Report on Point Ellice Bridge Maintenance and Enhancement Proposals

City of Victoria

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Sign-off Sheet

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Executive Summary

This Report on Point Ellice Bridge Maintenance and Enhancement Proposals (Report) briefly states the major outstanding maintenance requirements of painting the structural steel work, replacing the main span expansion joints, and concrete repairs to deteriorating concrete at the abutments. Sealed joints in the asphalt roadway surface and clearing blocked deck drains require ongoing maintenance.

This Report examines in detail the proposal to widen the deck to provide a two lane bridge with bicycle lanes and sidewalks on both sides. This review also evaluated the capacity of the deck structure to carry the Canadian Highway Bridge Design Code (CHBDC) CL-625 design vehicle as well as overload type permit vehicles, based on criteria established by the British Columbia Ministry of Highways and Infrastructure (MOTI) for major routes. In this analysis an allowance was made for loss of structural beam capacity through corrosion. Non-destructive investigation has been undertaken to provide a more accurate figure of percentage loss of steel in the thickness of the beam top flanges and the analysis adjusted accordingly. The present condition is considered safe for normal use.

A study of the original deck drawings revealed that the concrete thickness protecting the reinforcing bars was only 25.4 mm (1") (modern practice is 70 mm or nearly 3"), plus the 50.8 mm (2") of asphalt. This depth of cover is intended to prevent ingress of chlorides and water that would, over time, corrode the steel bars. There is a concern that delamination of the concrete (separation of the top concrete from that below at the reinforcement layer) will have occurred. An investigation to determine the extent to which this may have occurred has been undertaken by Goal Engineering whose report is attached. Little evidence of delamination and corrosion of reinforcement was detected.

With respect to the proposed widening, this would be accomplished using standard bridge design practice and materials, with the limiting condition that the increase in deck weight would be limited by that allowed for in the original design. The proposed cross-section is shown in SK-1 in Appendix B. The sections meet the minimum requirements specified by the brief of 1.7 m sidewalks, 1.8 m bicycle lanes, and 3.05 m traffic lanes.

Phasing of the work is also examined in detail; with the proposal that the Bridge be closed to public two-way traffic, but retains controlled one-way operation for emergency vehicles (fire routes to Vic West and ambulance to Royal Jubilee Hospital use Bay Street), police, transit, and pedestrian use on one sidewalk. This would necessitate the work being done in two phases; with the initial phase being on the north side of the centreline. It is recommended that the work be scheduled after completion of the Johnson Street Bridge when the improved road alignment will mitigate the increase in traffic.

1.0 BACKGROUND

The existing Point Ellice Bridge (Bridge) superstructure was constructed in 1956–57 upon the foundations and abutments of the pre-existing bridge. This bridge consisted of four equal spans, with a total length of approximately 183 m (600 ft.).

The piers were of unreinforced masonry and the abutments of reinforced concrete. The new Bridge utilized a three span continuous steel plate girder design, profiled to a higher elevation than previously to allow for increased navigable headroom under its centre span. The old west span was divided into three shorter steel girder spans with the addition of two reinforced concrete piers.

The new higher vertical alignment impacted the design and reuse of the older abutments, which, if raised and backfilled, would have resulted in them being unstable. Extra approach spans (approximately 9.6 m long) were added at each end in reinforced concrete to address this problem. These approach spans are enclosed at each side by masking walls so their existence is not obvious. Additional extensive wing walls were required at the east approaches to accommodate the higher grade; the west end being resolved mainly by fills.

At the east end, settlement of the approach span abutments has occurred resulting in an obvious dip in the roadway. This settlement arises from consolidation of the underlying soft soils from the new approach fills and possibly also influenced by the fills associated with concrete recycling industrial operation on the site to the south.

Currently the roadway width between curbs is 8.53 m, with a sidewalk of 1.6 m width on the south side only (this width is the effective width as reduced by the inwardly projecting guardrail). There is also a limited sidewalk on the north side, 0.6 m wide (after a similar adjustment for the inward leaning guardrail).

The Bridge received a seismic upgrade in 2001–2002, which included some reinforcement of the masonry piers, replacement of the main Bridge bearings, and work to seal joints in the roadway surface. The steel work has not been repainted for many years.

2.0 PREVIOUS RECENT REPORTS

A report titled *Inspection and Repair Options Report* was prepared by Hindi Engineering in April 2013. This report recorded known issues of leaking deck joints causing rusting to the top flanges and ends of the steel members and cracking/spalling in the area of the abutments and approach spans most likely associated with settlement. This report also shows options for a new concrete deck and overlay to the existing width or one widened to accommodate sidewalks and a bicycle lane on each side.

For ongoing maintenance, this report summarized the following:

- Repair failed cold joints (these occur laterally at about every 5.6 m centres over the full length of the Bridge [typically over every floor beam])
- Address blocked deck drains, improve or redesign
- Inspect the Bridge every six months; monitor for leaks, monitor settlement of the approaches—repair if necessary
- Estimated funding requirements for maintenance, widening, corrosion prevention/painting, and general miscellaneous repairs

3.0 MAINTENANCE

The immediate maintenance requirements have been identified in previous reports and summarized in Section 2.0.

Repainting of the steel work; either partially (where active corrosion is occurring) or overall, should be scheduled for within the next few years. Lead paint can be anticipated requiring full environmental protection measures. Encapsulation in sections of the centre span will place restrictions on the navigable headroom (which is fully utilized by current users as evidenced by bottom flange damage and deposition of wood chip debris on the bottom flange). To eliminate/reduce leaking joints and painting, the most appropriate phasing would be at the time of the proposed deck widening and the associated work, provided this would be undertaken in the next three to five years.

4.0 ENHANCEMENT PROPOSALS

The existing deck, while adequate for two lanes of motorized traffic, each being 4.26 m (14 ft.) wide is deficient for concurrent bicycle use and for pedestrian sidewalks, particularly on the north side.

The residential developments to the west will result in increased pedestrian and bicycle users.

The City of Victoria (City) has specified that a wider deck should consist, as a minimum, of the following:

- Sidewalks each side, clear width approximately 1.7 m
- Bicycle lanes each side, with 1.8 m
- Roadway, two lanes, each 3.05 m

This study has therefore evaluated the structural capacity of the deck steel work and increased deck weight from the proposed widening as follows:

4.1.1 Existing Structural Capacity of the Deck Steel Work

The 1956 bridge was designed to the H-20 truck specifications (and associated lane loading) of the American Association of Highway Officials. The H-20 truck design had two axles spaced 4.27 m (14 ft.). The front axle loading was 36 kN (8,000 lbs); rear axle loading was 143 kN (32,000 lbs), which equalled a total of 179 kN (40,000 lbs or 20 tons). This is substantially less than the current Canadian Highway Bridge Design Code (CHBDC) CL-625 design vehicle (which has more axles), but typically short span deck members - if in good condition - (i.e. Point Ellice stringers and floor beams) would normally be expected to support these localised axle loads. However, these members have undergone corrosion of the top flanges from water leakage through the deck joints and their capacity reduced.

The members have therefore been evaluated for the current CHBDC design vehicle, dynamic load allowances, etc. and also for permit overload vehicles as identified in recent bridge evaluations undertaken for the British Columbia Ministry of Highways and Infrastructure (MOTI) on major routes. The thickness of these member top flanges have been measured ultra-sonically and found to have lost up to about 15% of their nominal thickness. This corresponds to an 11% loss in structural flexural capacity. The resulting tabulations are presented in Appendix A, together with information on the vehicles use in the evaluation.

The current CHBDC design vehicle is a five axle vehicle of a gross weight of 625 kN (the largest axle load being 175 kN).

The overload vehicles include a 16 and 24 wheel tandem/tridem vehicle and multi-axle (6 axle) mobile crane axles.

The evaluation procedure is specified in Section 14 of the CHBDC.

The members considered were:

- The longitudinal steel stringers spanning 5.6 m between the transverse floor beams—only two occur in the cross section, the other members supporting the roadway deck in this direction being the main span girders (Note: There are also two stringers under the existing sidewalks)
- The floor beam (upon which the stringers bear)
- The stringer and floor beam end connections: rivets and bolts

The results are presented in the last column of Table 1 (Appendix A) and given as a ratio known as live load capacity factor (LLCF), which indicates:

$$\text{LLCF} = \frac{\text{Available live load capacity of the design member or detail}}{\text{Actual design load}}$$

Therefore a number greater than unity 1.0 shows the extent of spare capacity, while less than unity, indicates a measure of a deficiency.

The column "Load Case" identifies the design vehicle being considered. The letters "CL" being the identifier for the CHBDC vehicle; the results are generally acceptable, particularly if the flexural capacity is not reduced by corrosion.

"PS 85" (the tandem/tridem vehicle) and "PA" (being the mobile crane) on centerline are the permit vehicles; results being generally acceptable if a condition of 20 kph speed restriction is imposed. (The Table 1 calculation assumes a traffic speed in excess of 40 kph, but if the permit speed is reduced, in this case to less than 20 kph, the effect of sudden load being applied (technically called the Dynamic Load Allowance factor) is significantly reduced. Thus if this speed limitation is applied, the results trend to an acceptable range.

From the ultra-sonic measurement of the thickness of the top flanges, the flexural capacity of the floor beam was found to be reduced by 11%. The stringers have also lost some material from the top flanges but the measurements taken were anomalous, i.e. on the members sampled, the members showed no loss or even a thickening (although this may be a historical anomaly of supply, with the specified member not being available, therefore a stronger one was used). The previously assumed reduced capacity of 9.34% for the stringers was retained for the evaluation.

The reduced flexural capacity of the floor beams (11% reduction used) and the stringers (9.3% assumed) were input into the evaluation analysis - see Table 1). These produced a live load capacity factor low of 0.82 (less than 1.0). This warrants consideration of introducing a load restriction on the bridge, which can be derived directly from Figure 14.8 of the current Canadian Bridge Code. This limit is GVW of 50 Tonnes (50,000 kg). This GVW is higher than the typical downtown traffic heaviest vehicle, which we believe to be that of (or similar to) a fully loaded Butler Ready Mix Truck of GVW 41,300 kg or the heaviest Fire Department Ladder Truck #1 of 30,900 kg.

4.1.2 Criteria for Limiting Increase in Deck Weight from Proposed Widening

An increase width will involve an increase in deck self-weight, but some limitations need to be considered.

1. A significant increase in overall mass would reduce the effectiveness of the seismic upgrade undertaken earlier.
2. The new mass should not exceed that which governed the original 1956 design of the main steel girders (it being presumed an overall strengthening of these primary members is not contemplated).

The design drawings show that the main girders were designed for a load of 2,550 lbs per linear foot to each girder–effectively 5,100 lbs for the complete deck including concrete, asphalt, metal work (railings, etc.). This load in metric is approximately 74.7 kN per linear metre.

By calculations, the existing complete deck weighs some 66.93 kN. Modifying the deck cross section to provide bicycle lanes and sidewalks, by a design consciously trying to limit the weight, results in a mass of 69.90 kN/m. See cross section shown on SK-2 attached in Appendix B. This mass is approximately the median point of existing and original design limit and considered a reasonable target to comply with.

The deck thickness under the sidewalks, allowed for in the weight calculation, is 130 mm. In using this thickness, the use of stainless steel reinforcement with a reduced cover of 50 mm, is proposed.

Details of this proposed cross section have been reviewed with City staff and are described as follows:

4.1.3 Proposed Cross Section

The proposed cross section (see SK-1 and 2 in Appendix B) provides the required roadway and sidewalk widths.

- Distance between curbs 9.7 m (two bicycle lanes @ 1.8 m and two traffic at 3.05 m)
- A sidewalk structural width of 2.13 m, incorporating 0.3 m for curb and traffic barrier, and 1.83 m for the sidewalk and pedestrian type guardrail

The traffic barrier is of a type specified in the CHBDC and the guardrail shown is that based on the standard MOTI pedestrian design. The traffic barrier/curb is a requirement to limit the possibility of a vehicle reaching the sidewalk, which is not designed for traffic loads. This traffic barrier sets the associated required curb at 178 mm.

Light standards would be located behind the traffic barrier where adequate deck concrete thickness will be appropriate for post anchor bolts. Where light standards are set will result in localised reduction in sidewalk width.

The new deck would be set symmetrically on the main steel work in order to balance the mass equally. Note that the existing roadway centerline is some 0.53 m north of this centerline.

The support of the new curb line requires relocation of the existing sidewalk stringer (or a new member) and an additional stringer close to the outer edges to support the sidewalk. This stringer will require extending the floor beams for its support.

4.1.4 Telephone Ducts

Existing ducts are set in the north sidewalk concrete. This will be demolished as part of the widening. If active ducts are required, these will have to be provided under the deck—possibly accessible from the underdeck access maintenance walkway adjacent to the existing large water main. The existing ducts terminate in the area behind each approach abutment. The City is reviewing existing use of the telephone utilities.

4.1.5 Deck Joints

There are two primary roadway expansion joints at each end of the main span. These are in poor condition and require replacement. The logical time to do this would be when the deck is widened.

There are deck joints at each floor beam, originally these were intended to receive a caulk type seal, which deteriorated with time and was difficult to maintain/repair.

At the time of the seismic upgrade this detail was modified but the drawings do not show how they were modified. Some exploratory work is required to reveal the existing detail in the asphalt.

A design limitation of these joints is that they are all vulnerable to movement, either from vibration or temperature effects. This arises from the original design, which simply set the concrete deck sections on top of the steel work without any obvious mechanical anchorage. Modern decks are all tied to the steel work with shear studs, which cause the concrete and steel members to act as one structural unit.

It is envisaged that new curbs and sidewalks would be reinforced longitudinally, thus locking the slab section under the roadway together.

4.1.5.1 Condition of Existing Deck Concrete

From the underside, the deck concrete appears in good condition. The current concern is revealed on the 1956 deck design drawing, which shows the deck concrete to be 165 mm (6.5") covered by (51 mm) 2" of asphalt. The cover to the reinforcement is given as only 25.4 mm (1"); this is very substandard to modern practice where three times this is normal. The concern is that moisture and salts will have penetrated through this depth to cause corrosion of the reinforcement resulting in delamination of the concrete (i.e., separation of the concrete above the reinforcement from that below caused by the products of corrosion swelling, thus initiating cracking in the horizontal plane.

Evaluation of the deck to determine the presence of delamination and penetration of salt chloride is therefore an initial step in the preparation of any deck widening (and also to know if this is a problem that will need addressing in maintenance), as it will seriously impact the budget contingency and any scheduling.

Where extensive delamination is found, the normal method is to remove that concrete by hydro blasting to 25 mm below the top layer of reinforcement and to replace this with a bonded concrete topping.

In the deck widening process, this would be undertaken with the deck top surface being prepared to receive a waterproofing membrane underneath a new asphalt surface.

An evaluation to determine the occurrence and extent of deck deterioration has been undertaken by Goal Engineering and their report is appended. The method involved is a ground-penetrating radar technique that was be applied without removal of the asphalt. An assessment of the extent of probable delamination is useful for cost estimating purposes and for inclusion in any contract documents.

5.0 PHASING OF THE WORK

Complete closure of the roadway to traffic is the most cost effective when considering construction alone. Factors countering this are:

- Maintenance of pedestrian traffic (any detour being a considerable distance)
- Provision for emergency vehicles, i.e., police, and more particularly, the route of fire trucks from the Bay Street fire hall to Vic West, and for ambulances along Bay Street to the Royal Jubilee Hospital
- Impact on transit routes and schedules

We suggest controlled two-way use of single lane operation as follows for the above traffic.

1. One lane 3.3 m wide on the south side with the south sidewalk open for pedestrian (and possibly dismounted cyclists)
2. Construction traffic barrier on the north side of this lane (0.6 m wide concrete barrier or similar). Remaining use of deck to north approximately 4.6 m wide for 3.0 m construction traffic space, safety barrier 0.3 m, and work space for demolition of north sidewalk and new widening work.
3. Upon completion of sidewalk work, remove asphalt from half of the new roadway width and place new bonded concrete topping.
4. Switch pedestrian and single lane use to north side of deck.
5. Demolish and reconstruct south side of deck.

From a City perspective, we suggest it would be appropriate to schedule the work into a period after completion of the new Johnson Street Bridge. The improved traffic alignment on the west side, and increased provision for cyclists, will mitigate some increase in traffic.

5.1 SETTLEMENT OF THE EAST APPROACH AND LOCALIZED WIDENING

It is considered practical to raise the east end of the approach span to eliminate the existing dip in the roadway.

These spans will need some demolition of their outer beam line to incorporate the proposed deck widening. The sequence of operations would be that adopted for work on the main spans.

The existing wing walls, particularly the one set back from the back of the sidewalk on the south side, are very high and also currently supporting landscape fills. Further fills may present a design issue. This wall could possibly be raised but the uppermost retained fills will need modifying, possibly by replacement with encapsulated polystyrene blocks covered with 0.5 m (plus) of road base to support the new sidewalk. A geotechnical review is required.

6.0 APPROACH ROAD WORKS

The preliminary drawings developed by the City have been developed further to indicate the road work and structures necessary for the increased width sufficient for estimating purposes. These are shown on SK-3 in Appendix B.

7.0 CONSTRUCTION COST ESTIMATE

Stantec's sub consultant, Advicas Cost Consulting, has prepared a construction cost estimate (Appendix C).

