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Memorandum

Date: November 25, 2022
To: Lamme Zarei, P.Eng., MBA
Company: Project Manager, Design-Build/P3
Email: lzarei@mcelhanney.com
Prepared By/Email: Garry Y.P. Law, P.Eng. Garry.law@exp.com
Project Name: Portside/Blundell Road Improvement Project (PBRIP)
Richmond, BC
Subject: Geotechnical Consideration for Waste Layers; Material Re-use and Subgrade
Preparation for ADESA Berm (Update)
Document No.: ID020A- EXPG- MEM- GE- 0001- Waste Mtrl Reuse & Subgrade- A **Rev. No.:** Draft
Distribution/Email:

INTRODUCTION

EXP Services Inc. (“EXP”) is presenting the geotechnical recommendations for in-situ testing for voids and sinkholes location for the PBRIP Project. A municipal waste fill layer is found throughout the area of our geotechnical investigation area. Voids and Sinkholes are suspected near a ditch within this fill layer which contained random construction debris, organics, and possibly logs. This memo also briefly discuss the possible site improvement works if and where voids and sinkholes are located, as well as commenting on the availability of an on-site material for re-use.

IN-SITU GEOTECHNICAL ASSESSMENT FOR VOIDS AND SINKHOLES

Geophysical testing, an in-situ testing method is suitable to detect and define the locations and size of voids. Three lines of geophysical testing were approved by the VFPA and are scheduled to commence on November 29, 2022. Frontier Geosciences Inc. will be conducting a multichannel analysis of surface waves (MASW) investigation near the current ditch at north side of Blundell Road as well as perpendicular to the north ramp and north abutments. The alignments of the tests are illustrated in the attached SK-1 - “GeoPhysical Lines Mark-up” as L1, L2 and L3.

The purpose of the MASW survey is to determine geological conditions along the test alignments. This survey typically employs two Geometric Geode, signal enhancement seismographs and Oyo Geospace 10 Hz geophones. Geophone intervals along the multi-colored seismic cable are typically maintained at 2.5m in order to ensure high resolution data on subsurface layering.

Once data are recorded and collected, interpretation of MASW data would follow. At the end, a shear wave velocity depth section along the survey lines will be produced. The MASW is capable to produce shear wave velocity depth profiles up to approximately one third of the line lengths. In this project, the Lines L1, L2 and L3 are planned to be 53m, 51m and 28m respectively. Thus, we can expect a profile



Memorandum (cont'd)

*Geotechnical Consideration for Waste Layers; Material Re-use and Subgrade Preparation for ADESA Berm
ID020A- EXPG- MEM- GE- 0001- Waste Mtrl Reuse & Subgrade- A (Update)
Portside/Blundell Road Improvement Project (PBRIP)
Richmond, BC*

*Reference No.: VAN-22003875-A0
November 24, 2022*

from 18m to 9m deep. Based on the local logs, it would be capable to reach beyond the depths of the targeted waste fill layer.

POSSIBLE MITIGATION WORKS IF VOIDS ARE DETECTED

There are measures, such as Rapid Impulse Compaction (RIC) and 2.5m high Preload/ Surcharge, in our indicative design that may reduce the risk of poor performance due to voids and sinkholes. However, Grouting; Densifications; Excavation and Fill Replacement or other site improvement methods may still be required to mitigate if voids and sinkholes within waste fill layer are detected. Contractor should allow a budget for this work. Depends on the size(s), location(s), and severity of these voids detected, one or a combination of the above remedial methods may be employed. More detailed recommendations on the remedial work will be issued after the MASW results are made available.

