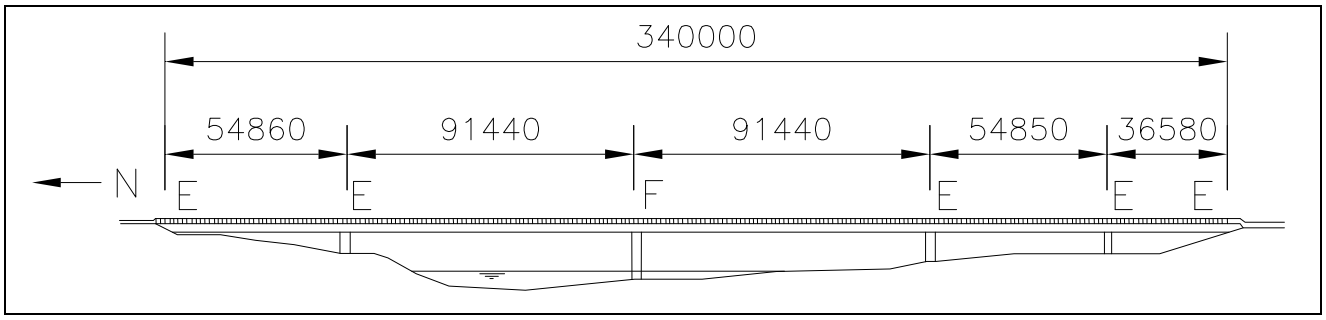
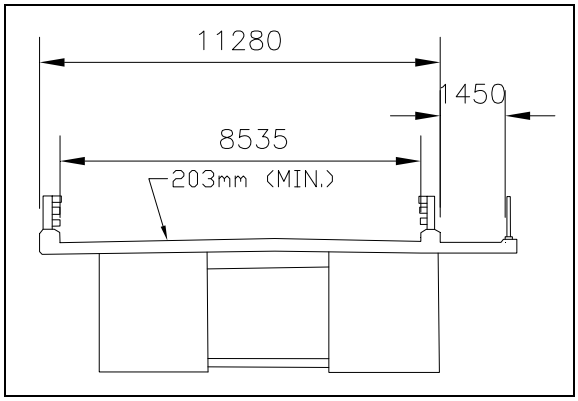
Muskwa River Bridge
Alaska Highway km 451.8



ELEVATION



SECTION

Description:

1. Continuous weathering steel box girders
2. Reinforced concrete deck with asphalt
3. Reinforced concrete piers and abutments
4. Steel piled foundations under piers and abutments
5. Spread foundations under abutments
6. Gravel roads under Spans 4 and 5