Appendix A TABLE 1- POINT ELLICE BRIDGE DECK STRINGERS AND FLOOR BEAM EVALUATION

- Canadian Highway Bridge Design Code – CL-625 Design Truck *(Figure 3.2 CL-W Truck pg. 53)*
- Permit Vehicles, PS Traffic, 8 Axle, 24 Wheel, Tridem Trailer, 85,500 kg *(Appendix C2 – Sketch 1)*
- Permit Vehicles, PA Traffic, Crane (6 axles) *(Appendix C2 – Sketch 2)*

TABLE 1 - POINT ELLICE BRIDGE DECK STRINGERS AND FLOOR BEAM EVALUATION:

— Normal Highway Bridge CL625 Truck in Two Adjacent Lanes
— Single CL Truck on Roadway Centreline
— PS 85 Truck on Roadway Centreline
— PA (Six Axle Crane) on Roadway Centreline

Notes:

1. Load rating method is referenced to CSA - S6 - 06, Section 14
2. Evaluation procedure: ULS method
3. Highway Class A (as per CSA - S6 - 06 Clause 1.4.2.2)
4. Evaluation was carried out for the following three live load models
   CL1 - CL1-625 Truck or Lane Load traffic;
   PS3 - 85.5t PS vehicle, 8 axle truck with a 40t, 24 wheel tridem trailer; and
   PA - PA vehicle, 6 axle Mobile Crane with 12,000 kg axle loads.
5. A 50-mm concrete overlay is included as per existing design
6. Inspection Level considered: “INSP2”
7. Target reliability index from Table 14.5.
8. Dead load factors from Table 14.7.
9. Live load factors from – Table 14.8, for Normal traffic.
   ▪ Table 14.13 for PS vehicles.
   ▪ BC Ministry of Transportation and Infrastructure (Table 1) for PA.
10. Resistance adjustment factor from Table 14.15
11. Live load capacity factor as per Clause 14.15.2.1.
12. Material strength: F_y = 230 MPa for structural steel.
distribution.

				Target reliability index				Dead load											Load Case	Live Load						Resistance		
								Unfact. Loads				Load factors			Fact. loads													
								D1	D2		D3	D1	D2 Deck	D3 Topping	D1	D2 Deck		D3										
Elt. #	Element – Force Effect	Gov. Girder	Effect Units	Syst Behav	Elem Behav	Insp Level	Beta	Beam	Deck		Topping Allowance								Truck Load Governs throughout	DLA Multiplier speed < 40 km/h	Lat Distr.	Type Span	Unfact. Load	Load Coeff	Fact Load	Fact Resist	Adjust Fact	LL Capacity Factor
1	Stringers Interior W 530 x 92 9.3% loss assumed		kN/m	S3	E3	2	2.75	3.73	38.50		11.60	1.06	1.12	1.30	3.95	43.12		12.99	CL	1.30	Static	Short	178.00	1.42	328.59	410.20	1.06	1.14
			kN/m	S3	E3	2	2.75	3.73	38.50		11.60	1.06	1.12	1.30	3.95	43.12		12.99	PS 85 on centreline	1.40	Static	Short	234.00	1.39	455.36	410.20	1.06	0.82
			kN/m	S3	E3	2	2.75	3.73	38.50		11.60	1.06	1.12	1.30	3.95	43.12		12.99	PA on centreline	1.40	Static	Short	148.00	1.19	246.57	410.20	1.06	1.52
2	Floor beams Centre three spans W 760 x 173 with 11% loss of capacity		kN/m	S2	E3	2	3.00	23	126.80		80.53	1.07	1.14	1.35	24.61	144.55		91.80	2 lanes CL	1.40	Static	Short	471.00	1.49	982.51	1048.00	1.06	0.87
			kN/m	S2	E3	2	3.00	23	126.80		80.53	1.07	1.14	1.35	24.61	144.55		91.80	CL on centreline	1.40	Static	Short	338.00	1.49	705.07	1048.00	1.06	1.21
			kN/m	S2	E3	2	3.00	23	126.80		80.53	1.07	1.14	1.35	24.61	144.55		91.80	PS 85 on centreline	1.40	Static	Short	466.80	1.44	941.07	1048.00	1.06	0.90
			kN/m	S2	E3	2	3.00	23	126.80		80.53	1.07	1.14	1.35	24.61	144.55		91.80	PA on centreline	1.40	Static	Short	465.00	1.23	800.73	1048.00	1.06	1.06
3	Floor beams West three spans W 760 x 161 with 11% loss of capacity		kN/m	S2	E3	2	3.00	22.1	110.40		70.10	1.07	1.14	1.35	23.65	125.86		79.91	2 lanes CL	1.40	Static	Short	451.00	1.49	940.79	956.00	1.06	0.83
			kN/m	S2	E3	2	3.00	22.1	110.40		70.10	1.07	1.14	1.35	23.65	125.86		79.91	CL on centreline	1.40	Static	Short	323.00	1.49	673.78	956.00	1.06	1.16
			kN/m	S2	E3	2	3.00	22.1	110.40		70.10	1.07	1.14	1.35	23.65	125.86		79.91	PS 85 on centreline	1.40	Static	Short	450.70	1.44	908.61	956.00	1.06	0.86
			kN/m	S2	E3	2	3.00	22.1	110.40		70.10	1.07	1.14	1.35	23.65	125.86		79.91	PA on centreline	1.40	Static	Short	410.10	1.23	706.19	956.00	1.06	1.11
4	Stringers shear		kN	S3	E3	2	2.75	2.6	26.85		8.09	1.06	1.12	1.30	2.76	30.07		9.06	CL	1.30	Static	Short	144.00	1.49	278.93	685.00	1.02	2.35
			kN	S3	E3	2	2.75	2.6	26.85		8.09	1.06	1.12	1.30	2.76	30.07		9.06	PS 85 on centreline	1.40	Static	Short	184.50	1.44	371.95	685.00	1.02	1.77
			kN	S3	E3	2	2.75	2.6	26.85		8.09	1.06	1.12	1.30	2.76	30.07		9.06	PA on centreline	1.40	Static	Short	128.50	1.23	221.28	685.00	1.02	2.97

Designer/Evaluator: A.J. Rushforth, P.Eng.______________________________ Checker: P.J. Dudzinski, P.Eng.______________________________________

				Target reliability index				Dead load											Load Case	Live Load						Resistance		
								Unfact. Loads				Load factors			Fact. loads													
Elt. #	Element – Force Effect	Gov. Girder	Effect Units	Syst Behav	Elem Behav	Insp Level	Beta	D1 Beam	D2 Deck		D3 Topping Allowance	D1	D2 Deck	D3 Topping	D1	D2 Deck		D3	Truck Load Governs throughout	DLA Multiplier speed < 40 km/h	Lat Distr.	Type Span	Unfact. Load	Load Coeff	Fact Load	Fact Resist	Adjust Fact	LL Capacity Factor
5	Stringers end connection (rivets shear)		kN	S3	E3	2	2.75	2.6	26.85		8.09	1.06	1.12	1.30	2.76	30.07		9.06	2 lanes CL	1.40	Static	Short	144.00	1.49	300.38	760.00	1.20	2.90
			kN	S3	E3	2	2.75	2.6	26.85		8.09	1.06	1.12	1.30	2.76	30.07		9.06	PS 85 on centreline	1.40	Static	Short	184.50	1.44	371.95	760.00	1.20	2.34
			kN	S3	E3	2	2.75	2.6	26.85		8.09	1.06	1.12	1.30	2.76	30.07		9.06	PA on centreline	1.40	Static	Short	128.50	1.23	221.28	760.00	1.20	3.93
6	Floor beam shear Centre three spans		kN	S2	E3	2	3.00	11.2	53.70		16.90	1.07	1.14	1.35	11.98	61.22		19.27	2 lanes CL	1.40	Static	Short	249.00	1.49	519.41	1383.00	1.02	2.54
			kN	S2	E3	2	3.00	11.2	53.70		16.90	1.07	1.14	1.35	11.98	61.22		19.27	CL on centreline	1.40	Static	Short	128.00	1.49	267.01	1383.00	1.02	4.94
			kN	S2	E3	2	3.00	11.2	53.70		16.90	1.07	1.14	1.35	11.98	61.22		19.27	PS 85 on centreline	1.40	Static	Short	174.00	1.44	350.78	1383.00	1.02	3.76
			kN	S2	E3	2	3.00	11.2	53.70		16.90	1.07	1.14	1.35	11.98	61.22		19.27	PA on centreline	1.40	Static	Short	198.50	1.23	341.82	1383.00	1.02	3.86
7	Floor beam rivets Centre three spans		kN	S2	E3	2	3.00	11.2	53.70		16.90	1.07	1.14	1.35	11.98	61.22		19.27	2 lanes CL	1.40	Static	Short	249.00	1.49	519.41	1370.00	1.20	2.99
			kN	S2	E3	2	3.00	11.2	53.70		16.90	1.07	1.14	1.35	11.98	61.22		19.27	CL on centreline	1.40	Static	Short	128.00	1.49	267.01	1370.00	1.20	5.81
			kN	S2	E3	2	3.00	11.2	53.70		16.90	1.07	1.14	1.35	11.98	61.22		19.27	PS 85 on centreline	1.40	Static	Short	174.00	1.44	350.78	1370.00	1.20	4.42
			kN	S2	E3	2	3.00	11.2	53.70		16.90	1.07	1.14	1.35	11.98	61.22		19.27	PA on centreline	1.40	Static	Short	198.50	1.23	341.82	1370.00	1.20	4.54
8	West three spans Shear		kN	S2	E3	2	3.00	9.71	46.60		14.70	1.07	1.14	1.35	10.39	53.12		16.76	2 lanes CL	1.40	Static	Short	238.00	1.49	496.47	1383.00	1.02	2.68
			kN	S2	E3	2	3.00	9.71	46.60		14.70	1.07	1.14	1.35	10.39	53.12		16.76	CL on centreline	1.40	Static	Short	123.00	1.49	256.58	1383.00	1.02	5.19
			kN	S2	E3	2	3.00	9.71	46.60		14.70	1.07	1.14	1.35	10.39	53.12		16.76	PS 85 on centreline	1.40	Static	Short	168.00	1.44	338.69	1383.00	1.02	3.93
			kN	S2	E3	2	3.00	9.71	46.60		14.70	1.07	1.14	1.35	10.39	53.12		16.76	PA on centreline	1.40	Static	Short	175.00	1.23	301.35	1383.00	1.02	4.41
9	West three spans Rivets		kN	S2	E3	2	3.00	9.71	46.60		14.70	1.07	1.14	1.35	10.39	53.12		16.76	2 lanes CL	1.40	Static	Short	238.00	1.49	496.47	1370.00	1.20	3.15
			kN	S2	E3	2	3.00	9.71	46.60		14.70	1.07	1.14	1.35	10.39	53.12		16.76	CL on centreline	1.40	Static	Short	123.00	1.49	256.58	1370.00	1.20	6.09
			kN	S2	E3	2	3.00	9.71	46.60		14.70	1.07	1.14	1.35	10.39	53.12		16.76	PS 85 on centreline	1.40	Static	Short	168.00	1.44	338.69	1370.00	1.20	4.62
			kN	S2	E3	2	3.00	9.71	46.60		14.70	1.07	1.14	1.35	10.39	53.12		16.76	PA on centreline	1.40	Static	Short	175.00	1.23	301.35	1370.00	1.20	5.19

3.8.3.2 CL-W Truck

The CL-W Truck is the idealized five-axle truck shown in Figure 3.2. The *W* number indicates the gross load of the CL-W Truck in kilonewtons. Wheel and axle loads are shown in terms of *W* and are also shown for the CL-625 Truck.

The wheel spacings, weight distribution, and clearance envelope of the CL-W Truck shall be as shown in Figure 3.2.

In Ontario, a CL-625-ONT Truck as specified in Annex A3.4 shall be used.

Note: *The total load of the CL-625-ONT Truck is* 625 kN, *but the axle load distribution differs from that shown in Figure 3.2.*

The CL-W and the CL-625-ONT Truck shall be placed centrally in a space 3.0 m wide that represents the clearance envelope for each Truck, unless otherwise specified by the Regulatory Authority or elsewhere in this Code.

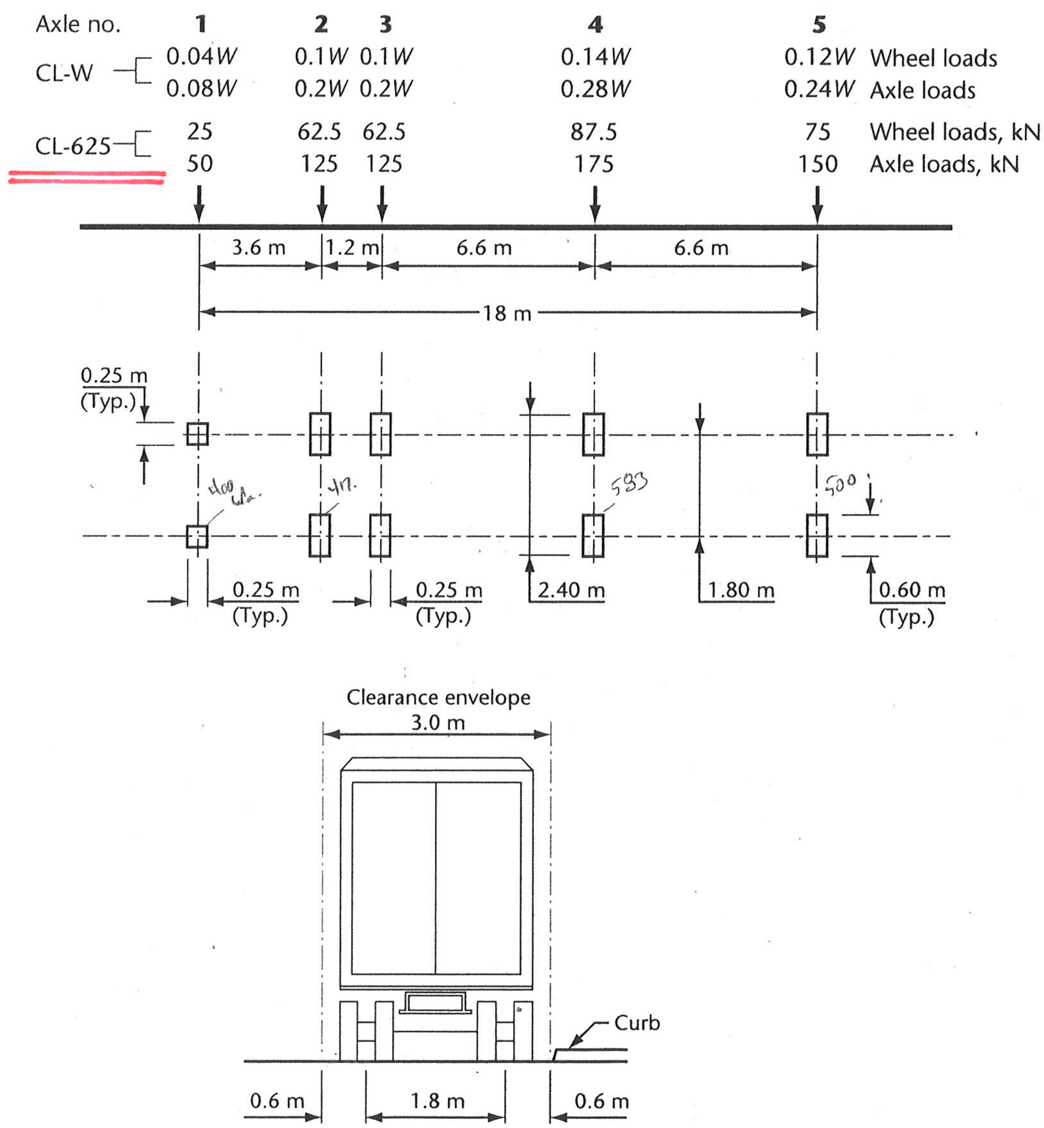
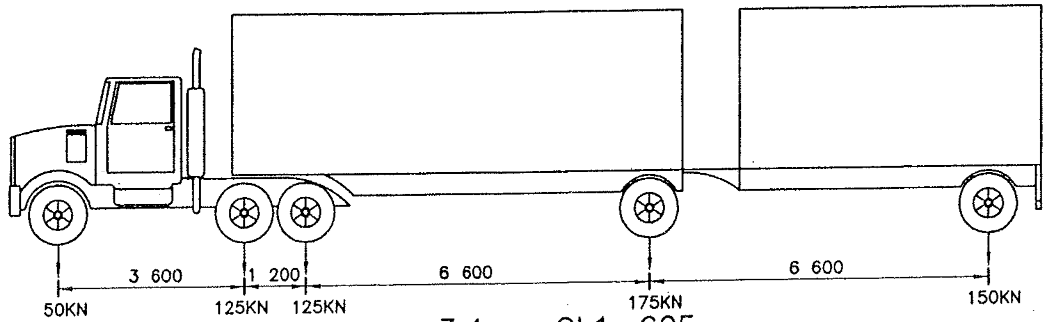
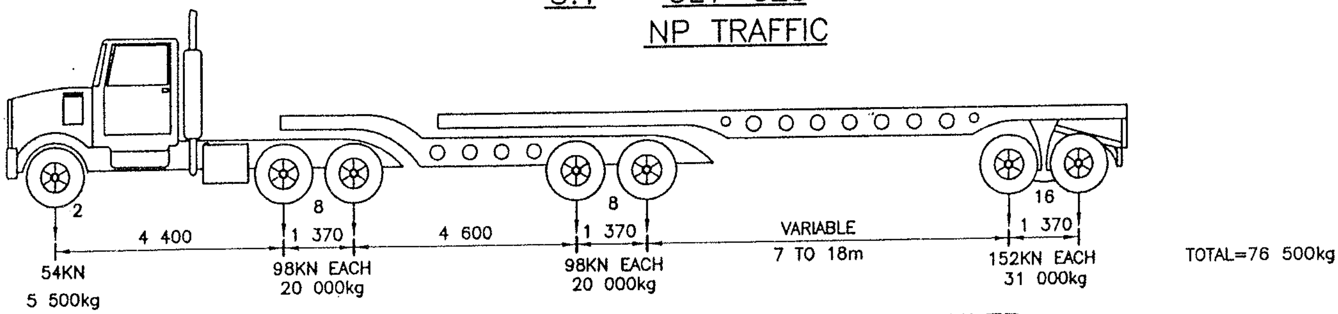


Figure 3.2
CL-W Truck
(See Clause 3.8.3.2.)

