillway width

Longitudinal grade based on grades within segement station range from R2-1249-200

Shoulder and contrib. width based on R2-1249-300 and -400

					Highpoint		Endpoint		Endpoint
Catchment Parameters									
CDB / Spillway ID			New	New	New	New	New	New	New
Side of Road		East	East	East	East	East	East	West	West
Start Station		**1004+93**	**1006+25**	**1007+70**	**1007+90**	**1008+35**	**1008+57**	**1008+45**	**1008+57**
Design Inputs									
Shoulder Width (SW)	[m]	1	1	1	N/A	1	1	1	N/A
Longit. Grade (s_y)	[m/m]	0.0411	0.0247	0.004	N/A	0.00911	0.0134	0.0134	N/A
Crossfall (s_x)	[m/m]	0.0366	0.06	0.06	N/A	0.03	0.02	0.0067	N/A
Manning's n (n)		0.020	0.020	0.020	N/A	0.020	0.020	0.020	N/A
Rainfall Intesity (i)	[mm/hr]	66.1	66.1	66.1	N/A	66.1	66.1	66.1	N/A
Contrib. Width	[m]	9.2	9.2	9.2	N/A	9.2	4.6	4.6	N/A
Runoff Coeff. (C_w)		0.95	0.95	0.95	N/A	0.95	0.95	0.95	N/A
Inlet Width (w)	[m]	0.6	0.6	0.6	N/A	0.6	0.6	0.6	N/A
Calculated Design Gutter Flow									
Pond Width (PW)	[m]	**1.2**	**1.2**	**1.2**	**N/A**	**1.2**	**1.2**	**1.2**	**N/A**
Max Gutter Depth (y_0)	[m]	**0.044**	**0.072**	**0.072**	**N/A**	**0.036**	**0.024**	**0.008**	**N/A**
R_s		**0.89**	**2.43**	**15.00**	**N/A**	**3.29**	**1.49**	**0.50**	**N/A**
w_eff	[m]	**0.660**	**0.660**	**0.780**	**N/A**	**0.660**	**0.660**	**0.660**	**N/A**
v	[m/s]	**1.25**	**1.35**	**0.54**	**N/A**	**0.51**	**0.48**	**0.23**	**N/A**
Gutter Flow (Q_0)	[m3/s]	**0.0247**	**0.0437**	**0.0176**	**N/A**	**0.0083**	**0.0051**	**0.0008**	**N/A**
Max Depth outside w (y_over)	[m]	**0.020**	**0.032**	**0.025**	**N/A**	**0.016**	**0.011**	**0.004**	**N/A**
Overflow (Q_over)	[m3/s]	**0.0029**	**0.0052**	**0.0011**	**N/A**	**0.0010**	**0.0006**	**0.0001**	**N/A**
Intercepted flow (Q_int)	[m3/s]	**0.0218**	**0.0385**	**0.0165**	**N/A**	**0.0073**	**0.0045**	**0.0007**	**N/A**
Eff	[%]	**88.1**	**88.1**	**93.9**	**N/A**	**88.1**	**88.1**	**88.1**	**N/A**
CDB / Spillway Spacing									
Initial CDB Spacing	[m]	**153.8**	**272.2**	**109.5**	**N/A**	**51.9**	**64.0**	**10.3**	**N/A**
Consecutive CDB Spacing	[m]	**135.6**	**239.9**	**102.9**	**N/A**	**45.8**	**56.4**	**9.1**	**N/A**
CDB / Spillway Location									
Catchbasin Catchment		**Existing**	**New**	**New**	**New**	**New**	**New**	**New**	**New**
Side of Road		**East**	**East**	**East**	**East**	**East**	**East**	**West**	**West**
Actual Distance between CBs		**132**	**145**	**20**	**N/A**	**45**	**22**	**20**	**12**

APPENDIX C

Statement of Limitations

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