Muskwa River Bridge
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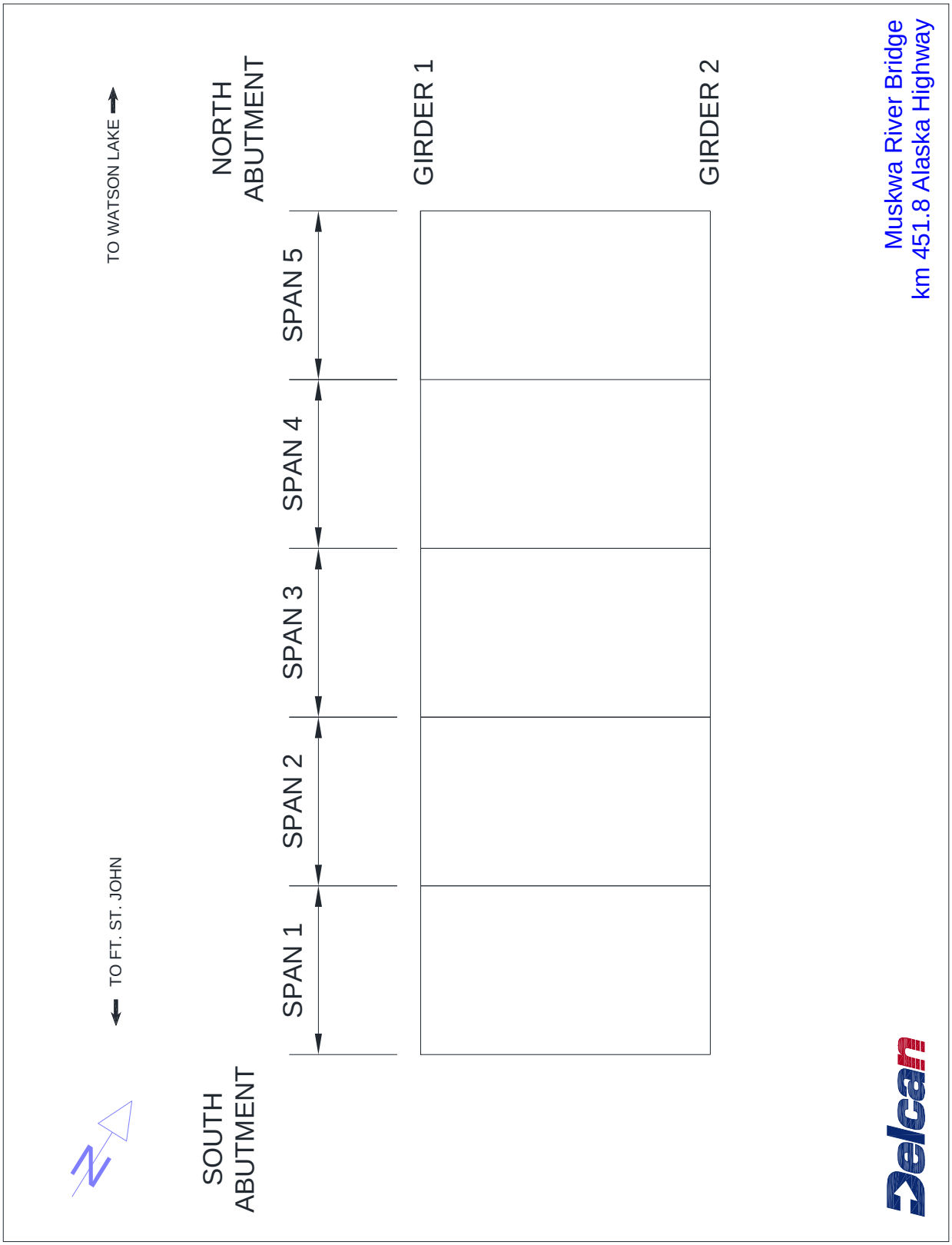

Muskwa River Bridge
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Year Constructed:	1975
Original Design:	PWGSC
Drawings Available:	Yes
Last Load Rating:	2006 – Meets CHBDC Live Load Requirements
Last Underwater Inspection:	**2011 – Included in this report**
Previous C Inspection Report for 2009:	Delcan – Stan Reimer, P.Eng.
Previous G Inspection Report for 2010:	PWGSC – Alex Taheri, P.Eng., Pei-Chin Tsai, E.I.T. and Jeff Downing, P.Eng.
Current Inspection Date:	August 15 and 25, 2011
Inspectors:	Delcan Corporation Stan Reimer, P.Eng. Peter Phillips, E.I.T.,
Temperature:	14°C on August 15th
Weather:	Sunny with occasional showers
Equipment:	Standard Inspection Equipment, Snooper and Enclosed Space Air Tester
2009 Structural Condition Rating:	5
2009 Functional Rating:	4
2010 Structural Condition Rating:	5
2010 Functional Rating:	4
2011 Structural Condition Rating:	**5**
2011 Functional Rating:	**4 (clear width low by 9%)**
Watercourse Flow Direction:	West to East (Girder 1 is on West Side)
Estimated Replacement Cost:	$40 million (2011 dollars)
GPS Coordinates:	N 58°-47'-11.7", W 122°-39'30.3"

Ten Year Plan - Cost Estimate (2011 dollars)

Recommended Work	Priority Code	Units	Qty	Unit Cost	Within 1 Yr	Within 3 Yrs	Within 5 to 10 Yrs	Maint./ Studies
1. Repair deck spalls in west cantilever facsia	C	lump	1	$5,000			$5,000	
2. Grind span 4 collision notches smooth	C	lump	1	$5,000			$5,000	
3. Repair pot hole in NW corner of deck	M	lump	1	$500				$500
4. Repair pot holes in south approach	M	lump	1	$1,000				$1,000
5. Flush bridge drains each spring	M	lump	1	$500				$500
6. Replace the bearing covers (need snooper)	M	lump	1	$8,000				$8,000
7. Install missing south river name sign	M	each	1	$200				$200
Construction/Maintenance Cost Subtotals:					$0	$0	$10,000	$10,200
Enineering Costs (20% of construction cost):					$0	$0	$2,000	
20% Contingency:					$0	$0	$2,000	$2,040
Note: Costs do not include: mobilization or flagging — Subtotals:					$0	$0	$14,000	$12,240
Total Cost Estimate:					**$26,240**			