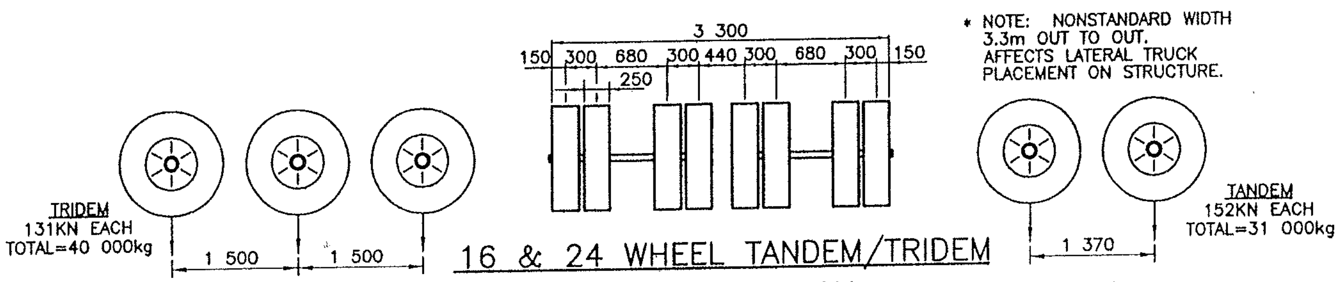
85 TONNE CEILING G.V.W. RATING TRUCKS



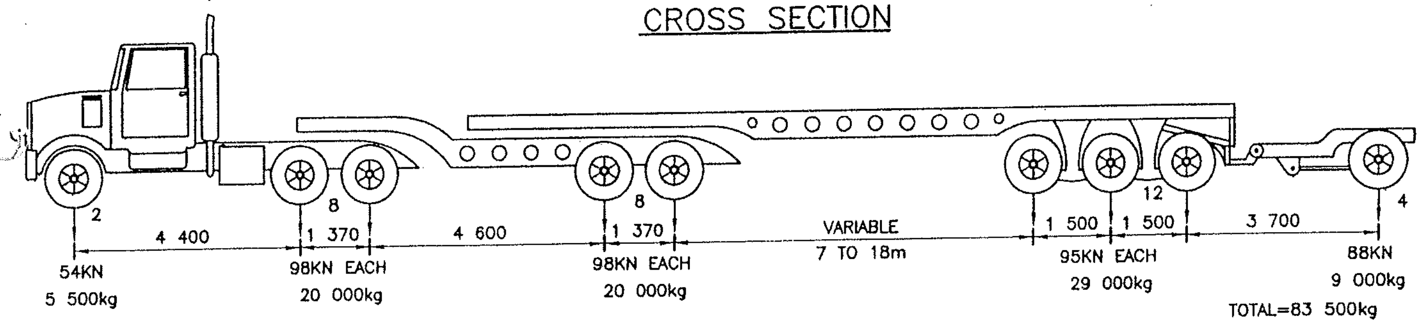
3.1 – CL1–625
NP TRAFFIC



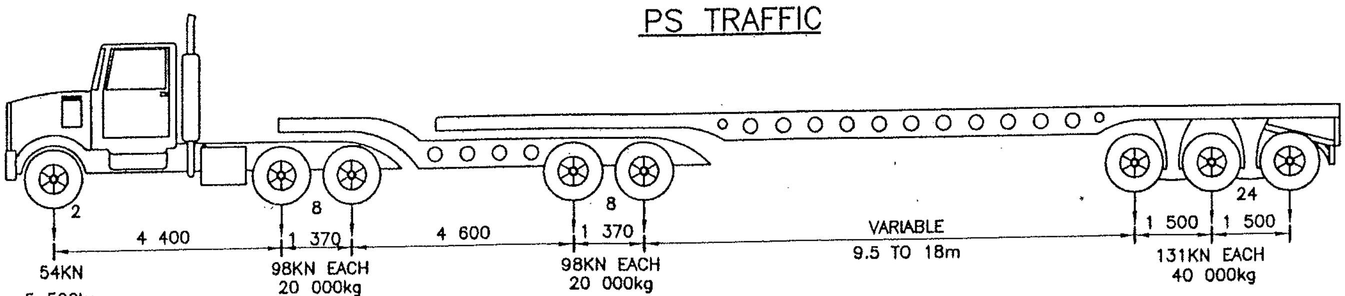
3.2 – 7 AXLE 16 WHEEL TANDEM TRAILER
PS TRAFFIC



16 & 24 WHEEL TANDEM/TRIDEM
CROSS SECTION



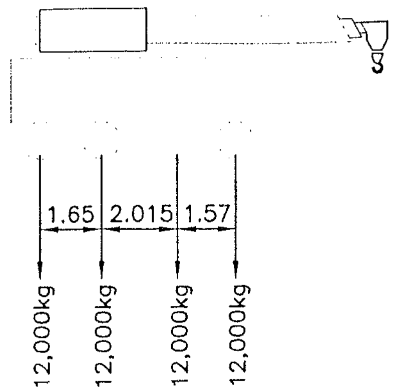
3.3 – 9 AXLE FULL PERMIT VEHICLE
PS TRAFFIC



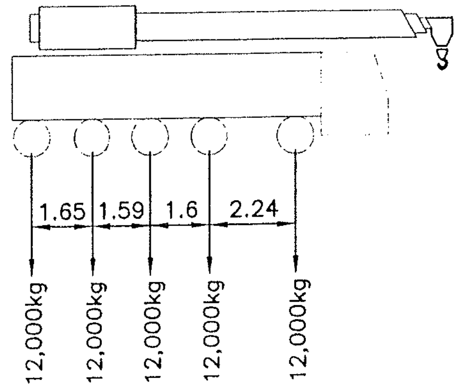
3.4 – 8 AXLE 24 WHEEL TRIDEM TRAILER
PS TRAFFIC

BRIDGE ENGINEERING SECTION
REVISED NOV/07 WHK

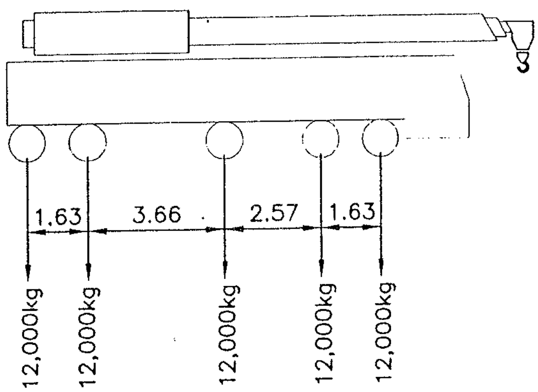
ANNUAL PERMIT CRANES



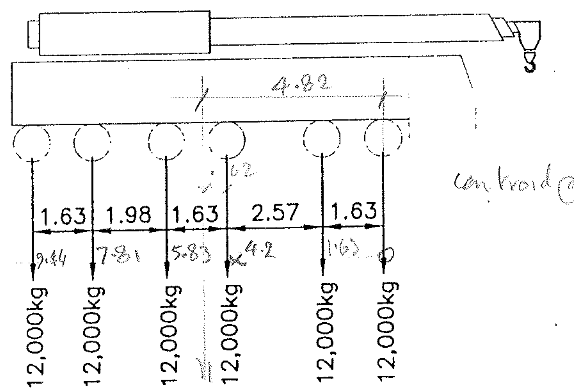
Crane–4ax



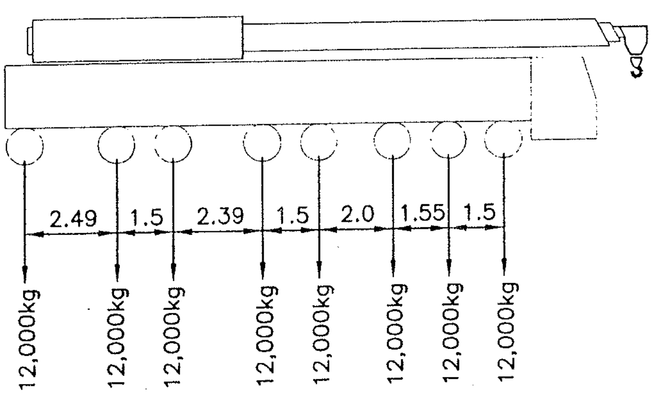
Crane–5ax



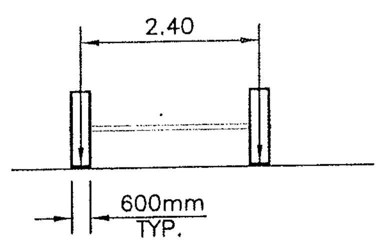
Crane–Long 5ax



Crane–6ax



Crane–8ax



Transverse Dimension Between ℄'s of Wheels (Typical All Cranes) = 2.4m

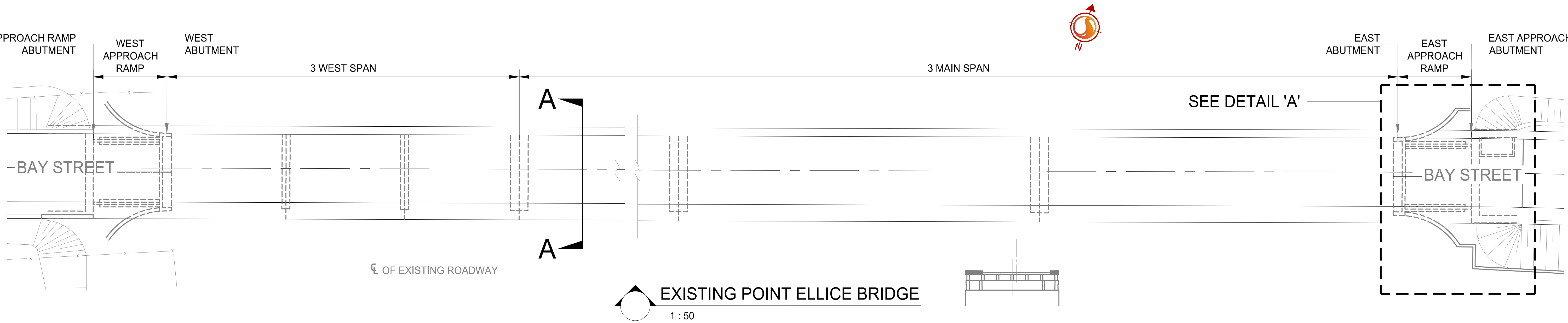
PA VEHICLES

MARCH 2007

APPENDIX C2 – SKETCH 2

Appendix B DRAWINGS

- SK-1 Proposed Widening Plan, Sections
- SK-2 Proposed Widening Typical Section Details
- SK-3 Conceptual Design – Civil Road Works Plan and Sections



EXISTING POINT ELLICE BRIDGE

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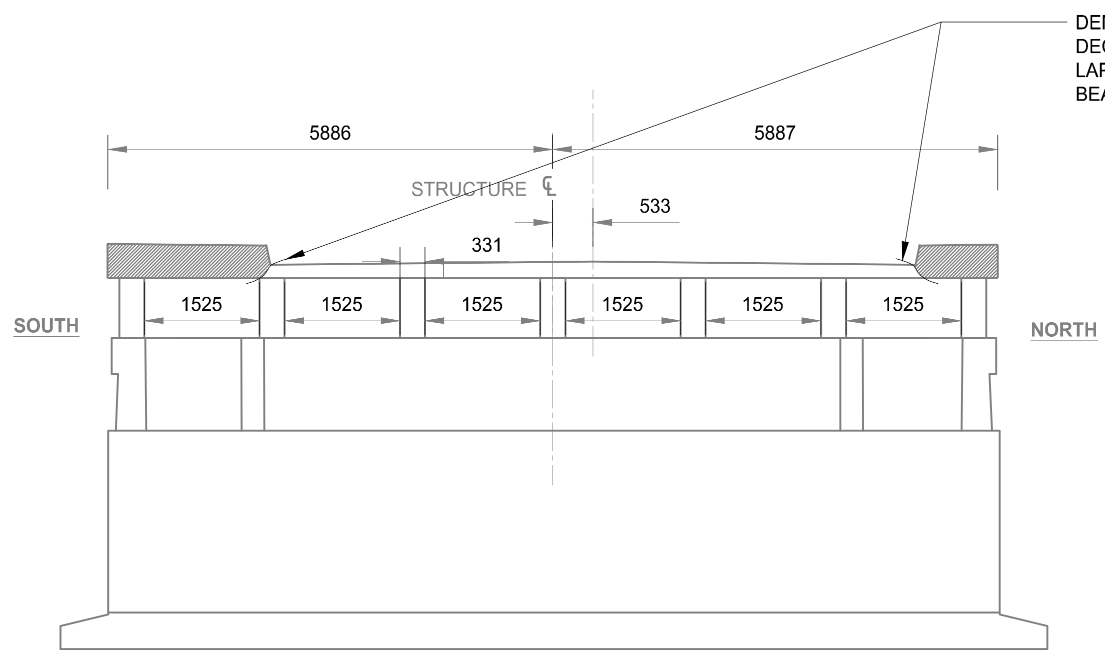

B-1 EXISTING SECTION AT WEST APPROACH ABUTMENT

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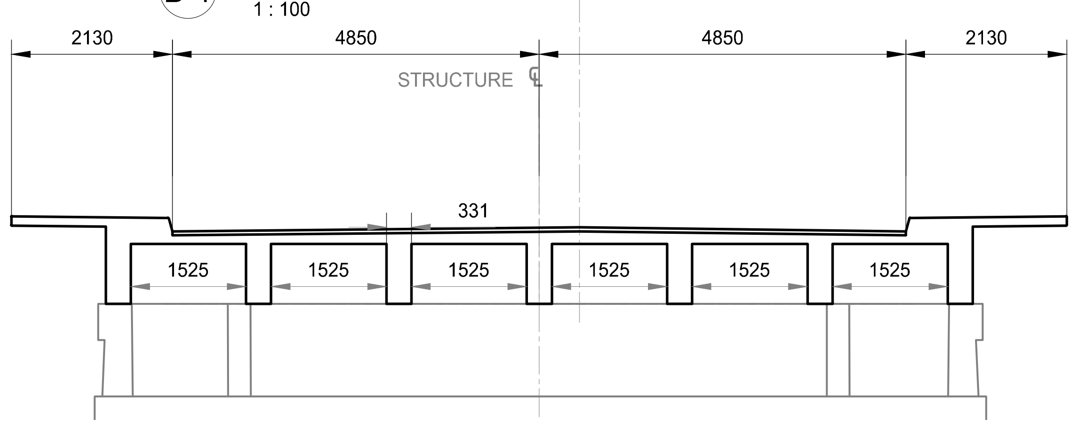