ONSITE MATERIAL AVAILABLE FOR RE-USE

From our geotechnical subsurficial soil investigation and our site observations, there is a berm of sand fill placed near the ADESA property. This berm is located near Station STA 20+70 to STA 21+05 of the proposed ramp area and its sand fill appeared to be of reasonable quality. This irregularly shaped berm is understood to be approximately 50m long (at centerline) x 26m wide x 0m to 1.9m thick above the design local ramp subgrade. The area is shown highlighted in yellow at the attached SK-2 - "Road and Profile with Fill Berm Mark-up". However, part of the berm surface is covered with vegetation and asphalt which must be removed prior to re-use. Based on the nearby testhole data, we anticipate that about 30% of that fill from the ADESA Berm maybe re-usable.

We recommend the sand fill should also be sampled for sieve analysis and be assessed prior to possible re-used as subgrade fill. If the gradation of the fill is acceptable according to MMCD's SGSB gradation specifications upon EXP's review, it can be placed at the nearby road subgrade preparation. The fill gradation is important for the fill compactibility and stability point of view. It is especially critical when fill is being placed and compacted in the wetter or winter weather. However, if the contractor can prove that they can compact finer grained material, than the SGSB specifications, to the project's compaction specifications, EXP would be willing to waive this requirement.

As an option, the approved ADESA berm fill can even be re-used as void mitigation if excavation and fill replacement method is required and selected. A field engineer from EXP should be on site for the excavation of this fill to confirm its suitability as a subgrade fill.



Memorandum (cont'd)

Geotechnical Consideration for Waste Layers; Material Re-use and Subgrade Preparation for ADESA Berm
ID020A- EXPG- MEM- GE- 0001- Waste Mtrl Reuse & Subgrade- A (Update)
Portside/Blundell Road Improvement Project (PBRIP)
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CLOSURE

The information presented in this memorandum is based on the referenced information and EXP's understanding of the project as described herein. If the project information differs from those described in this memorandum, EXP should be notified promptly in order to review the geotechnical aspects of the project and modify them if necessary.

This memorandum has been prepared for the exclusive use of McElhanney Ltd. and its designated consultants or agents. Any use of the materials contained in this memorandum for other than its intended purpose or by any other party must first be verified in writing by EXP Services Inc.

The attached "Interpretation & Use of Study and Report" forms an integral part of this report and must be included with any copies of this report. EXP does not accept any responsibility or damages as a result of any other party relying on or using the information and recommendations contained in this report.

We trust that this meets your current requirements. Should you have any concerns or questions, please do not hesitate to contact the undersigned.

Submitted by:

EXP Services Inc.

Reviewed by:

Reviewed by:

Garry Y.P. Law, P.Eng.
Geotechnical Engineer

Yasser Abdelghany, Ph.D., P.Eng.; PMP.
Geotechnical Lead , Alternative Project Delivery (P3/DB)

- Attachments: Interpretation & Use of Study and Report
SK-1 - "GeoPhysical Lines Mark-up"
SK-2 - "Road and Profile with Fill Berm Mark-up"

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INTERPRETATION & USE OF STUDY AND REPORT

1. STANDARD OF CARE

This study and Report have been prepared in accordance with generally accepted engineering consulting practices in this area. No other warranty, expressed or implied, is made. Engineering studies and reports do not include environmental consulting unless specifically stated in the engineering report.

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 us by the Client, communications between us and the Client, and to any other reports, writings, proposals or documents prepared by us for the Client relative to the specific site described herein, all of which 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. WE CANNOT BE RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF THE REPORT

The Report has been prepared for the specific site, development, building, design or building assessment objectives and purpose that were described to us by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the document are only valid to the extent that there has been no material alteration to or variation from any of the said descriptions provided to us unless we are 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 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 OUR WRITTEN CONSENT. WE WILL CONSENT TO ANY REASONABLE REQUEST BY THE CLIENT TO APPROVE THE USE OF THIS REPORT BY OTHER PARTIES AS "APPROVED USERS". The contents of the Report remain our copyright property and we authorise only the Client and Approved Users to make copies of the Report only in such quantities as are reasonably necessary for the use of the Report by those parties. The Client and Approved Users may not give, lend, sell or otherwise make the Report, or any portion thereof, available to any party without our written permission. Any use which a third party makes of the Report, or any portion of the Report, are the sole responsibility of such third parties. We accept no responsibility for damages suffered by any third party resulting from unauthorised use of the Report.