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Significant Inspection Concerns	1. A new embankment concern was raised this year regarding an area several hundred metres upstream of the bridge on the north embankment. The shoreline is being scoured away and has completely eroded an access road along the shoreline. It is understood that a hydrology study has been undertaken to address the rate of erosion and potential consequences for this bridge. 2. These weathering steel box girders are generally in good shape with some collision denting and scraping in span 4 very close to pier 4. 3. Underwater inspection carried out this year with no significant underwater defects found.

Element	2009 MCR	2009 PCR	2009 Priority	2011 MCR	2011 PCR	2011 Priority	Observations	Photo References
Primary Components								
Watercourse	5	5	S	5	5	S	The river appears to be straight and flows from east to west under spans 3 and 4. It appears to be relatively stable, however, there is shoreline scour several hundred metres upstream of the bridge on the north embankment (see Photos P06 and P07). It is understood that a hydrology study has been undertaken to address the rate of erosion and potential consequences for this bridge.	3-8
Foundations	5	5	D	5	5	D	No visible defects.	
South Abutment	5	5	D	5	5	D	Abutment concrete is in good condition with no visible defects.	25, 56-60
North Abutment	5	5	D	5	5	D	No visible defects	77, 78
Pier 1	5	5	D	5	5	D	Pier 1 concrete is generally in good condition. There are stones epoxied to the south face likely for climbing. Pier concrete is in good condition. Accessible pier surfaces are covered in graffiti paint. There are gunshot spalls on the walls of piers 1 and 2 probably caused by removal of climbing stones that were previously glued to these piers. Pier 3 is the only pier in the water. There are 2 rebar dowels protruding from the south face of pier 3 near the bearing seat.	5, 61-63
Pier 2	5	5	D	5	5	D	Pier 2 concrete is generally in good condition. There is a minor spall 30 mm deep at the west end of the bearing seat and stones epoxied to the north face, likely for climbing.	5,64-68

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Element	2009			2011			Observations	Photo References
	MCR	PCR	Priority	MCR	PCR	Priority		
Pier 3	5	5	D	5	5	D	Pier 3 concrete is generally in good condition. It is the only pier in the water. An underwater inspection was carried out on this pier this year with no significant underwater concerns. There are 2 pieces of rebar sticking out of the south face near the bearing seat. There are also 5 rifle shot spalls on the north face. **Underwater Inspection Results** No significant underwater defects found. - The pier footing is surrounded by permanent sheet pile formwork. - The depth of water above the footing is 2.3 m. - There is log and stick debris built up on the footing on the west (upstream) and north side of the pier. - The depth of water outside the formwork ranged from 1.3 m on the west (upstream) side to 3.8 m on the east (downstream) and north side. - There is a small scour hole 3.5 m deep on the downstream side of the pier nosing that is not a significant concern. - Six gunshot spalls identified up to 38 mm deep with no exposed rebar or staining. - All spalls near or above waterline. - See underwater sketches and photos that follow Key for Underwater Photos and Sketches HC = High Chainage (north) LC = Low Chainage (south) US = Upstream direction DS = Downstream direction	5,69-72
Pier 4	5	5	D	5	5	D	Pier 4 concrete is generally in good condition and covered with graffiti on both sides.	8,73-75
West Continuous Box Girder (#1)	5	5	C	5	5	C	Both girders were inspected along their entire length on the inside and outside. The west continuous weathering steel box girder is generally in good shape with some collision denting and scraping in span 4 very close to pier 4. Past seepage through the deck has resulted in some corrosion of top and bottom flanges at both abutments. The loose bolts mentioned previously are obsolete, likely used during erection and not a problem. No deer	5,24,25, 29,30,34, 36,38, 50-55