B-2 PROPOSED SECTION AT WEST APPROACH ABUTMENT

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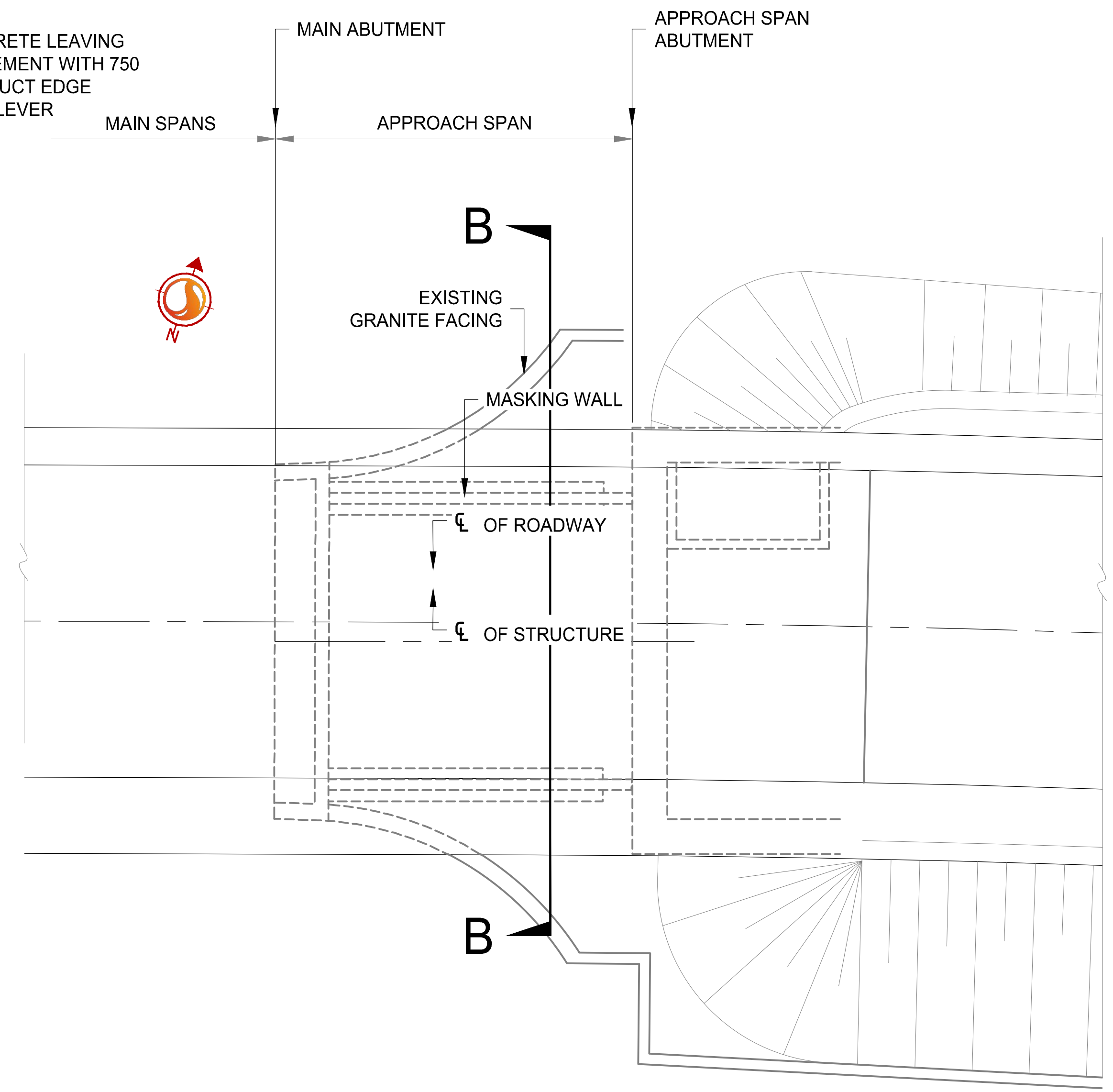

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Stantec Consulting Ltd.
400 655 Tyee Road
Victoria BC Canada
V9A 6X5
Tel. 250.388.9161
Fax. 250.382.0514
www.stantec.com

Client/Project
CITY OF VICTORIA

PROPOSED POINT ELLICE BRIDGE WIDENING

Title
PLAN, SECTIONS

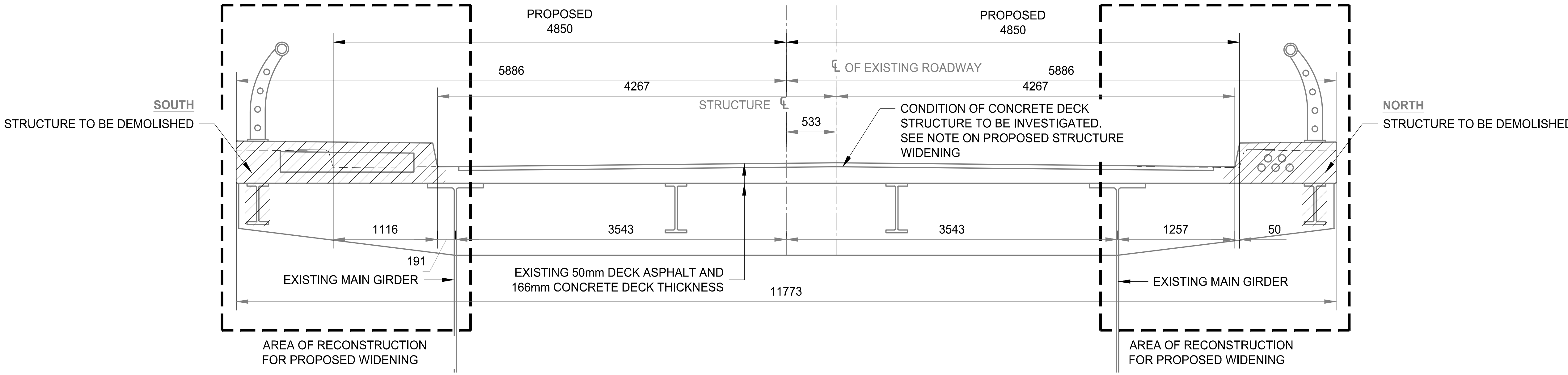
Project No.

Scale
AS SHOWN

Drawing No.
SK-1

Sheet
1 of 1

Revision



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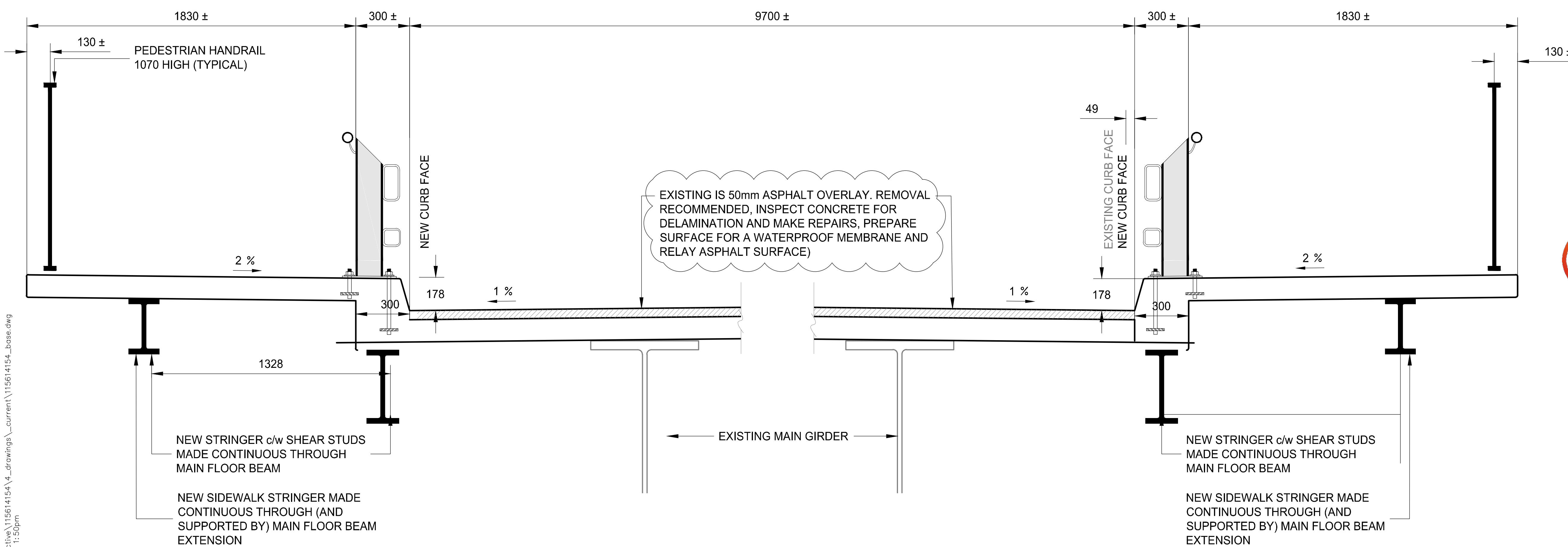

PROPOSED
STRUCTURE WIDENING
B
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ORIGINAL SHEET - 11x17

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PROPOSED POINT ELLICE BRIDGE WIDENING

Title
TYPICAL SECTIONS DETAILS

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	AS SHOWN	
Drawing No.	**Sheet**	**Revision**
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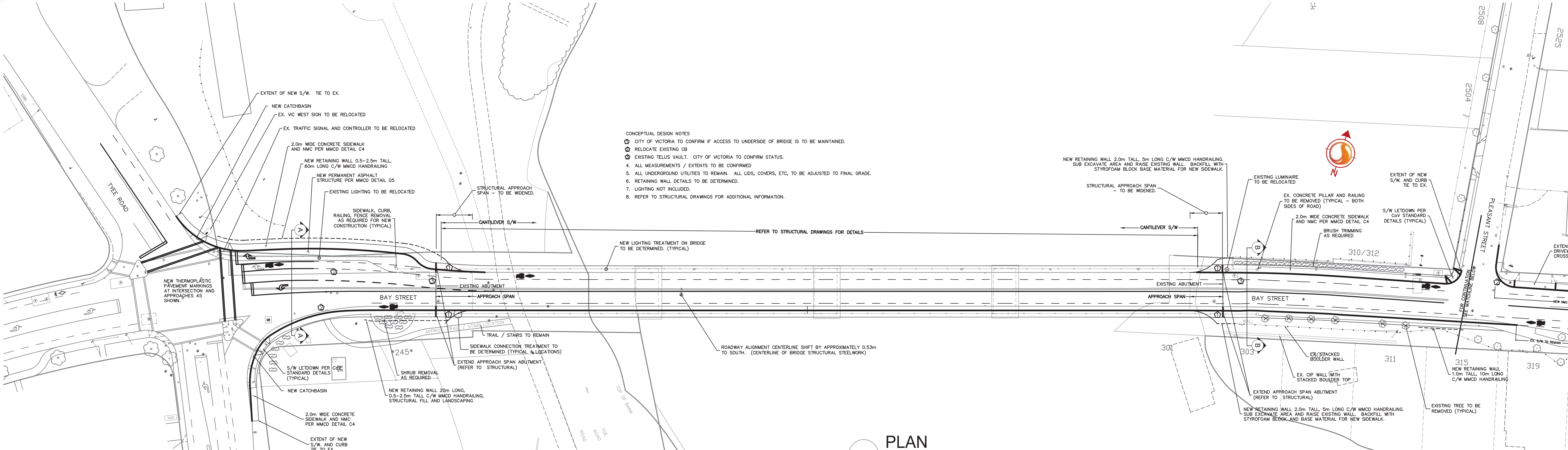

PLAN

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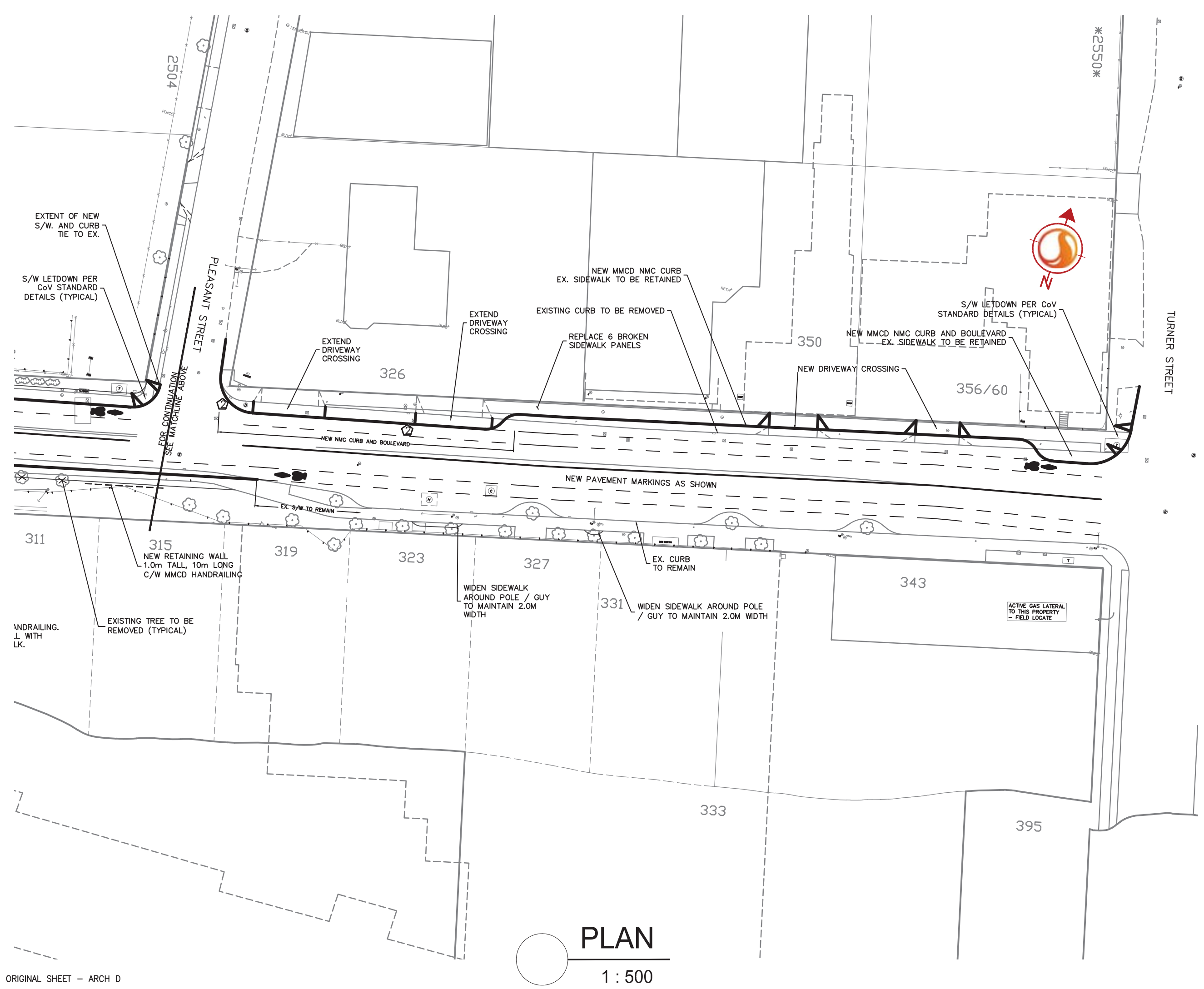
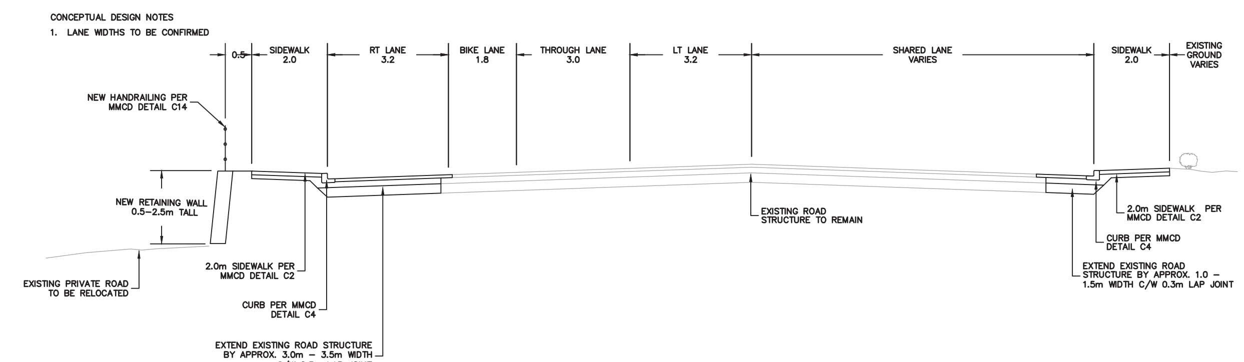


PLAN

1 : 500



SECTION AT WEST APPROACH

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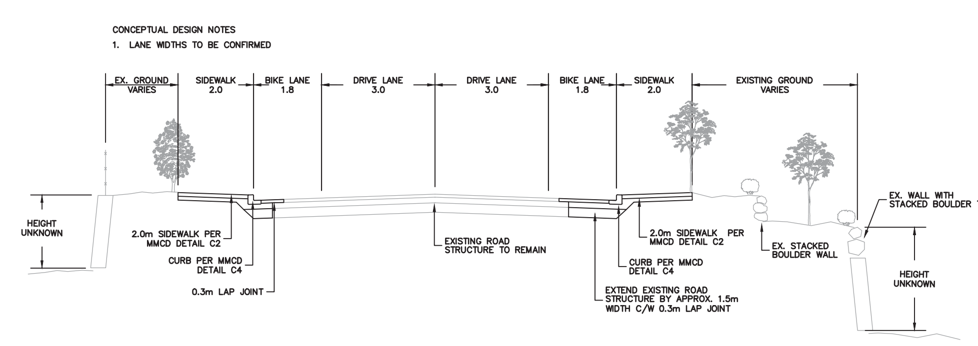

SECTION AT EAST APPROACH

1 : 100

CONCEPTUAL DESIGN ONLY
FOR DISCUSSION PURPOSES

Stantec Consulting Ltd.
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Client/Project

CITY OF VICTORIA

PROPOSED POINT ELLICE BRIDGE WIDENING

Prepared By: TAZ Date: May 12, 2014

Title

CONCEPTUAL DESIGN
CIVIL - PLAN AND SECTIONS

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ORIGINAL SHEET – ARCH D

Appendix C COST CONSULTANT REPORTS

- Class D Concept Estimate dated July 14, 2014
- Class D Concept Estimate dated November 17, 2014

Professional Quantity Surveyors
Sustainability Consultants

CLASS D CONCEPT ESTIMATE

POINT ELLICE BRIDGE WIDENING,

VICTORIA, BC

July 14, 2014

Prepared by
Advicas Group Consultants Inc.

#100-31 Bastion Square
Victoria, BC V8W 1J1 Canada

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APPENDICES

INTRODUCTION

This report sets out the estimate of project cost at concept design stage for the proposed Point Ellice Bridge Widening, Victoria, BC.