5. INTERPRETATION OF THE REPORT

- a. Nature and Exactness of Descriptions: Classification and identification of soils, rocks, geological units, contaminant materials, building envelopment assessments, and engineering estimates 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 and even comprehensive sampling and testing programs, implemented with the appropriate equipment by experienced personnel, may fail to locate some conditions. All investigations, or building envelope descriptions, utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarising 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 all persons making use of such documents or records should be aware of, and accept, this risk. 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. Where 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 us. We have relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, we cannot accept responsibility for any deficiency, misstatement or inaccuracy contained in the report as a result of misstatements, omissions, misrepresentations or fraudulent acts of persons providing information.
- c. To avoid misunderstandings, EXP Services Inc. (EXP) should be retained to work with the other design professionals to explain relevant engineering findings and to review their plans, drawings, and specifications relative to engineering issues pertaining to consulting services provided by EXP. Further, EXP should be retained to provide field reviews during the construction, consistent with building codes guidelines and generally accepted practices. Where applicable, the field services recommended for the project are the minimum necessary to ascertain that the Contractor's work is being carried out in general conformity with EXP's recommendations. Any reduction from the level of services normally recommended will result in EXP providing qualified opinions regarding adequacy of the work.

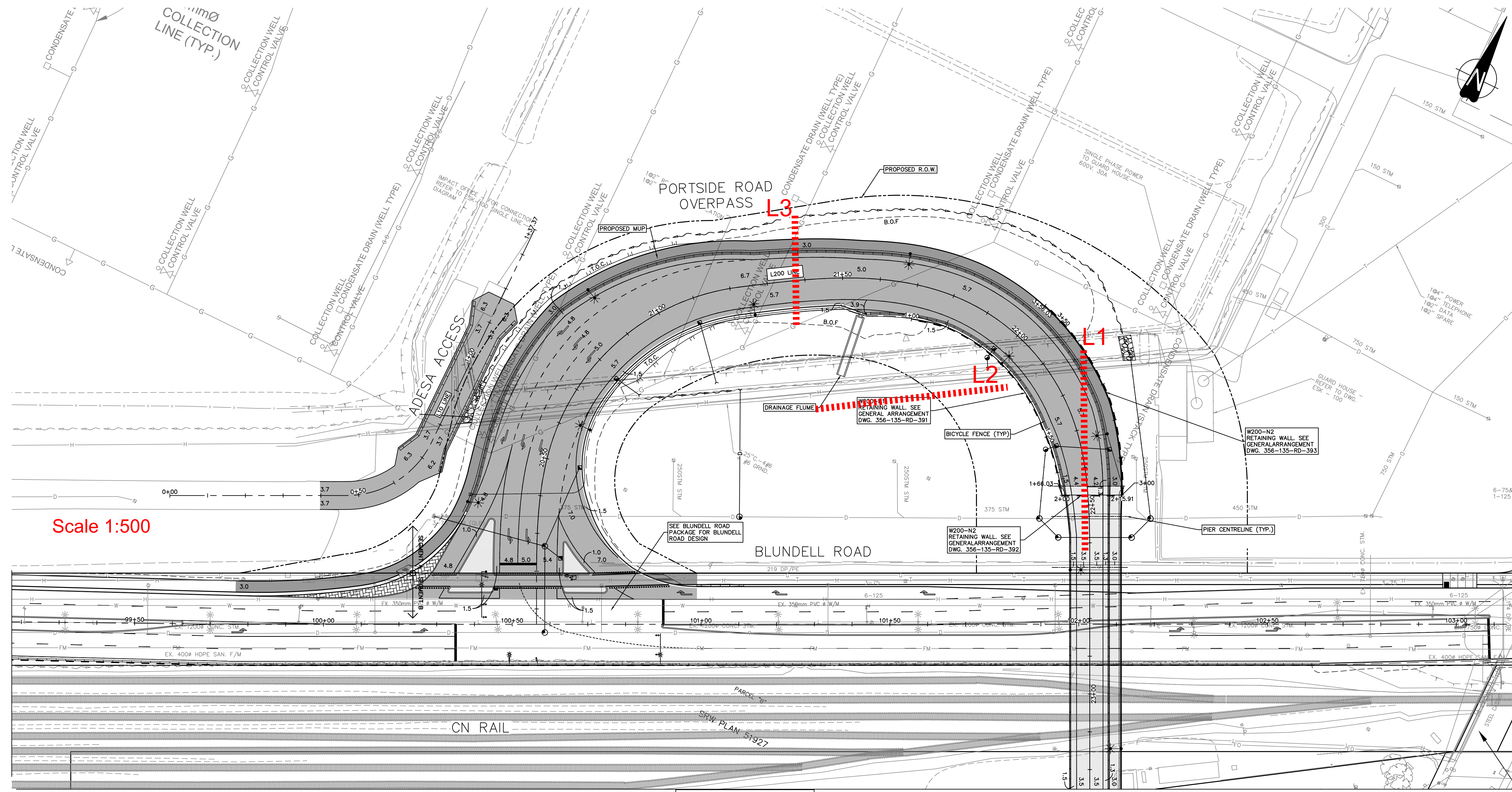
6. ALTERNATE REPORT FORMAT

When EXP submits both electronic file and hard copies of reports, drawings and other documents and deliverables (EXP's instruments of professional service), the Client agrees that only the signed and sealed hard copy versions shall be considered final and legally binding. The hard copy versions submitted by EXP shall be the original documents for record and working purposes, and, in the event of a dispute or discrepancy, the hard copy versions shall govern over the electronic versions. Furthermore, the Client agrees and waives all future right of dispute that the original hard copy signed version archived by EXP shall be deemed to be the overall original for the Project.

The Client agrees that both electronic file and hard copy versions of EXP's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except EXP. The Client warrants that EXP's instruments of professional service will be used only and exactly as submitted by EXP.

The Client recognizes and agrees that electronic files submitted by EXP have been prepared and submitted using specific software and hardware systems. EXP makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