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Element	2009			2011			Observations	Photo References
	MCR	PCR	Priority	MCR	PCR	Priority		
							mice were spotted in the girders this year.	
East Continuous Box Girder (#2)	5	5	C	5	5	C	The east continuous weathering steel box girder is generally in good shape with some collision denting and scraping in span 4 very close to pier 4. Past seepage through the deck has resulted in some corrosion of top and bottom flanges at both abutments.	25,26,27, 30,34,37, 38,40-49
Connections of Primary Components	5	5	D	5	5	D	No defects noted.	
Deck	5	5	C	5	5	C M	The deck is covered with an asphalt wearing surface. There is one pot hole in the new asphalt at the NW corner of the bridge. Numerous transverse cracks are evident in the deck soffit of the cantilevers, between the girders and inside the girders with efflorescence and rust staining in some places. Prior to recent deck repairs, water seeped through the soffit and into the box girders with efflorescence build-up in the bottom flanges of the girders. Deck repairs were carried out in 2007 including installation of a waterproof membrane and replacement of the asphalt. After the deck repairs there now are 6 locations within the girders where soffit patches have been made and formwork has been left in the girders. There is extensive efflorescence staining in the soffit in all spans but no evidence of recent seepage. There are 2 locations where spall repairs are still required in span 3 west cantilever.	9, 14, 28, 31-35, 41-44, 48, 51, 53, 54
Wearing Surface	5	5	D	5	5	D	Asphalt wearing surface recently replaced	1, 2, 9
Sidewalks	5	5	D	5	5	D	Sidewalks have asphalt wearing surface installed in 2007 during the deck repairs.	10, 11
Secondary Components								
Embankments	5	5	D	5	5	D	The bridge is popular for use by ATV's to cross the river along the sidewalk. An ATV trail has been carved into the embankments at both abutments to provide access onto the bridge. The approaches to the sidewalk are rutted. The south embankment is protected with gabions. There are minor gullies up to 100 mm deep at the SE corner of the south embankment where runoff bypasses the drain and in the south river embankment beside pier 2. There is also minor scouring in front of the north abutment and the	7, 8, 23, 56, 65, 76

Element	2009			2011			Observations	Photo References
	MCR	PCR	Priority	MCR	PCR	Priority		
							embankment below pier	
Ballast Walls	5	5	D	5	5	D	No defects noted.	57, 58
Wingwalls	5	5	D	5	5	D	No defects noted.	57
Bearing Seats	5	5	D	5	5	D	Bearing seats are in good condition.	58-60, 62, 66, 68, 78
Bearings	5	5	M	5	5	M	Most bearings are cladded in styrofoam boxes except some on the south abutment, Pier 1, Pier 2, Pier 3 and the north abutment. This protection should be reinstalled to protect the bearings.	58-60, 62, 62, 68, 74, 75, 78
Joints	6	5	D	6	5	D	Expansion joints were installed in 2007 at both abutments. Water is ponding in the sidewalk expansion joint depressions (see Photo P11). The sidewalk joint at the north abutment is leaking.	11, 12, 13
Diaphragms	5	5	D	5	5	D	Internal abutment end diaphragms of both girders are moisture stained from past leakage through the deck and/or expansion joints.	40, 46, 49, 50, 52, 55
Bracing	5	5	D	5	5	D	Bracing is generally in good condition. Some internal box girder diaphragm braces have minor scaling to past seepage through the deck.	25, 30, 34, 38
Connections of secondary components	5	5	D	5	5	D	Bracing connections are in good condition with no missing or loose bolts.	25, 30, 34, 38
Curbs	5	5	D	5	5	D	Most curb defects were repaired during recent deck repairs. There are 2 spalls up to 60 mm deep with exposed rebar on the west cantilever of span 3, one at midspan and one near pier 3.	10, 11, 18, 21
Approach Slabs	5	5	D	5	5	D	The approach slabs are covered with asphalt. No defects were noted.	15, 16, 20
Approaches	5	5	D	5	5	M	There are wide transverse cracks and pot holes in the asphalt on the south approach.	1, 2, 15, 16
Approach Barriers	5	5	D	5	5	D	The concrete approach barriers are in good condition, up to standard, and properly transitioned onto the bridge barriers.	1, 2, 15, 22
Bridge Barriers	6	6	D	6	6	D	Bridge railing on both sides of the roadway and sidewalk railing were replaced in 2007. They are in excellent condition.	9, 17
Coatings on Primary Components	5	5	D	5	5	D	Past seepage through the deck has resulted in some corrosion of top flanges and in the bottom flanges of both girders at the south abutment.	5, 25-27, 60
Auxiliary Components								
Slope Protection	5	5	D	5	5	D	The south embankment is protected with	8, 23, 56,