ESTIMATE COSTS

The estimate costs have been developed in current (July, 2014) dollars. The project cost is as follows:

	Cost
Design and Management	$2,173,000
Base Building Construction	$10,865,000
Fittings and Equipment	$0
Correlated Costs	$285,813
Contingency Reserves	$1,195,150
City of Victoria Costs	$726,037
TOTALS	**$15,245,000**

A project cost summary is included in Appendix A

A capital construction cost estimate summary and back up sheets is included in Appendix B

Escalation

The estimate is priced at current market price levels.

It is common knowledge that Victoria saw a major correction in market price levels during the latter part of 2008 and early 2009. A further downward correction occurred in Spring, 2010 driven by pressure on pricing levels from mainland contractors pursuing work in Victoria.

While there has been varying opinion on timing for a resurgence in the construction market, to date this has not occurred. We believe there will be a sustained upward movement in market price levels commencing in the latter part of 2014. As such we recommend that provision be made for escalation, commencing in the fourth quarter 2014, at 0.25% per month (3% range, per annum).

We recommend annual re-evaluation of the estimate to reflect the expected upward movement in market price levels and to ensure the budget remains appropriate for completion of the work.

BASIS OF THE ESTIMATE

We have assumed that the work will be tendered competitively in one contract.

In all cases the estimates are based upon our assessment of fair value for the work to be carried out. We define fair value as the amount a prudent contractor, taking into account all aspects of the project, would quote for the work. We expect our estimate to be in the middle of the bid range to ensure that funding for the work remains adequate for the duration of the project.

It should be noted that Advicas Group Consultants Inc. does not have control over the cost of labour, materials, or equipment, over the Contractor's methods of determining bid prices, or over competitive market conditions. We define competitive conditions in the project as attracting a minimum of four general contractors' bids with a minimum of two sub-trade tenders within each of the sub-trade categories. Accordingly, Advicas Group Consultants Inc. cannot and does not warrant or represent that bids will not vary from the estimate.

Contingency Reserves

Contingency is an allowance specifically identified within our elemental cost analysis to meet unforeseen circumstances, and represents an assessment of the financial risk relating to this project. As detailed design information becomes available, this risk will diminish and the contingency allowances will accordingly reduce.

Design contingency is introduced into the estimated cost at the earliest estimate stage and is a measurement of the amount and detail of the design information available. As the design develops and systems and material selections are fixed, the amount of the contingency allowance is reduced and is absorbed into the measured elements. On completion of contract documents, at tender stage, the allowance is normally reduced to zero.

Our determination of this risk level and the amount of the contingency allowance is the result of many years of cost planning, on over 2,000 construction projects, and of monitoring the increasing design information that occurs during the design phase. The design contingency is not a discretionary cost element.

A design contingency allowance has been included, calculated at 20% of the construction costs, to provide for unforeseen items arising during the design phase.

A construction contingency allowance has been included, calculated at 10% of the construction costs. This typically provides for unforeseen items arising during the construction period – such as field conditions, coordination discrepancies – which will result in change orders and extra costs to the contract, other than changes in scope.

No allowance has been made for project contingency, which typically provides for changes in program, scope and other Client requests.

Taxes

GST is excluded from the estimate.

On August 26, 2011 HST was defeated through public referendum. British Columbia returned to Provincial Sales Tax and Goods and Services Tax on April 1, 2013. 7% Provincial Sales Tax has been included in the estimate.

Exclusions

The following items are excluded from the capital construction cost:

- Fittings and equipment
  - Vending machines
  - Closed circuit TV
- Rock excavation
- Site furniture
- Site signage
- Clerk of Works
- Premium costs associated with environmental contaminants
- Traffic study costs
- Survey fees

- Financing costs
- Phasing of the work
- Out of hours working
- Escalation
- GST

Documentation

The estimate is based on the following:

- Stantec
  - Conceptual design civil plan and sections – drawing nos. SK1, SK2, SK3
  - Sections and detail drawings prepared by A. B. Sanderson and Company Ltd for the current bridge. All received April 7, 2014

- A briefing meeting with Andrew Rushforth on April 7, 2014, and telephone discussions during the preparation of the estimate

APPENDIX A

PROJECT COST SUMMARY

Point Ellice Bridge Widening,
Victoria, BC

Date: July 14, 2014

CLASS D CONCEPT ESTIMATE - PROJECT COST

Design and Management			
Architect and design consultants	15.00%	$1,629,750	
Consultant disbursements			
Project Manager	5.00%	$543,250	
Pre-planning			$2,173,000
Base Building Construction			
Net Construction Cost	1.00%	$6,964,400	
General Contractor's overhead and profit	1.00%	$2,089,320	
Design contingency	1.00%	$1,811,280	$10,865,000
Fittings and Equipment			$0
Correlated Costs			
Permits, DCCs		$135,813	
Legal		$25,000	
Insurances		$25,000	
Commissioning		$100,000	$285,813
Contingency Reserves			
Design and management fees	5.00%	$108,650	
Construction and fit out	10.00%	$1,086,500	$1,195,150
SUB TOTAL			**$14,518,963**
City of Victoria Costs	5.00%	$726,037	
Finance and working capital		excl	
Escalation		excl	
Goods and Services Tax		excl	$726,037
PROJECT COST PLAN (Current Dollars)			**$15,245,000**

APPENDIX B

CAPITAL CONSTRUCTION COST ESTIMATE SUMMARY AND BACK UP

	QUANTITY	UNIT	RATE	COST
SUMMARY - TOTAL CAPITAL CONSTRUCTION COST				**$10,865,000**
Main Suspended Bridge Span				**$4,284,100**
Suspended Approach Spans - EAST & WEST				**$505,700**
Abutment Extensions - EAST & WEST				**$362,500**
On Grade Approach - EAST				**$538,800**
On Grade Approach - WEST				**$1,273,300**
General Conditions				**$2,089,320**
Design Contingency	**20%**			**$1,811,280**
Main Suspended Bridge Span				$4,284,100
Demolish pedestrian pipe handrail	360	m	$50.00	$18,000
Remove existing lighting poles	1	sum	$4,000.00	$4,000
Demolish concrete pedestrian sidewalk and curb	283	m³	$765.00	$216,495
Saw cut existing 165mm thick concrete road deck and reinforcement bar	360	m	$75.00	$27,000
Break up existing asphalt paving to road deck	1,350	m²	$30.00	$40,500
Break up existing 165mm thick concrete road base and expose reinforcement bar	270	m²	$300.00	$81,000
Premium for removing existing drainage	1	sum	$5,000.00	$5,000
Remove existing 16 x 36 outrigger beam and connection plates and prepare for new	360	m	$150.00	$54,000
Clean edge of existing road deck, exposed reinforcement bar and exposed shear studs to main girder beam	360	m	$100.00	$36,000
Strip off lead paint to underside of existing steel deck and prepare for new	4,577	m²	$100.00	$457,700
New W410 x 67 stringer beam	24,120	kg	$10.00	$241,200
New W310 x 60 stringer beam	21,600	kg	$10.00	$216,000
Grind existing fin plates	147	m	$150.00	$22,050
Steel connection plates including weld to existing	6,858	kg	$25.00	$171,450
Shear studs	2,400	no	$15.00	$36,000
165mm thick suspended concrete road deck	467	m²	$115.00	$53,705
Concrete in curb	25	m³	$350.00	$8,750
140mm thick suspended concrete pedestrian deck	878	m²	$105.00	$92,190
Formwork to:				
- road deck soffit	467	m²	$750.00	$350,250
- soffit upstand	83	m²	$750.00	$62,250
- splayed curb	83	m²	$250.00	$20,750
- pedestrian deck soffit	600	m²	$750.00	$450,000
- edge of pedestrian deck	55	m²	$750.00	$41,250
Reinforcement bar	110,545	kg	$3.50	$386,908
50mm asphalt paving	1,764	m²	$25.00	$44,100
New catchbasins and drains to edge of deck	1	sum	$100,000.00	$100,000
New road barrier/handrail	360	m	$1,500.00	$540,000
New pedestrian handrail	360	m	$800.00	$288,000
New expansion joint to road deck	20	m	$350.00	$7,000
New expansion joint to pedestrian deck	4	m	$350.00	$1,400
Paint underside of existing steel deck	4,577	m²	$35.00	$160,195
New lighting	1	sum	$50,000.00	$50,000
Line painting	1	sum	$1,000.00	$1,000

	QUANTITY	UNIT	RATE	COST
Suspended Approach Spans - EAST & WEST				**$505,700**
Demolish pedestrian pipe handrail	40	m	$50.00	$2,000
Remove existing lighting poles	1	sum	$2,000.00	$2,000
Demolish concrete pedestrian sidewalk and curb	32	m³	$765.00	$24,480
Saw cut existing 165mm thick concrete road deck and reinforcement bar	40	m	$75.00	$3,000
Break up existing asphalt paving to road deck	150	m²	$30.00	$4,500
Break up existing 165mm thick concrete road base and expose reinforcement bar	30	m²	$300.00	$9,000
Premium for removing existing drainage	1	sum	$2,000.00	$2,000
Clean edge of existing road deck and exposed reinforcement bar	40	m	$150.00	$6,000
165mm thick suspended concrete road deck	84	m²	$115.00	$9,660
380mm thick suspended concrete pedestrian deck/curb	34	m²	$165.00	$5,610
140mm thick suspended concrete pedestrian deck	38	m²	$105.00	$3,990
Concrete in drop beams	22	m³	$350.00	$7,700
Formwork to:				
- beam soffit	28	m²	$750.00	$21,000
- deck soffit	128	m²	$750.00	$96,000
- beam sides	128	m²	$750.00	$96,000
- soffit upstand	10	m²	$750.00	$7,500
- splayed curb	10	m²	$350.00	$3,500
- edge of pedestrian deck	6	m²	$750.00	$4,500
Reinforcement bar	17,190	kg	$3.50	$60,165
50mm asphalt paving	192	m²	$25.00	$4,800
New catchbasins and drains to edge of deck	1	sum	$10,000.00	$10,000
New road barrier/handrail	40	m	$1,500.00	$60,000
New pedestrian handrail	40	m	$800.00	$32,000
New expansion joint to road deck	20	m	$350.00	$7,000
New expansion joint to pedestrian deck	8	m	$350.00	$2,800
New lighting	1	sum	$20,000.00	$20,000
Line painting	1	sum	$500.00	$500
Abutment Extensions - EAST & WEST				**$362,500**
Abutment foundation:				
- south west	5	m	$5,000.00	$25,000
- north west	5	m	$5,000.00	$25,000
- south east	5	m	$5,000.00	$25,000
- north east	5	m	$5,000.00	$25,000
Abutment wall				
- south west	10	m²	$2,500.00	$25,000
- north west	10	m²	$2,500.00	$25,000
- south east	20	m²	$2,500.00	$50,000
- north east	25	m²	$2,500.00	$62,500
Tie into existing abutments	1	sum	$100,000.00	$100,000

	QUANTITY	UNIT	RATE	COST
On Grade Approach - EAST				**$538,800**
Remove existing trees	6	no	$500.00	$3,000
Break up existing concrete sidewalk	240	m²	$50.00	$12,000
Break up existing concrete curb	120	m	$40.00	$4,800
Break up existing roadbase	60	m²	$30.00	$1,800
Saw cut road base	120	m	$75.00	$9,000
Break up existing asphalt paving	392	m²	$30.00	$11,760
Strip/excavate existing landscape areas to new formation level including imported fill as required	1	sum	$25,000.00	$25,000
New roadbase	240	m²	$45.00	$10,800
New concrete curb	120	m	$75.00	$9,000
New pedestrian paving	240	m²	$80.00	$19,200
New asphalt paving	576	m²	$25.00	$14,400
New catchbasins and drains to edge of deck	1	sum	$30,000.00	$30,000
New road barrier/handrail	120	m	$1,500.00	$180,000
New pedestrian handrail	120	m	$800.00	$96,000
New lighting	1	sum	$10,000.00	$10,000
Line painting	1	sum	$2,000.00	$2,000
Make good new to existing	1	sum	$50,000.00	$50,000
New landscaping	1	sum	$50,000.00	$50,000
On Grade Approach - WEST				**$1,273,300**
West Approach - North Side:				
Demolish pedestrian pipe handrail	54	m	$50.00	$2,700
Break up existing concrete sidewalk	104	m²	$50.00	$5,200
Break up existing concrete curb	72	m	$40.00	$2,880
Saw cut road base	72	m	$75.00	$5,400
Break up existing asphalt paving	700	m²	$30.00	$21,000
Strip/excavate existing landscape areas to new formation level including imported fill as required	1	sum	$75,000.00	$75,000
New retaining wall:				
- foundation	70	m	$1,500.00	$105,000
- wall	175	m²	$1,000.00	$175,000
Imported fill to make up levels	710	m³	$80.00	$56,800
New roadbase	242	m²	$45.00	$10,890
New concrete curb	81	m	$75.00	$6,075
New pedestrian paving	162	m²	$80.00	$12,960
New asphalt paving	918	m²	$25.00	$22,950
New catchbasins and drains	1	sum	$30,000.00	$30,000
New road barrier/handrail	52	m	$1,500.00	$78,000
New pedestrian handrail	70	m	$800.00	$56,000
Relocate existing lighting	1	sum	$10,000.00	$10,000
Line painting	1	sum	$2,000.00	$2,000
Make good new to existing	1	sum	$50,000.00	$50,000
New landscaping	1	sum	$50,000.00	$50,000
Relocate existing Vic West sign	1	sum	$1,500.00	$1,500
Relocate existing traffic control and signaler	1	sum	$75,000.00	$75,000

	QUANTITY	UNIT	RATE	COST
West Approach - South Side:				
Demolish pedestrian pipe handrail	45	m	$50.00	$2,250
Break up existing concrete sidewalk	121	m²	$50.00	$6,050
Break up existing concrete curb	67	m	$40.00	$2,680
Saw cut road base	67	m	$75.00	$5,025
Break up existing asphalt paving				incl above
Strip/excavate existing landscape areas to new formation leve	1	sum	$75,000.00	$75,000
New retaining wall:				
- foundation	20	m	$1,500.00	$30,000
- wall	40	m²	$1,000.00	$40,000
Imported fill to make up levels	90	m³	$80.00	$7,200
New roadbase	67	m²	$45.00	$3,015
New concrete curb	67	m	$75.00	$5,025
New pedestrian paving	134	m²	$80.00	$10,720
New asphalt paving				incl above
New catchbasins and drains	1	sum	$30,000.00	$30,000
New road barrier/handrail	36	m	$1,500.00	$54,000
New pedestrian handrail	45	m	$800.00	$36,000
Relocate existing lighting	1	sum	$10,000.00	$10,000
Line painting	1	sum	$2,000.00	$2,000
Make good new to existing	1	sum	$50,000.00	$50,000
New landscaping	1	sum	$50,000.00	$50,000

advicas

Professional Quantity Surveyors
Sustainability Consultants

CLASS D CONCEPT ESTIMATE

POINT ELLICE BRIDGE REPAIRS AND REPAINTING,

VICTORIA, BC

November 17, 2014

Prepared by
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APPENDICES

INTRODUCTION

This report sets out the estimate of project cost at concept design stage for the proposed Point Ellice Bridge Repairs and Repainting, Victoria, BC.

The work has been separated into two contracts comprising:

- Contract #1 – cathodic protection, concrete deck repairs and repaving
- Contract #2 – removing lead paint and repainting exposed steel bridge structure, pedestrian handrails and lighting poles

ESTIMATE COSTS

The estimate costs have been developed in current (November, 2014) dollars. The project costs are as follows:

Contract #1	$1,348,000
Contract #2	$2,274,000

A breakdown of the project cost, for Contract #1, is included in Appendix A

A breakdown of the project cost, for Contract #2, is included in Appendix B

Escalation

The estimate is priced at current market price levels.

It is common knowledge that Victoria saw a major correction in market price levels during the latter part of 2008 and early 2009. A further downward correction occurred in Spring, 2010 driven by pressure on pricing levels from mainland contractors pursuing work in Victoria.

While there has been varying opinion on timing for a resurgence in the construction market, to date this has not occurred. We believe there will be a sustained upward movement in market price levels commencing in the latter part of 2014. As such we recommend that provision be made for escalation, commencing in the fourth quarter 2014, at 0.25% per month (3% range, per annum).

We recommend annual re-evaluation of the estimate to reflect the expected upward movement in market price levels and to ensure the budget remains appropriate for completion of the work.

BASIS OF THE ESTIMATE

We have assumed that the work will be tendered competitively in one contract.

In all cases the estimates are based upon our assessment of fair value for the work to be carried out. We define fair value as the amount a prudent contractor, taking into account all aspects of the project, would quote for the work. We expect our estimate to be in the middle of the bid range to ensure that funding for the work remains adequate for the duration of the project.

It should be noted that Advicas Group Consultants Inc. does not have control over the cost of labour, materials, or equipment, over the Contractor's methods of determining bid prices, or over competitive market conditions. We define competitive conditions in the project as attracting a minimum of four general contractors' bids with a minimum of two sub-trade tenders within each of the sub-trade categories. Accordingly, Advicas Group Consultants Inc. cannot and does not warrant or represent that bids will not vary from the estimate.