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Scale 1:500

CONTINUED ON SHEET 356-135-RD-102

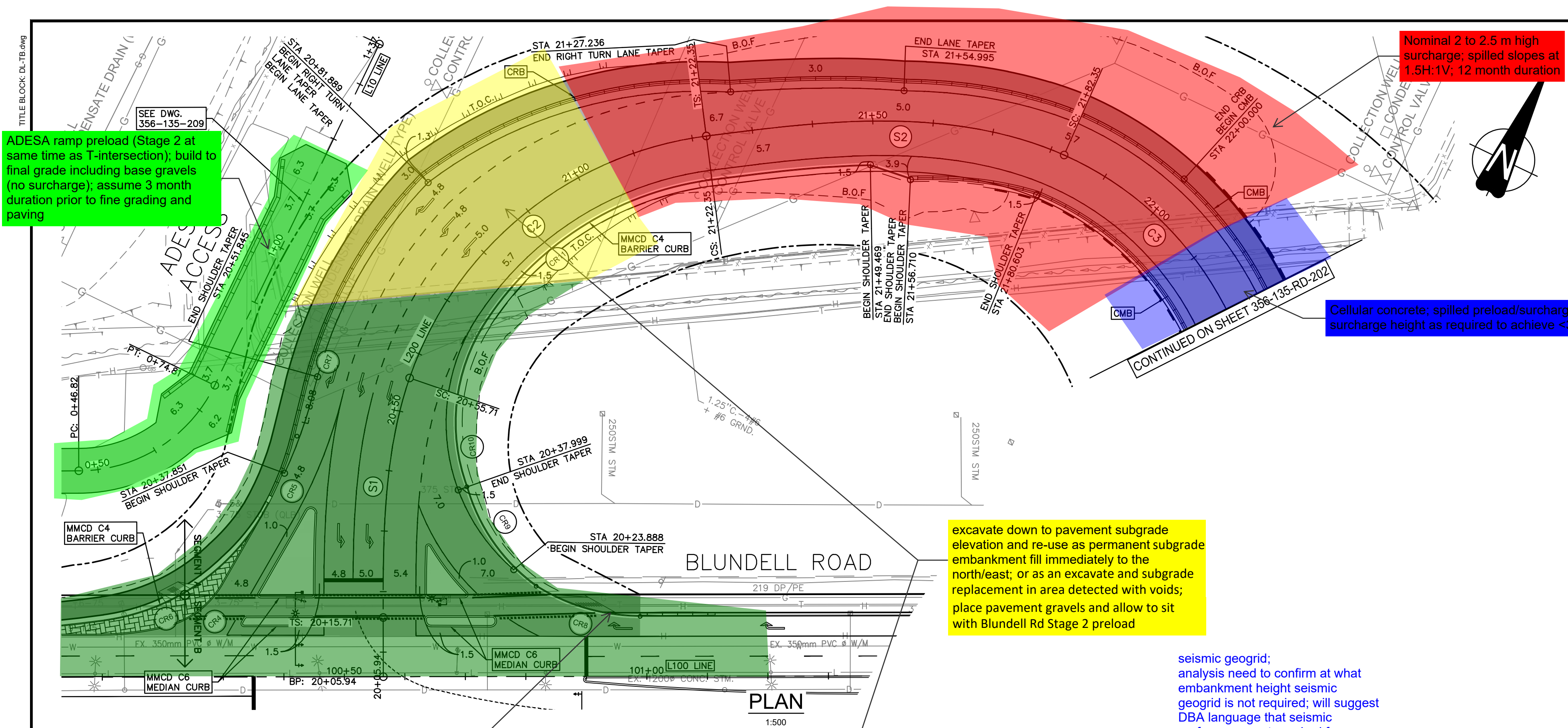
EXP Services Inc.

VAN-22003875-A0

November 24, 2022

SK-1 - "GeoPhysical Lines Mark-up"

DATE: 20220812 - 2:36pm
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CURVE TABLE							
CURVE No.	RADIUS	DELTA	TANGENT	LENGTH	B.C. STA	E.C. STA	C.C. COORD.
C2	60.00	63°37'49"	37.22	66.63	2+055.71	2+122.34	N 5447140.427 E 498230.327
C3	55.00	45°10'45"	22.88	43.37	2+182.35	2+225.72	N 5447158.538 E 498253.994

SPIRAL DATA						
SPIRAL No.	A	R	L	START DIRECTION	START COORD.	END COORD.
S1	48.990	INFINITY	40.000	N25° 43' 30.30"W	N 5447095.952 E 498183.926	N 5447133.503 E 498170.728
S2	57.446	INFINITY	60.000	N57° 00' 13.78"E	N 5447190.753 E 498197.659	N 5447213.513 E 498252.320