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Element	2009			2011			Observations	Photo References
	MCR	PCR	Priority	MCR	PCR	Priority		
							gabions that are in good condition. The north embankment is protected with vegetation.	65, 76
Deck Drains and Drainage Systems	5	4	M	5	4	M	All deck drains appear to be consistently plugged as they have been in previous inspections (see Photo P19). It was previously reported that this is resulting of ponding of water on the sidewalk which could be a icing hazard for pedestrians during cold temperatures.	11, 19
Signs	4	4	M	4	4	M	The bridge ID sign is in place on the north approach but is missing from the south approach. All delineators are in place There are vertical clearance signs on both girders above the access road below span 4.	1, 2
Utilities	5	5	M	5	5	D	There are a number of utilities carried by this bridge including street lighting, a water pipe and a number of conduits.	26, 60
Coatings on Secondary Components	5	5	D	5	5	D	Past seepage of water through the deck caused some scaling internal girder braces. There is no rust showing through galvanized railing coatings.	48, 50, 54
Inspection Platform				5	3	D	The inspection platform appears to be in working order but it is locked into position at the north abutment. No key was available during this inspection to unlock it but the underside of the superstructure was inspected by snooper.	56,77

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Bearing Measurements													
Span	**End**	**Girder**	**Fixity**	**Type**	**Temp °C**	**Measured (mm)**	**Design Setting**	**Difference**	**Room to Move**	**Slot Size**	**Dirty (Y/N)**	**Corrosion**	**Comments**
Abut 1	S	B1W	E	NT	-	-	-	-	-	-	N	None	Not Cladded, Photo 58,60
		B1E			-	-	-	-	-	-	N	None	Not Cladded, Photo 58,60
		B2W			-	-	-	-	-	-	N	None	Not Cladded, Photo 58
		B2E			14	50	38	-12	90	-	N	None	Not Cladded, Photo 58,59
Pier 1	N	B1W	E	NT	-	-	-	-	-	-	N	None	Not Cladded
		B1E			-	-	-	-	-	-	N	None	Cladded, Photo 62
		B2W			-	-	-	-	-	-	N	None	Cladded, Photo 62
		B2E			-	-	-	-	-	-	N	None	Cladded, Photo 62
Pier 2	N	B1W	E	NT	-	-	-	-	-	-	N	None	Cladded,
		B1E			-	-	-	-	-	-	N	None	Cladded, Photo 68
		B2W			-	-	-	-	-	-	N	None	Not Cladded, Photo 68
		B2E			-	-	-	-	-	-	N	None	Not Cladded, Photo 68
Pier 3	N	B1W	F	NT							N	None	Cladded
		B1E									N	None	Not Cladded, Photo 72
		B2W									N	None	Cladded
		B2E									N	None	Cladded
Pier 4	N	B1W	E	PF	-	-	-	-	-	-	N	None	Not Cladded, Photo 73,75
		B1E			-	-	-	-	-	-	N	None	Cladded, Photo 73,74
		B2W			-	-	-	-	-	-	N	None	Cladded, Photo 73,74
		B2E			-	-	-	-	-	-	N	None	Cladded, Photo 73,74
Abut 2	N	B1W	E	NT	-	-	-	-	-	-	N	None	Cladded, Photo 77
		B1E			-	-	-	-	-	-	N	None	Cladded, Photo 77
		B2W			-	-	-	-	-	-	N	None	Not Cladded, Photos 77,78
		B2E			14	81	31	-50	90	-	N	None	Not Cladded, Photos 77,78

RN=Roller Next, NR=Reinforced Neoprene Pads, NT=NR+Teflon and Stainless Steel, RK=Rocker, RL=Roller, DD=Disk and Dome, SP=Sliding Plates, PF=Pinned (used for all fixed bearings)
Design Setting = .000011 x (temp+5) x (bridge length), Measurements are in mm

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P01 - South Approach - Looking North - 3 Delineators in Place but River Name Sign Missing

P02 - North Approach - Looking South - All Delineators and River Name Sign in Place

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P03 - Upstream Watercourse to the West

P04 - Downstream Watercourse to the East

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P05 - West Side - Looking South

P06 - Erosion Upstream on the NW River Embankment

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P07 - Erosion Upstream on the NW River Embankment