Contingency Reserves

Contingency is an allowance specifically identified within our elemental cost analysis to meet unforeseen circumstances, and represents an assessment of the financial risk relating to this project. As detailed design information becomes available, this risk will diminish and the contingency allowances will accordingly reduce.

Design contingency is introduced into the estimated cost at the earliest estimate stage and is a measurement of the amount and detail of the design information available. As the design develops and systems and material selections are fixed, the amount of the contingency allowance is reduced and is absorbed into the measured elements. On completion of contract documents, at tender stage, the allowance is normally reduced to zero.

Our determination of this risk level and the amount of the contingency allowance is the result of many years of cost planning, on over 2,000 construction projects, and of monitoring the increasing design information that occurs during the design phase. The design contingency is not a discretionary cost element.

A design contingency allowance has been included, calculated at 20% of the construction costs, to provide for unforeseen items arising during the design phase.

A construction contingency allowance has been included, calculated at 10% of the construction costs. This typically provides for unforeseen items arising during the construction period – such as field conditions, coordination discrepancies – which will result in change orders and extra costs to the contract, other than changes in scope.

No allowance has been made for project contingency, which typically provides for changes in program, scope and other Client requests.

Taxes

GST is excluded from the estimate.

On August 26, 2011 HST was defeated through public referendum. British Columbia returned to Provincial Sales Tax and Goods and Services Tax on April 1, 2013. 7% Provincial Sales Tax has been included in the estimate.

Exclusions

The following items are excluded from the capital construction cost:

- Bridge widening
- Fittings and equipment
  - Vending machines
  - Closed circuit TV
- Rock excavation
- Site furniture
- Site signage
- Clerk of Works
- Premium costs associated with environmental contaminants
- Traffic study costs

- Survey fees
- Financing costs
- Phasing of the work
- Out of hours working
- Escalation
- GST

Documentation

The estimate is based on the following:

- Stantec
  - Conceptual design civil plan and sections – drawing nos. SK1, SK2, SK3
  - Sections and detail drawings prepared by A. B. Sanderson and Company Ltd for the current bridge. All received April 7, 2014

- A briefing meeting with Andrew Rushforth on April 7, 2014, and telephone discussions during the preparation of the estimate.
- A further meeting with Andrew Rushforth on November 13, 2014

APPENDIX A

PROJECT COST – CONTRACT #1

	QUANTITY	UNIT	RATE	COST
SUMMARY - PROJECT COST				**$1,348,000**
CAPITAL CONSTRUCTION COST:				
Bridge Repairs				**$595,600**
General Conditions				**$178,680**
Design Contingency	**20%**			**$155,720**
SOFT COSTS				**$418,000**
Bridge Repairs				$595,600
Main Suspended Bridge Span:				
Break up existing asphalt paving to road deck	1,350	m²	$30.00	$40,500
Repairs to existing concrete deck	1	sum	$10,000.00	$10,000
Anodes to deck comprising:				
- drill existing concrete deck for seating anode	1,326	no	$30.00	$39,780
- drill through existing concrete deck for anode wire placement	1,326	no	$5.00	$6,630
- anode including mortar and wiring	1,326	no	$42.00	$55,692
- install mortar fill to bore hole and make good	1,326	no	$10.00	$13,260
- drill existing steel beam and connect anode wire, including temporary work platform	1,326	no	$100.00	$132,600
Membrane to exposed concrete deck	1,764	m²	$70.00	$123,480
50mm asphalt paving	1,764	m²	$25.00	$44,100
New expansion joint to road deck	20	m	$350.00	$7,000
New expansion joint to pedestrian deck	4	m	$350.00	$1,400
Line painting	1	sum	$1,000.00	$1,000
Suspended Approach Spans - EAST & WEST:				
Break up existing asphalt paving to road deck	150	m²	$30.00	$4,500
Repairs to existing concrete deck	1	sum	$5,000.00	$5,000
Anodes to deck				incl above
Membrane to exposed concrete deck	192	m²	$70.00	$13,440
50mm asphalt paving	192	m²	$25.00	$4,800
New expansion joint to road deck	20	m	$350.00	$7,000
New expansion joint to pedestrian deck	8	m	$350.00	$2,800
Line painting	1	sum	$500.00	$500
On Grade Approach - EAST:				
Break up existing asphalt paving	392	m²	$30.00	$11,760
Repairs to existing road base	1	sum	$3,000.00	$3,000
New asphalt paving	576	m²	$25.00	$14,400
Line painting	1	sum	$2,000.00	$2,000
On Grade Approach - WEST:				
Break up existing asphalt paving	700	m²	$30.00	$21,000
Repairs to existing road base	1	sum	$3,000.00	$3,000
New asphalt paving	918	m²	$25.00	$22,950
Line painting	1	sum	$4,000.00	$4,000

APPENDIX B

PROJECT COST – CONTRACT #2

Class D Concept Estimate - CONTRACT #2 DATE: 17-Nov-14

	QUANTITY	UNIT	RATE	COST
SUMMARY - PROJECT COST				**$2,274,000**
CAPITAL CONSTRUCTION COST				
Bridge Repainting				**$1,040,700**
General Conditions				**$312,210**
Design Contingency	**20%**			**$271,090**
SOFT COST				**$650,000**
Bridge Repainting				$1,040,700
Main Suspended Bridge Span:				
Prepare and refinish existing pedestrian pipe handrail	360	m	$50.00	$18,000
Prepare and refinish existing lighting poles	1	sum	$1,000.00	$1,000
Strip off lead paint to underside of existing steel deck and prepare for new	4,577	m²	$185.00	$846,745
Paint underside of existing steel deck	4,577	m²	$35.00	$160,195
Suspended Approach Spans - EAST & WEST:				
Prepare and refinish existing pedestrian pipe handrail	40	m	$50.00	$2,000
Prepare and refinish existing lighting poles	1	sum	$500.00	$500
On Grade Approach - EAST:				
Prepare and refinish existing pedestrian pipe handrail	120	m	$50.00	$6,000
Prepare and refinish existing lighting poles				
On Grade Approach - WEST:				
Prepare and refinish existing pedestrian pipe handrail	115	m	$50.00	$5,750
Prepare and refinish existing lighting poles	1	sum	$500.00	$500

Appendix D GOAL ENGINEERING LTD. REPORT ON CONCRETE DECK INVESTIGATION

GOAL ENGINEERING LTD.

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October 30, 2014
Project No. GE14027

Stantec
400-655 Tyee Road
Victoria, B.C.
V9A 6X5

Attn: Andrew Rushforth, P.Eng

Re: Point Ellice Bridge
Concrete Deck Investigation
Ultrasonic Thickness Gage Measurements

EXECUTIVE SUMMARY

An investigation into the current condition of the Point Ellice Bridge has been conducted. The focus of the investigation and this report is the reinforced concrete deck which is located below the asphalt road surface. Concrete structures of this age will typically undergo deterioration due to the corrosion of reinforcing steel. The chemical process of corrosion causes expansive forces to be exerted within the concrete matrix leading to cracking, spalling and a loss of serviceability.

The results of the investigation and non-destructive testing outlined in this report indicate the concrete deck is in relatively **Good Condition**. The extent of the concrete repair required below the asphalt is expected to be minimal.

Also, as part of this investigation, the steel beam members below the concrete deck were measured to determine the amount of steel material loss due to corrosion. It was noted that many of the steel cross beams have suffered corrosion deterioration on the top flanges. The field measurements have been reported and a potential cathodic protection method has been suggested. It is recommended that that further research is required to determine the most appropriate protection measure.

Rust products observed on many of the steel superstructure members indicate that a re-painting effort is soon required.

1.0 INTRODUCTION

An investigation has been completed to assess the present condition of the concrete bridge deck of the Point Ellice Bridge in Victoria BC. The goal of this investigation was to estimate the amount of concrete repair required if the existing asphalt surface is removed for a potential bridge renovation/ expansion.

Also included in this report are Ultrasonic Thickness Gage (USTG) test results of various superstructure steel member flanges below the bridge deck.

2.0 STRUCTURE DESCRIPTION

The Point Ellice Bridge was constructed circa 1956 and consists of a reinforced concrete deck supported by a steel superstructure. The design drawings indicate a 6 ½" concrete deck with two layers of reinforcing steel. The concrete deck is overlaid with 2" of asphalt concrete to act as a wear surface.

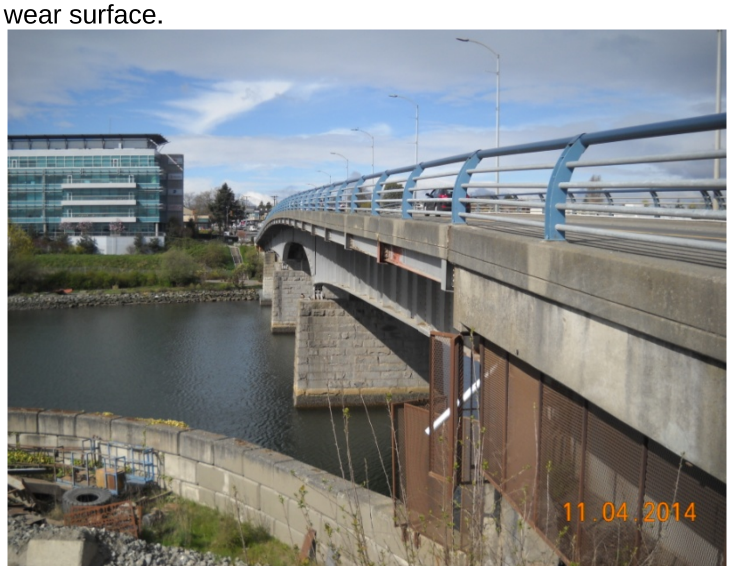


Photo 1 – View of the South face of the Point Ellice Bridge looking west from the east abutment.

3.0 SURVEY OBSERVATIONS

To complete the assessment, various testing and inspection techniques were used including a Ground Penetrating Radar (GPR) scan completed in accordance with *ASTM D6087-08 Evaluation of Asphalt-Covered Concrete Bridge Decks Using Ground Penetrating Radar*. A section of asphalt was also removed to allow for visual inspection and testing of the concrete deck. The condition of this section of concrete deck would be correlated to the results of the GPR scan to estimate the possible extent of concrete repair and to evaluate the GPR scan effectiveness.

3.1 Ground Penetrating Radar Scan

The GPR scanning was completed by Canadian Subsurface Investigations from Vancouver, BC. The entirety of the concrete bridge deck was scanned on August 12th 2014. The results of the scan are topographic style maps which provide the following information:

- **Rebar Depth** (from Surface): This provides a measure to the top layer of steel reinforcing from the top of the asphalt wear surface.

- **Rebar Amplitude**: This provides an indication of the presence of corrosion products around the reinforcing steel and consequently the likelihood of cracking or spalling of concrete. (Low amplitude number indicates a higher potential for concrete damage)
- **Asphalt Thickness**: Measure of the asphalt wear surface thickness. The GPR scan indicates that the thickness varies from 30mm to 75mm.
- **Asphalt Amplitude**: This data provides an indication of the bond between the asphalt wear surface and the concrete deck. (Higher amplitude number indicates a better bond)
- **Rebar Cover:** Measure from the concrete surface to the top layer of steel reinforcement.

The results of the scan have been appended to this report.

3.2 Visual and Sounding Survey

Several locations of rebar are exposed on the concrete sidewalk across the bridge. The locations of the exposed rebar have been summarized on the appended drawing.

Cracks were noted on the outside vertical surface of the concrete sidewalk (which cantilevers off the bridge edge). The cracks were typically located above the cross beam supports, which is also the typical location of the bridge deck construction joints (See appended photo 2). Access was available to a limited number of these locations and it was observed that the concrete was debonded and/or loose.

Following the removal of the asphalt surface from the concrete deck, a visual and sounding survey was conducted to identify locations of debondment. No loose or debonded concrete was identified in the test area (See the appended drawing for the location of the test area surveyed).

Three concrete joints were exposed and it was observed that the joint sealant was intact and appeared to be performing well.

3.3 Chloride ion Content

The samples used for chloride ion determination were obtained by dry drilling at three locations on the bridge deck. Samples were obtained at depths between 0mm and 55mm. The chloride ion test procedure used was the 'water soluble' method. The concentrations have been calculated for a concrete with average density of 2350 kg/m^3 and cement content of 300 kg/m^3. The results are presented in Table 1.

Table 1 - Chloride Sample Summary

Chlorides Samples:
Bay Street Bridge Deck

Sample:	*Location:*	*Concentration (ug/g)*	*Depth:*	*% by mass concrete*	**% by mass cement**
1A	Location 1 (East)	76	0-12mm	0.008	**0.04**
1B	Location 1 (East)	75	12-20mm	0.008	**0.04**
1C	Location 1 (East)	77	20-35mm	0.008	**0.06**
2A	Location 2 (Middle)	<50	0-10mm	0.005	**0.04**
2B	Location 2 (Middle)	53	10-25mm	0.005	**0.04**
2C	Location 2 (Middle)	56	25-36mm	0.006	**0.04**
2D	Location 2 (Middle)	54	36-55mm	0.005	**0.04**
3A	Location 3 (west)	94	0-15mm	0.009	**0.07**
3B	Location 3 (west)	84	15-23mm	0.008	**0.07**
3C	Location 3 (west)	78	23-30mm	0.008	**0.06**
3D	Location 3 (west)	51	30-46mm	0.005	**0.04**

Assumed Average Density ***2350kg/m3***
Assumed Cementitious Content: ***300kg/m3***

The American Concrete Institute (ACI) proposed threshold for chloride concentration in conventionally reinforced concrete is 0.15 % by mass of cement. At levels higher than 0.15 % there is a significant increase in the potential for chloride induced corrosion of the reinforcing steel. As shown in Table 1, all of the chloride concentrations are under the ACI threshold value.

3.4 Rebound Hammer

Rebound hammer is a non-destructive test used to estimate concrete strength. Readings were obtained on the deck at locations shown on the drawing. These results are presented in Table 2.

Table 2. Rebound Hammer Test Summary

Location	Rebound Number	Estimated Compressive Strength (MPa) Including correction factor
1	33.7	29.0
2	34.3	29.0
3	39.2	36.0

The test results indicate that the concrete compressive strength for the deck ranges between 29 MPa and 36 MPa. It is noted that the Rebound hammer manufacturer lists an accuracy of +/- 7 MPa for results in the range of 40 MPa.

3.5 Half-Cell Survey

The half-cell survey measures the electrical potential for corrosion between the concrete and the reinforcing steel. The results of the tests provide an indication of the probability of corrosion. A survey was conducted on a portion of the deck and the results are provided in table 3 below.

Table 3. Summary of Half Cell Survey Results (measurements are on a ~1 meter gird)

Half Cell Rebar Potentials (mV) - Point Ellice Bridge (West Bound Lane Over Pier #1)

West (left) / East (right)

-161	-74	-42	-61	-100	-225	-111	-80	-72	-98	-180
-274	-135	-164	-116	-173	-291	-128	-110	-87	-180	-177
-142	-88	-92	-104	-94	-202	-117	-47	-40	-98	-170
-132	-89	-77	-106	-108	-133	-96	-35	-122	-88	-140
][~ Location of Floor Beam					][~ Center Line of Peir #1					][~ Location of Floor Beam

Table 4. Interpretation of half-cell results.

Half Cell Potential (mV)	Probability of Corrosion Activity
> -200	Less than 10 %
-200 to -350	Uncertain
<-350	Greater than 90 %

*Per ASTM C876-09 Corrosion Potentials of Uncoated Reinforcing Steel in Concrete

The readings ranged from -42 to -291 mV. This indicates the majority of areas have a less than 10% probability of corrosion while some areas are uncertain.

It is noted that higher half-cell potentials were recorded on the slab areas above the approximate location of steel beams below. It may be that the half cell readings are measuring the potential for corrosion of the steel members rather than the embedded reinforcing (These areas are indicated by shading in table 3 above).

3.6 Concrete Core Compressive Strength Test Results

A total of 6 concrete cores were retrieved from 2 locations on the bridge deck for compressive strength testing and depth of carbonation testing. The results of the compressive strength testing have been summarized below in table 5. A complete compressive strength test report has been appended.

Table 5. Summary of Compressive Strength Test Results

Location	Sample Number	Compressive Strength (Mpa)	Average (Mpa)
3	1	43.9	
3	2	41.3	
3	3	41.6	42.3
1	4	34.1	
1	5	28.8	
1	6	37.8	33.6

3.7 Depth of Carbonation Testing

Concrete carbonation can be visually identified by applying a phenolphthalein solution to the concrete sample. Non-carbonated concrete reacts with the concrete to create a purple colour on the surface and the carbonated concrete does not undergo a colour change. Typically, the concrete will carbonate from the exterior surface inwards and the depth of carbonation is typically measured from the exposed surface. When concrete becomes carbonated, its alkalinity is decreased and its ability to inhibit corrosion is compromised.

Following the testing of the six concrete cores, it was observed that there was a minimal amount (<1mm) of carbonation of the concrete, measured from the upper concrete surface.

3.8 Ultrasonic Thickness Gage Testing

The underside of the bridge was accessed from the maintenance walkway and a number of Ultrasonic Thickness Gage Tests (USTG) were conducted on the flanges of the steel girders, beams and stringers. The results from the thickness testing have been appended to this report. It was noted that top flanges of many of the steel elements have suffered from varying degrees of corrosion, especially the steel beam members below the concrete deck joints (see photo 4 and 10 - 20).