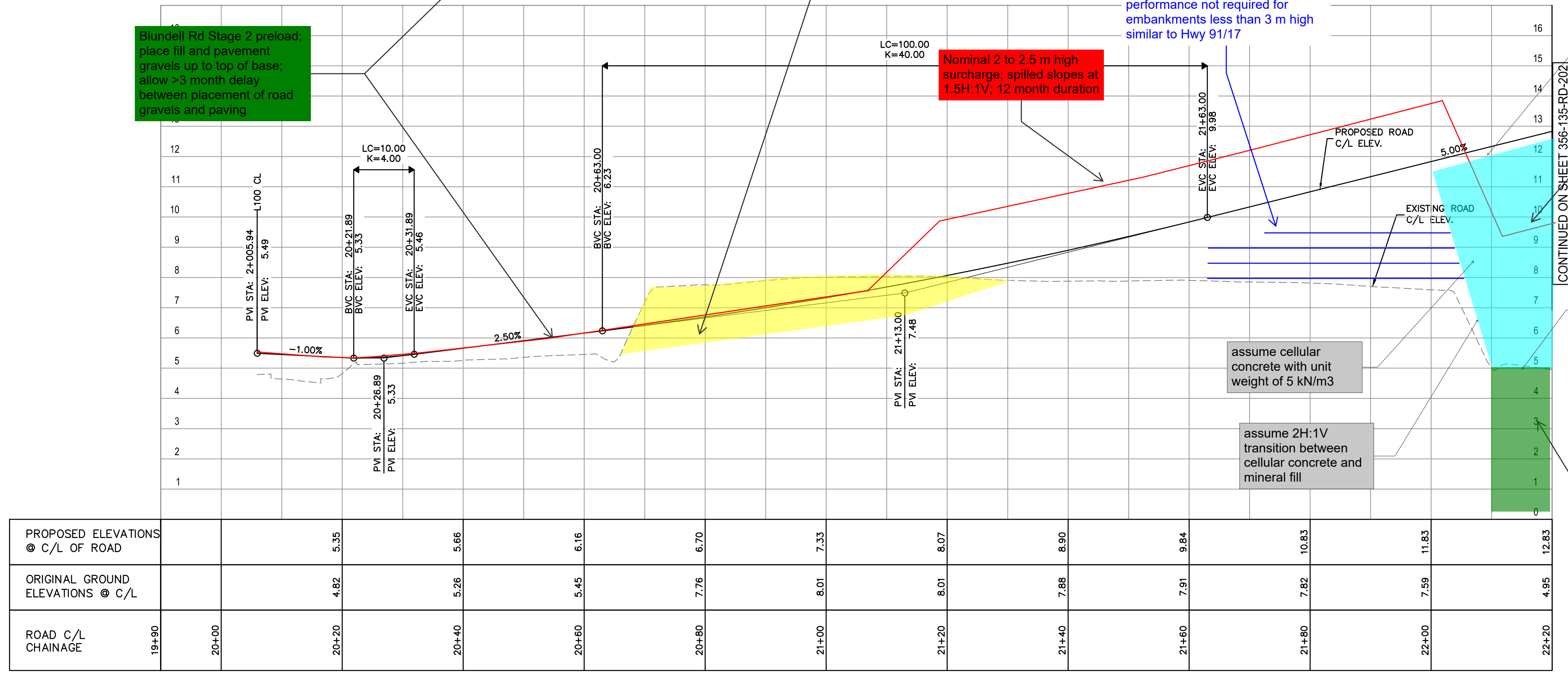
CURVE RETURN TABLE							
CURVE No.	RADIUS	DELTA	TANGENT	LENGTH	B.C. STA	E.C. STA	C.C. COORD.
CR4	15.40	46°15'57"	6.58	12.44	1+059.23	1+071.66	N 5447090.529 E 498142.654
CR5	50.40	15°58'21"	7.07	14.05	1+031.71	1+045.76	N 5447106.570 E 498108.755
CR6	36.30	52°05'31"	17.74	33.00	1+045.77	1+078.78	N 5447105.526 E 498122.717
CR7	77.51	3°33'54"	2.41	4.82	1+016.55	1+021.38	N 5447140.646 E 498208.219
CR8	32.30	32°27'27"	9.40	18.30	2+025.27	2+043.56	N 5447143.326 E 498208.216
CR9	30.80	38°19'43"	10.70	20.60	2+043.56	2+064.17	N 5447141.558 E 498209.906
CR10	30.80	53°27'23"	15.51	28.74	2+064.17	2+092.90	N 5447143.326 E 498208.216
CR11	53.10	24°45'59"	11.66	22.95	2+092.90	2+115.86	N 5447140.427 E 498230.327

EXP Services Inc.
VAN_22003875-A0
November 24, 2022
SK-2 - "Road and Profile with Fill Berm Mark-up"