P08 - North Embankment and Pier 4 - Erosion along Embankment

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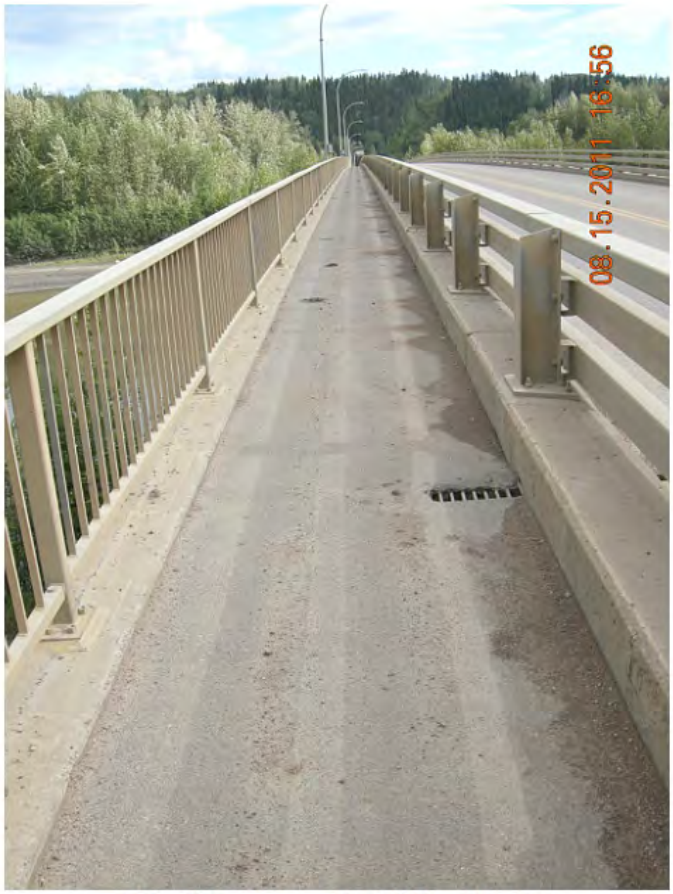
P09 - Overall Deck - Looking North



P10 - Sidewalk on East Side of Bridge

P11 - Water Ponding in NE Sidewalk Deck Joint

P12 - South Expansion Joint - Looking West

P13 - North Deck Joint

P14 - Small Pothole in Asphalt Wearing Surface at NW Corner of Bridge

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P15 - South Approach - Wide Transverse Cracks and Pot Holes in Asphalt

P16 - South Approach - Wide Transverse Cracks and Pot Holes in Asphalt

P17 - Galvanized Steel Pedestrian Railing on East Side - Minor Collision Damage in Several Locations

P18 - Span 5 - East Curb Spalled ~60 mm Deep with Timber Formwork Embedded

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P19 - Some Deck Drains Plugged

P20 - NE Sidewalk Approach

P21 - East Curb - Random Narrow Shrinkage Cracks Throughout

P22 - NW Bridge Railing - Concrete Approach Barrier Transition

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P23 - SE Corner Embankment - Minor Erosion Gullies - 100 mm Deep

P24 - West Side - Looking North

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P25 - Span 1 and South Abutment

P26 - Span 2 - East Girder - Looking North

P27 - Span 2 - Paint Ball Marks on Both Girders

P28 - Span 2 - Narrow Transverse Cracks in Cantilevers - Typical - No Sign of Recent Moisture Staining

P29 - Span 2 - West Girder - Minor Notches in Bottom Flange Near Pier 1

P30 - Span 3 - Box Girders and Soffit - Utilities Suspended from Interior Soffit - Both Sides

P31 - Span 3 - Soffit Patch near Midspan - Timber Formwork Still in Place

P32 - Span 3 - Spall in West Cantilever Facia ~60 mm Deep with Exposed Rebar at Midspan

P33 - Span 3 - Spall in West Cantilever Facia ~40 mm Deep at Pier 3

P34 - Span 4 Girders and Soffit - Looking South

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P35 - Span 4 Soffit - Utilities on Both Girders

P36 - Span 4 - West Girder - Notch in East Side of Bottom Flange - From Overheight Vehicle

P37 - Span 4 - East Girder - Notch in West Side of Bottom Flange - From Overheight Vehicle