The following were noted from the visual review of the underside of the bridge deck during the USTG testing:

- A build-up of rust products was noted above many of the cross beam top flanges (see photos 10 – 20)
- Surface rust and pitting was noted at several locations on all elements of the structure (see the appended photo 5).
- Concrete spalling was observed adjacent to the top flanges of the steel members at multiple locations (See photo 6).

4.0 DISCUSSION

The loose concrete located on the outside vertical faces of the sidewalks should be removed as soon as possible. These pieces of concrete pose a fall hazard. This damage may be due to forces initiated by rust jacking of the cross-beams below.

The area of asphalt removal in the west bound lane was selected based on the GPR scan. It was anticipated there may be locations with varying degrees of concrete damage. The goal was to correlate the GPR scan with the observed damage and estimate the amount of total concrete damage. However, as areas of concrete damage/ debondment were not observed, the correlation is not possible. Therefore, it is expected that majority of the concrete deck will not require repair. A small amount of concrete repair should be allowed for to address likely small damage areas below the asphalt.

The steel superstructure is showing many indications of deterioration due to corrosion; in particular on the top flange of the girders, beams and stringers. The most severe damage appears to be located over the cross beams, which is below the concrete deck joints. The thickness of various flanges of the steel elements has been presented in this report however these have not been compared to the original flange thicknesses. The deterioration will likely continue to proceed without the implementation of protective measures. Protective measures should include 1) limiting water ingress and 2) some form of cathodic protection.

The continuing corrosion of the top flanges will likely cause further steel material loss and the build-up of corrosion products above the top flange (this is also known as Rust Jacking). Rust Jacking can generate distress in the concrete by lifting the edges of the concrete deck. As an example, the loose concrete observed on the vertical edges of the sidewalks (see photo 2) may have been due to this rust jacking.

It was noted that the sealant within the concrete joints appeared in satisfactory condition and it may be that the water ingress from the top of the deck is already limited. It is expected however that if the asphalt wear surface is removed, the joint sealant will likely become damaged and a replacement system will be required.

Even in the absence of water infiltration from the top of the bridge deck, it is likely that the corrosion of the beam steel flanges will continue to occur. This is caused by moisture in the air from the sea water environment. This ongoing corrosion of the beams may have caused the increased half cell readings (reported in section of 3.5 of this report) observed in the corrosion potential survey.

One possible solution to limiting the ongoing corrosion issue is the installation of sacrificial anodes into the concrete deck above the beam top flanges. This could be achieved by coring holes into the concrete deck at regularly spaced intervals above the various beam top flanges, inserting a sacrificial metal anode electrically connected to the beam top flange and grouting the holes with an appropriate mortar.

5.0 RECOMMENDATIONS

1. Remove loose concrete from the outside vertical faces of the sidewalks (See photo 2).

2. The extent of concrete repair below the driving surface is expected to be minimal. A small contingency should be considered however to complete the repairs to the exposed rebar noted on the appended drawings and any other small concrete issues which may have not been detected by the GPR scan. It is recommended that an appropriate budget to cover these concrete repairs would be for ~1% of the concrete deck area (~ 15 m^2 of repair area).

3. The exposed rebar noted on the sidewalk areas should be repaired by chipping the area around the rebar, depressing the bar to provide additional cover and patching with an appropriate mortar.

A similar repair procedure should be used for patching the concrete spalling locations observed on the underside of the bridge deck.

4. Conduct a review of remedial options to address the corrosion damage observed on the top flange of the steel beams, stringers and girders. One potential solution to reduce the rate of corrosion is through the installation of sacrificial anodes. This and other options for limiting the corrosion of the top flange of the beams should be explored.

5. It is time for a new coating on the bridge steelwork superstructure. As shown in photo 5, localized pitting and surface rust is extensive and this damage will continue to occur at a likely accelerating rate.

6. When the asphalt concrete is removed it would be prudent to restore all of the transverse concrete joints as the existing joints will likely be damaged in the asphalt removal process.

6.0 CLOSING

The overall condition of the concrete deck is good. Relatively minor amounts of concrete repair can be expected based on the observation of the exposed portion of deck

The steel beams require attention and further consideration should be given to explore options to limit ongoing corrosion of the top flanges.

I trust this information is sufficient. Please call if you have any questions.

Sincerely
Per: GOAL Engineering Ltd,

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — C. T. APPELMAN # 38915 — 30 Oct 2014

Craig Appelman, P.Eng
Materials Engineer

Reviewed by:

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — G. OVSTAAS # 13909 — 30 Oct 2014

Greg Ovstaas, P.Eng.
Senior Materials Engineer

:

Appendix A
Photos

Photo 2 – View of typical loose concrete on the outside vertical surfaces of the sidewalks.

Photo 3 – Ground Penetrating Scan being completed on the bridge deck.

Photo 4 – Typical condition of the cross beams. Corrosion typically present on the top flange of the steel members in contact with the concrete.

	Photo 5 – Interior view of the North Girder near Pier #1. Surface corrosion and pitting is visible on steel elements.
	Photo 6 – Concrete spalling observed at the connection point of the cross beam and stringer

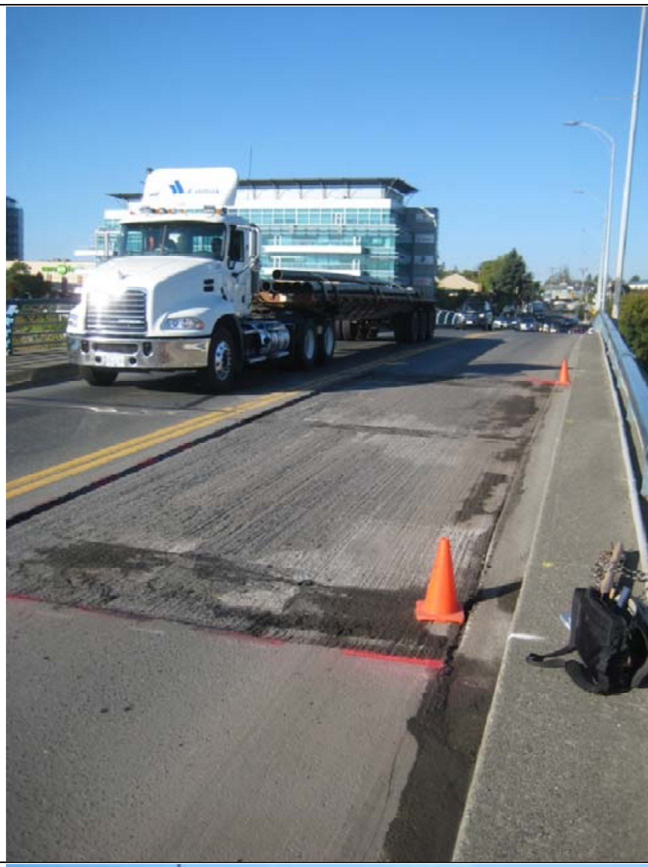
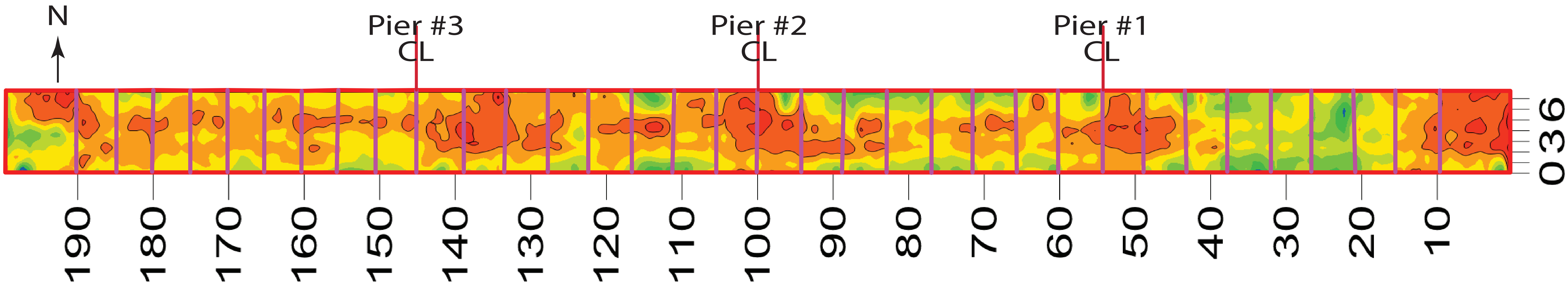


Photo 7 – View of the asphalt removal test patch. The test patch was centrally located over Pier #1 in the West bound lane of traffic.

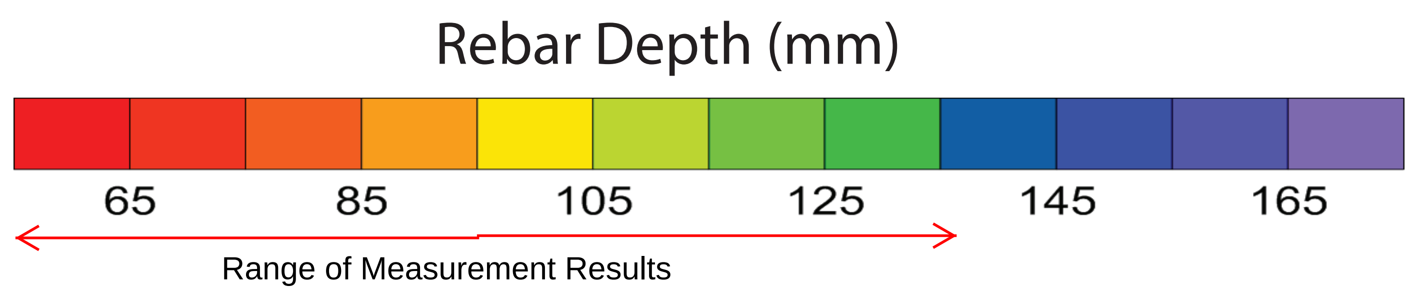
Photo 8 – Obtaining concrete core samples.

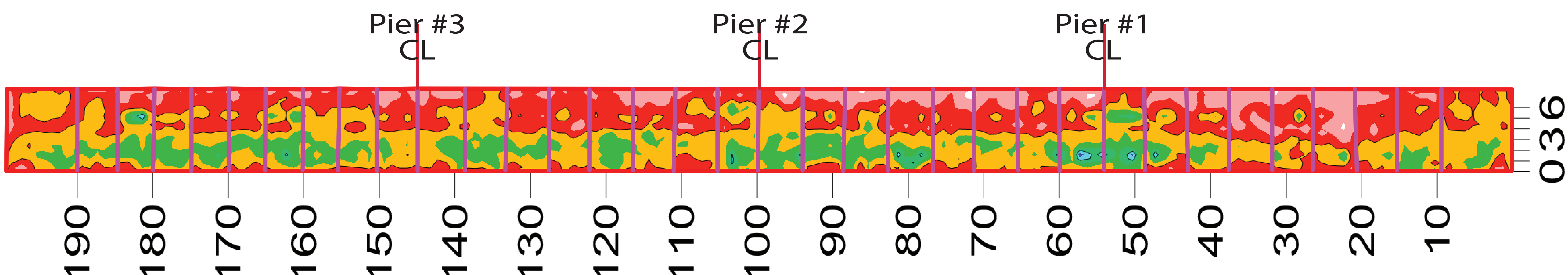
	Photo 9 – Close view of the concrete deck. Groves can be observed from the milling process. No locations of concrete debondment were noted.

Appendix B
Ground Penetration Rebar Test Results

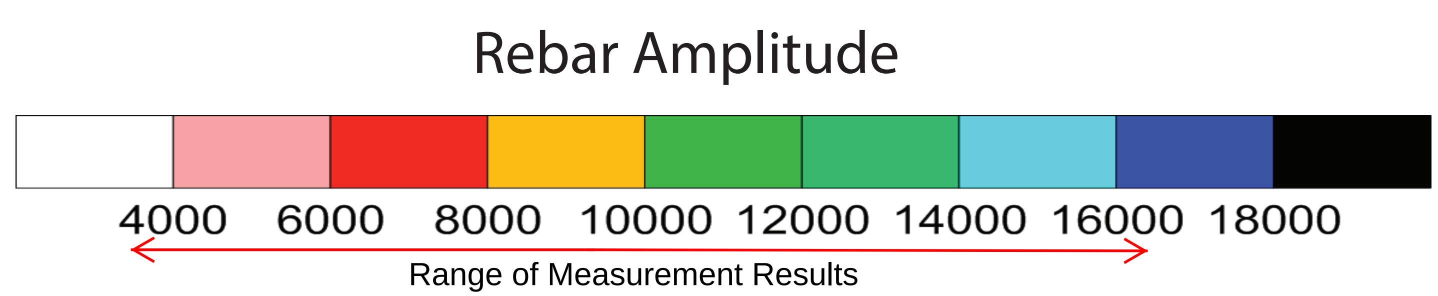


Rebar Depth (from Surface): This provides a measure to the top layer of steel reinforcing from the top of the asphalt wear surface.



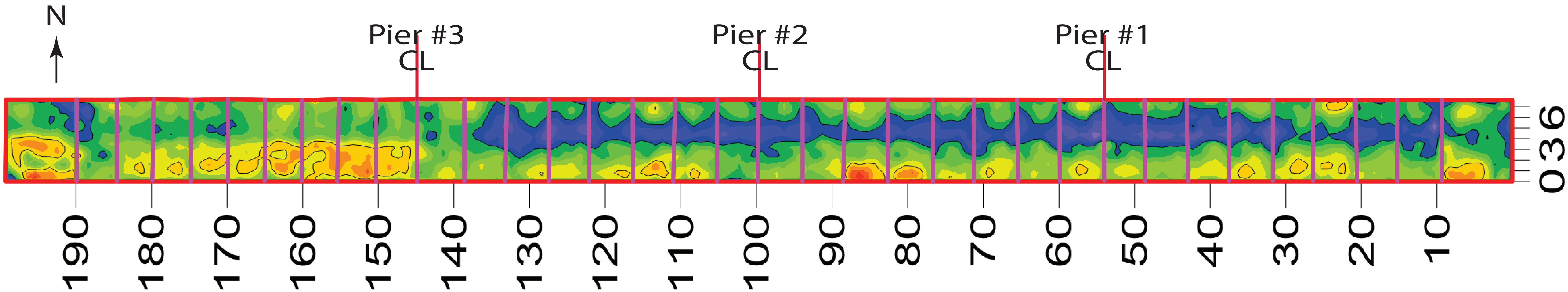


Rebar Amplitude: This provides an indication of the presence of corrosion products around the reinforcing steel and consequently the likelihood of cracking or spalling of concrete. (Low amplitude number indicates a higher potential for concrete damage)

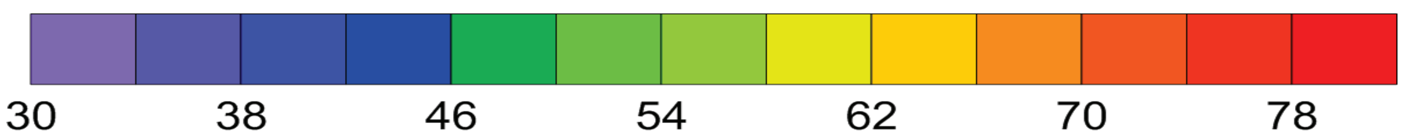


Unit: Meter

Client: Goal Engineering Ltd. 9-755 Vanalman Ave., Victoria, BC V8Z 3B8	Ground Penetrating Radar Survey Point Ellice Bridge, Victoria, BC		Canadian Subsurface Investigations Inc.
Preliminary Results	Prepared By: Terry Wong	Date: August 12, 2014	Project No. CSI20140812A



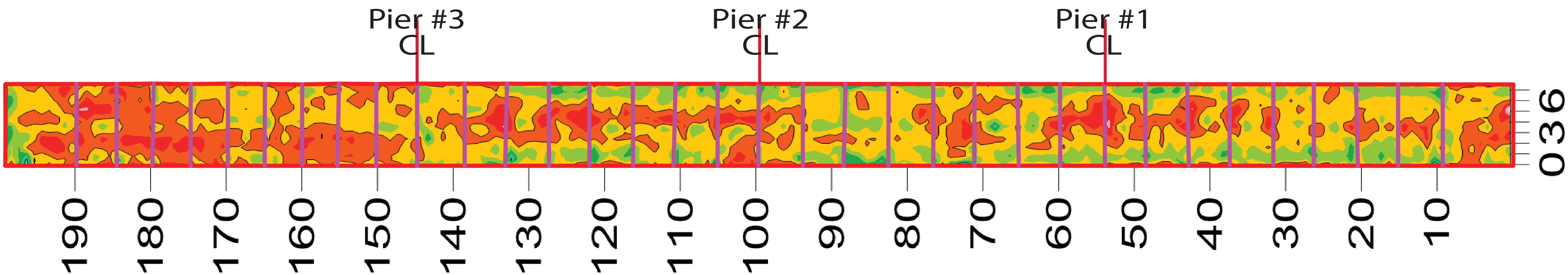
Asphalt Thickness (mm)



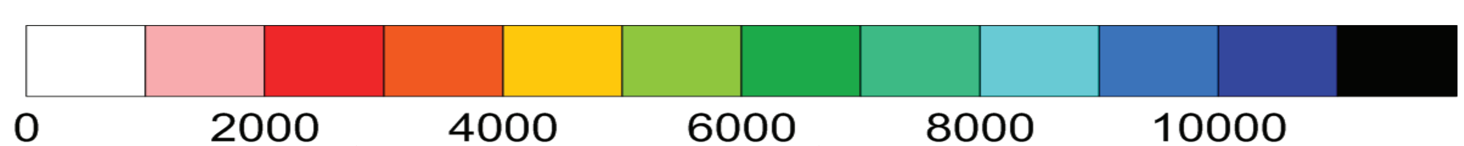
Range of Measurement Results - Westbound Lane

Range of Measurement Results - Eastbound Lane

Asphalt Thickness: Measure of the asphalt wear surface thickness. The GPR scan indicates that the thickness varies from 30mm to 75mm.