Blundell Rd Stage 2 preload; place fill and pavement gravels up to top of base; allow >3 month delay between placement of road gravels and paving

Nominal 2 to 2.5 m high surcharge; spilled slopes at 1.5H:1V; 12 month duration

Cellular concrete; spilled preload/surcharge slopes at 1.5H:1V; 12 month duration; surcharge height as required to achieve <30 mm at end of warranty and <60 mm at 30 years



L200 SUPERELEVATION TABLE						
SUPERELEVATION REGION	START STATION	DESCRIPTION	LEFT SHOULDER (MUP)	LEFT LANE	RIGHT LANE	RIGHT SHOULDER
	2+005.942m	BEGIN ALIGNMENT				
	2+012.7420m	TIE-IN TO BLUNDELL				
2	2+015.710m	TS	0.00%	0.00%	0.00%	0.00%
2	2+035.710m	SRO-IN	2.00%	2.00%	-2.00%	-2.00%
2	2+055.710m	SC-R60	2.00%	4.00%	-4.00%	-4.00%
2	2+122.343m	CS-R60	2.00%	4.00%	-4.00%	-4.00%
3	2+182.351m	SC-R55	2.00%	6.00%	-6.00%	-6.00%
3	2+225.720m	CS-R55	2.00%	6.00%	-6.00%	-6.00%
3	2+252.387m	SRO-OUT	2.00%	2.00%	-2.00%	-2.00%
3	2+265.720m	ST	2.00%	2.00%	-2.00%	-2.00%
12	2+340.216m	TS	2.00%	2.00%	-2.00%	-2.00%
12	2+354.009m	SRO-IN	2.00%	2.00%	-2.00%	-2.00%
12	2+380.216m	SC-R65	2.00%	5.80%	-5.80%	-5.80%
12	2+468.957m	CS-R65	2.00%	5.80%	-5.80%	-5.80%
	2+555.308m	0% CROSSOVER	2.00%	0.00%	0.00%	0.00%
13	2+605.927m	SC-R500	2.00%	-3.40%	3.40%	3.40%
13	2+770.803m	CS-R500	2.00%	-3.40%	3.40%	
	2+830.000m	END ALIGNMENT		-2.00%	-2.00%	

PROPOSED ELEVATIONS @ C/L OF ROAD	
19+90	5.35
20+00	5.33
20+20	5.66
20+40	6.16
20+60	6.70
21+00	7.33
21+20	8.07
21+40	8.90
21+60	9.84
21+80	10.83
22+00	11.83
22+20	12.83

ORIGINAL GROUND ELEVATIONS @ C/L	
19+90	4.82
20+00	5.26
20+20	5.45
20+40	5.76
20+60	6.16
20+80	6.76
21+00	7.33
21+20	8.01
21+40	8.88
21+60	9.91
21+80	10.82
22+00	11.83
22+20	12.83

Ref. No.	REFERENCE

PRELIMINARY NOT FOR CONSTRUCTION

B 2022-09-13 INDICATIVE DESIGN SUBMISSION DRAFT FOR IDR HG LZ

A 2022-06-30 PRELIMINARY DESIGN SUBMISSION EY LZ

THIS DRAWING HAS NOT BEEN APPROVED AND MAY CONTAIN ERRORS AND OMISSIONS

No.	Date	REVISION	Dr'n	Ch'd

PORT of Vancouver

Vancouver Fraser Port Authority

ENGINEERING DEPARTMENT

DESIGN BY	T. BOOTH
DRAWN BY	E. YANG
APPROVED	L. ZAREI
DATE	2022-06-30
SCALE	1:500
VFPA SITE	356

GREATER VANCOUVER GATEWAY 2030

PORTSIDE / BLUNDELL ROAD IMPROVEMENT PROJECT

PORTSIDE ROAD

ROAD PLAN AND PROFILE

SIZE	DWG	356-135-RD-201	SHEET	1 of 9	REV	A
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