P38 - Span 5 Girders - Looking North

P39 - Box Girder Bottom Flanges - Typical - Obsolete Bolt Holes Likely Used for Shipping or Erection

P40 - East Girder - Span 1 - South End

P41 - East Girder - Span 2 Soffit - Leaching Hairline Map Cracks - Typical - No Sign of Recent Seepage - No Delamination

P42 - East Girder - Span 3 - Soffit Patch and Rust Staining Near Midspan - Formwork Left in - No Delaminations

P43 - East Girder - Span 3 Soffit - Random Rust Staining - No Recent Moisture Staining

P44 - East Girder - Span 4 - Soffit Patch - Formwork Left In

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P45 - East Girder - Span 4 - Concrete on Bottom Flange below Deck Patch from Deck Repairs

P46 - East Girder - Pier 4 Diaphragm

P47 - East Girder - Span 5 - Bottom Flange Stiffeners

P48 - East Girder - Span 5 - Soffit Patch at Midspan - Formwork Left In - Leaching Narrow Map Cracks - No Delaminations

P49 - East Girder - Span 5 - North End - Moisture Staining in Bottom Flange

P50 - West Girder - Span 1 - South End

P51 - West Girder - Span 2 Soffit - Leaching Hairline Map Cracks - No Signs of Recent Moisture Staining - No Delaminations

P52 - West Girder - Pier 2 Diaphragm

P53 - West Girder - Span 3 - 3 Soffit Patches near Midspan - Formwork Left in Place - Leaked Concrete on Bottom Flange

P54 - West Girder - Span 3 - Patch in Soffit with Formwork Still in Place

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P55 - West Girder - Span 5 - North End

P56 - South Abutment and Embankment - Gabion Slope Protection

P57 - South Abutment and SE Wingwall - Utility Conduit Running Along East Curb

P58 - South Abutment - Cladding Missing on All Bearings

P59 - South Abutment - East Girder - East Expansion Bearing

P60 - Several Utility Conduits Attached to the Inside Web of the West Girder

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P61 - Pier 1 - North Face

P62 - Pier 1 - Bearings and Seat

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P63 - Pier 1 - South Face - Stones Epoxied to South Face Likely for Climbing

P64 - Pier 2 - North Face - Erosion Gully in South Embankment

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P65 - South Embankment - Erosion Gully up to 400 mm Deep

P66 - Pier 2 Bearing Seat - Minor Spall 30 mm Deep at West End

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P67 - Pier 2 - North Face - Stones Epoxied to Pier Face Likely for Climbing

P68 - Pier 2 Bearings - All Uncladded

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P69 - Pier 3 - South Face

P70 - Pier 3 - South Face - 2 Pieces of Rebar Sticking out of South Face near Bearing Seat

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P71 - Pier 3 - North Face - Rifle Shot Spalls

P72 - Pier 3 - West Girder - East Fixed Bearing - Fixed Bearings on Pier 3 Only

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P73 - Pier 4 - South Side

P74 - Pier 4 - Bearing Seat

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P75 - Pier 4 - 1 Bearing Exposed below West Girder