Asphalt Amplitude

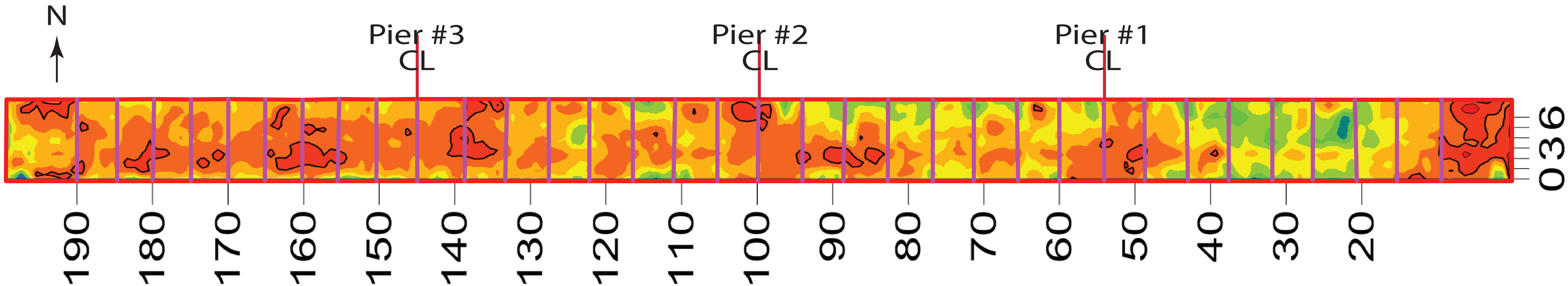


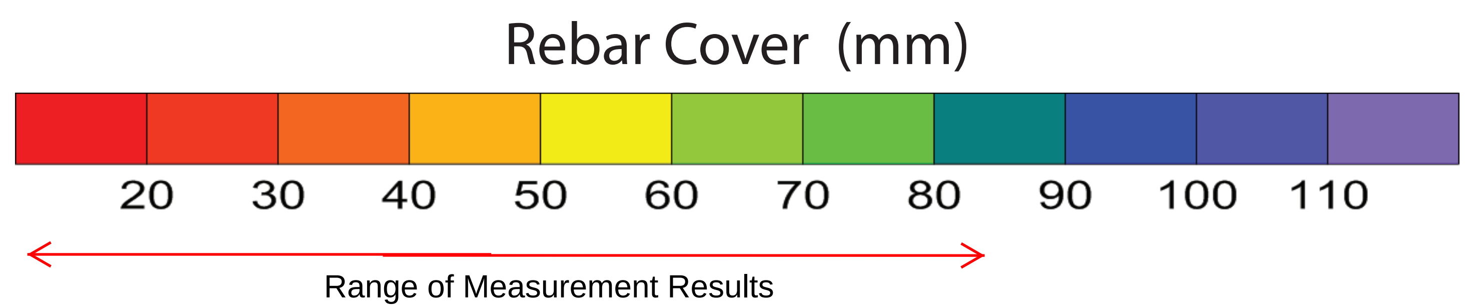
Range of Measurement Results

Asphalt Amplitude: This data provides an indication of the bond between the asphalt wear surface and the concrete deck. (Higher amplitude number indicates a better bond)

Unit: Meter

Client: Goal Engineering Ltd. 9-755 Vanalman Ave., Victoria, BC V8Z 3B8	Ground Penetrating Radar Survey Point Ellice Bridge, Victoria, BC		CSi Canadian Subsurface Investigations Inc.
Preliminary Results	Prepared By: Terry Wong	Date: August 12, 2014	Project No. CSI20140812A



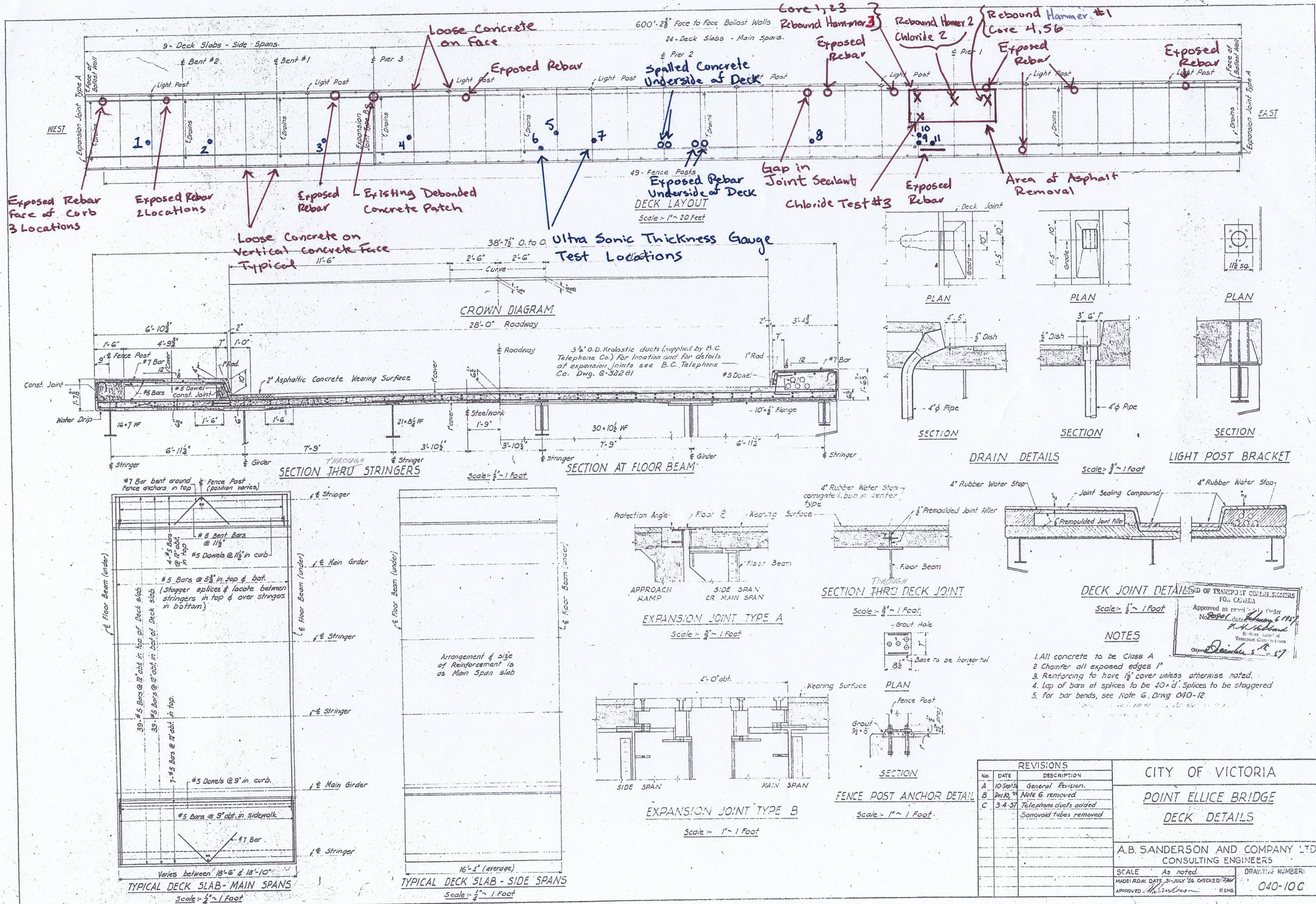


Rebar Cover: Measure from the concrete surface to the top layer of steel reinforcement.

Unit: Meter

Client: Goal Engineering Ltd. 9-755 Vanalman Ave., Victoria, BC V8Z 3B8	Ground Penetrating Radar Survey Point Ellice Bridge, Victoria, BC		Canadian Subsurface Investigations Inc.
Preliminary Results	Prepared By: Terry Wong	Date: August 12, 2014	Project No. CSI20140812A

Appendix C
Sketch of Field Observations


Core 1,2,3
Rebound Hammer 3
Rebound Hammer 2
Chloride 2
Rebound Hammer #1
Core 4,5,6
Loose Concrete on Face
Exposed Rebar
Spalled Concrete Underside of Deck
Exposed Rebar Face of Curb 3 Locations
Exposed Rebar 2 Locations
Exposed Rebar
Existing Debonded Concrete Patch
Loose Concrete on Vertical Concrete Face Typical
Ultra Sonic Thickness Gauge Test Locations
Exposed Rebar Underside of Deck
Gap in Joint Sealant
Chloride Test #3
Area of Asphalt Removal
600'-2⅝" Face to Face Ballast Walls
9 - Deck Slabs - Side Spans
24 - Deck Slabs - Main Spans
WEST
EAST
Expansion Joint Type A
Expansion Joint Type B
Face of Ballast Wall
Light Post
Drains
℄ Bent #2
℄ Bent #1
℄ Pier 3
℄ Pier 2
℄ Pier 1
49 - Fence Posts
DECK LAYOUT
Scale - 1" ~ 20 Feet
CROWN DIAGRAM
28'-0" Roadway
38'-7½" O. to O.
2" Asphaltic Concrete Wearing Surface
3¾" O.D. Kralastic ducts (supplied by B.C. Telephone Co.) For location and for details of expansion joints see B.C. Telephone Co. Dwg. G-32281
SECTION THRU STRINGERS
SECTION AT FLOOR BEAM
Scale - ½" ~ 1 Foot
TYPICAL DECK SLAB - MAIN SPANS
Scale - ¼" ~ 1 Foot
39 - #5 Bars @ 12" abt. in top of Deck slab.
39 - #5 Bars @ 12" abt. in bot. of Deck slab.
7 - #5 Bars @ 12" abt. in top.
#5 Bars @ 5¾" in top & bot. (Stagger splices & locate between stringers in top & over stringers in bottom)
#5 Dowels @ 9" in curb.
#5 Bars @ 9" abt. in sidewalk
Varies between 18'-6" & 18'-10"
TYPICAL DECK SLAB - SIDE SPANS
Scale - ¼" ~ 1 Foot
Arrangement & size of Reinforcement is as Main Span slab
16'-4" (average)
EXPANSION JOINT TYPE A
Scale - ¾" ~ 1 Foot
EXPANSION JOINT TYPE B
Scale - 1" ~ 1 Foot
SECTION THRU DECK JOINT
Scale - ¾" ~ 1 Foot
DECK JOINT DETAILS
Scale - ¾" ~ 1 Foot
DRAIN DETAILS
Scale - ¾" ~ 1 Foot
LIGHT POST BRACKET
FENCE POST ANCHOR DETAIL
Scale - 1" ~ 1 Foot
NOTES
1. All concrete to be Class A
2. Chamfer all exposed edges 1"
3. Reinforcing to have 1½" cover unless otherwise noted.
4. Lap of bars at splices to be 40×d. Splices to be staggered
5. For bar bends, see Note 6, Drwg 040-12
REVISIONS
A 10-Sept-56 General Revision.
B Dec10,'56 Note 6 removed
C 3-4-57 Telephone ducts added
Sonovoid tubes removed
CITY OF VICTORIA
POINT ELLICE BRIDGE
DECK DETAILS
A.B. SANDERSON AND COMPANY LTD.
CONSULTING ENGINEERS
SCALE As noted.
DRAWING NUMBER: 040-10C

Appendix D
Concrete Test Results

GOAL ENGINEERING LTD.

Core Test Report

Client: Stantec Consulting
655 Tyee Road
Victoria, B.C. V9A 6X5

Project No. : 14-027
Date: 18-Sep-14

Attention: Andrew Rushforth

Project: Point Ellice Bridge

Date Cored: 15-Sep-14
Cored By: GOAL Engineering Ltd.

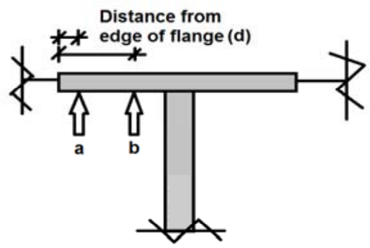
Core No.	Load kN	Diameter mm	Length mm	Weight grams	Compressive Strength MPa	Corrected Mpa	L/D Ratio	Factor
1	164.0	69	139	1283.3	43.9	43.9	> 2	1.0
2	154.5	69	143	1314.2	41.3	41.3	> 2	1.0
3	155.5	69	139	1265.5	41.6	41.6	> 2	1.0
4	131.5	69	110	992	35.2	34.1	1.59	0.97
5	111.5	69	108	976.9	29.8	28.8	1.57	0.97
6	142.1	69	134	1229	38.0	37.8	1.94	0.99

COMMENTS: **Tested in accordance with CSA CAN3 A23.2 - 14C**
Dry Conditioned prior to testing
Parallel to Compaction

GOAL Engineering Ltd. per: G. Ovstaas **G. Ovstaas P.Eng**
Unit 9, 755 Vanalman Ave
Victoria, BC
V8Z 3B8

Appendix E
Ultra Sonic Thickness Gage Test Results

GOAL ENGINEERING LTD.



Ultrasonic Thickness Gage Test Results

Client: Stantec
Attention: Andrew Rushforth
Project: Point Ellice Bridge
Project No. : GE14027
Date: 21-Aug-14

Location No.	Description	Test No.	Distance from Flange Edge - d (mm)	Thickness Measurement (mm)	Location Description	Notes
1	Top Flange of Cross Beam (One West of Bent #2)	a_1	20	14.3	670 mm North of South Stringer	Several Sheets of Debondment Noted on top Flange between beam and concrete Caliper Measurement of Edge Thickness: 15.3 mm
		b_1	95	17.6		
		a_2	20	16.2	980 mm North of South Stringer	
		b_2	95	17.8		
2	Top Flange of Cross Beam (two west of Bent #1)	a_1	22	14.2	1020 mm North of South Stringer	
		b_1	100	18.1		
		a_2	25	13.2	1370 mm North of South Stringer	
		b_2	95	18.6		
3	Top Flange of South/ Central Stringer (two spans west of Pier 3)	a_1	21	15.0	2100 mm to east cross beam	
		b_1	69	15.1		
		a_2	27	15.1	2440 mm to east cross beam	
		b_2	69	14.6		
4	Top Flange of Cross Beam (one span east of Peir 3)	a_1	25	18.4	750 mm North of South Stringer	Caliper Measurement of Edge Thickness: 22.7 mm
		b_1	93	20.3		
		a_2	27	17.3	1150 mm North of South Stringer	
		b_2	100	22.0		
5	Top Flange of Cross Beam (Fourth Span West of Pier 2)	a_1	19	17.3	870 mm North of South Stringer	Caliper Measurement of Edge Thickness: 17.3 mm
		b_1	93	21.9		
		a_2	27	17.9	1290 mm North of South Stringer	
		b_2	100	22.2		
6	Top Flange of South Central Stringer (third Span West of Pier 2)	a_1	18	16.3	500 mm West of cross beam	
		b_1	72	16.3		
		a_2	21	15.5	1050 mm West of cross beam	
		b_2	74	16.1		
7	Top Flange of Cross Beam (Third Cross Member West of Pier 2)	a_1	31	18.6	520 mm South of South Stringer	Heavy pitting on surface may have resulted in greater thickness readings. Caliper Measurement of Edge Thickness: 17.0 mm
		b_1	103	20.6		
		a_2	-	-	-	
		b_2	-	-		
8	Top Flange of Cross Beam (Third cross beam west of peir 1)	a_1	28	19.3	660 mm South of South Stringer	Caliper Measurement of Edge Thickness: 17.9 mm
		b_1	87	19.8		
		a_2	-	-	-	
		b_2	-	-		
9	Bottom Flange of Cross Beam (One span West of Pier 1)	a_1	27	18.1	550 mm South of South Stringer	Heavy pitting on surface may have resulted in greater thickness readings. Caliper Measurement of Edge Thickness: 18.9 mm
		b_1	80	20.1		
		a_2	-	-	-	
		b_2	-	-		
10	Top flange of Cross beam (One Span west of peir 1)	a_1	22	16.9	360 mm North of South Stringer	Caliper Measurement of Edge Thickness: 18.5 mm
		b_1	103	20.4		
		a_2	25	19.0	1160 mm North of South Stringer	
		b_2	102	20.0		
11	Top flange of South/Central Stringer (first span west of Peir 1)	a_1	18	16.4	1490 mm east of cross beam	
		b_1	72	16.5		
		a_2	17	16.6	2080 mm east of cross beam	
		b_2	74	15.5		

Photos of Ultra Sonic Thickness Gage Test Locations

	Photo 10 – Test Location 1		Photo 11 – Test Location 2
	Photo 12 – Test Location 3		Photo 13 – Test Location 4
	Photo 14 – Test Location 5		Photo 15 – Test Location 6
	Photo 16 – Test Location 7		Photo 17 – Test Location 8
	Photo 18 – Test Location 9		Photo 19 – Test Location 10

	Photo 20 – Test Location 11		