P76 - North Abutment and Embankment

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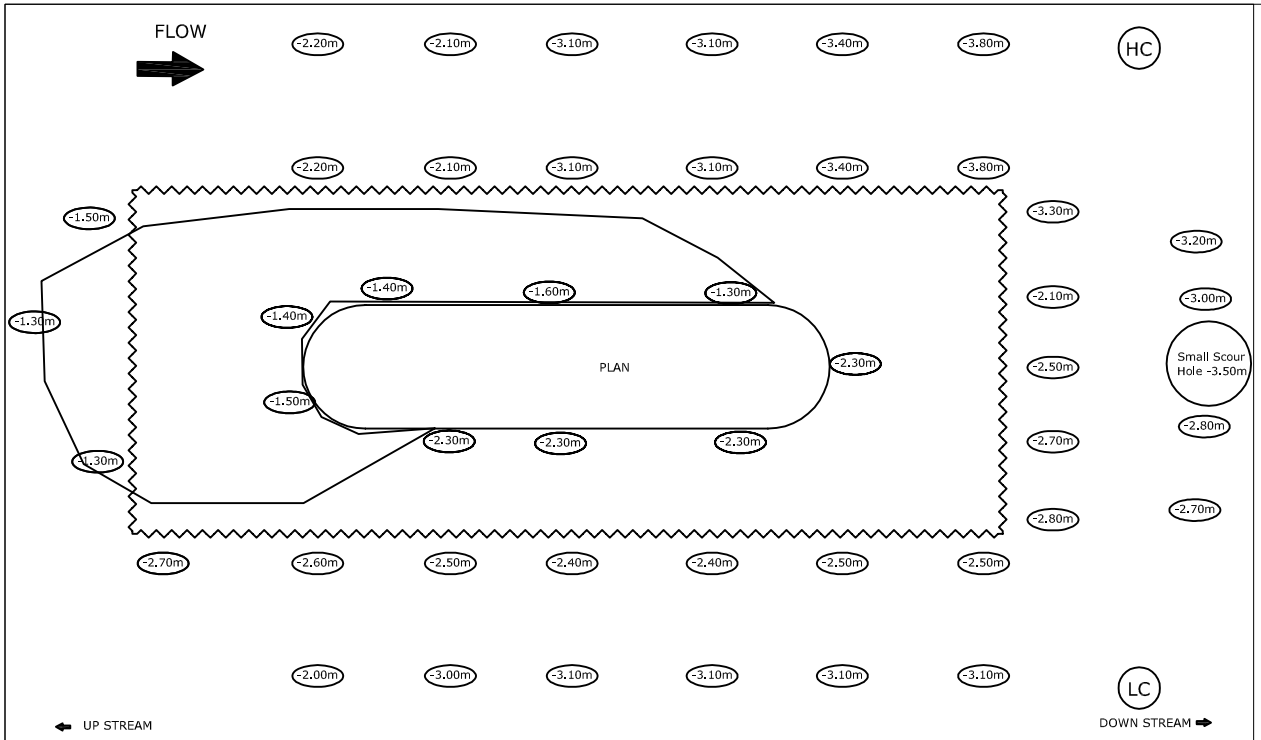
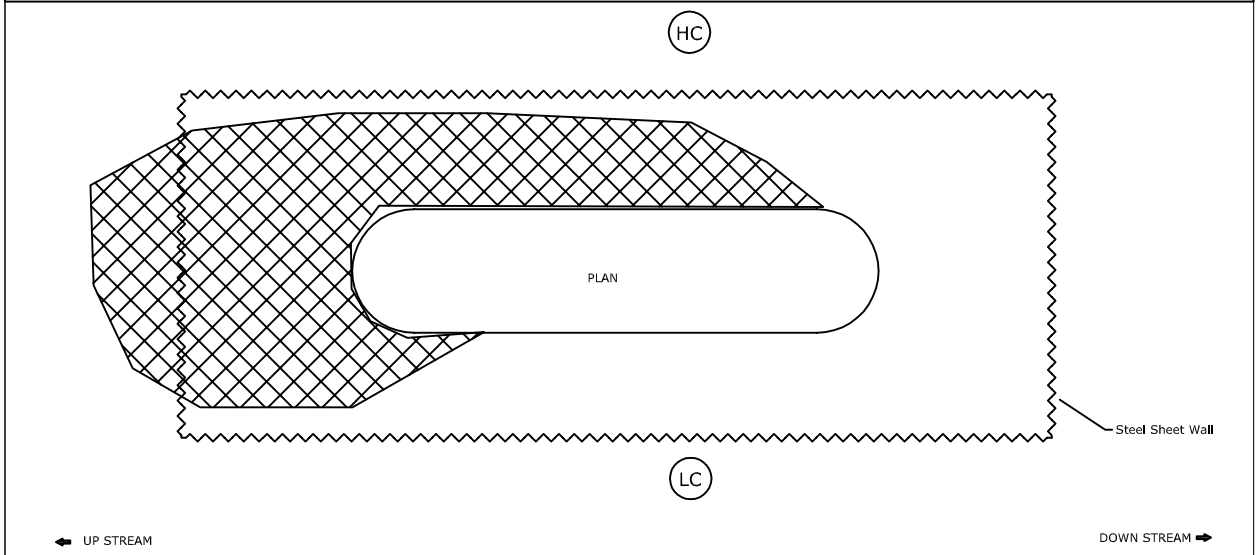
P77 - North Abutment - Inspection Platform Locked Out

P78 - North Abutment - East Girder Bearings have Cladding Removed



Depths around Pier No. 3



Debris around Pier No. 3

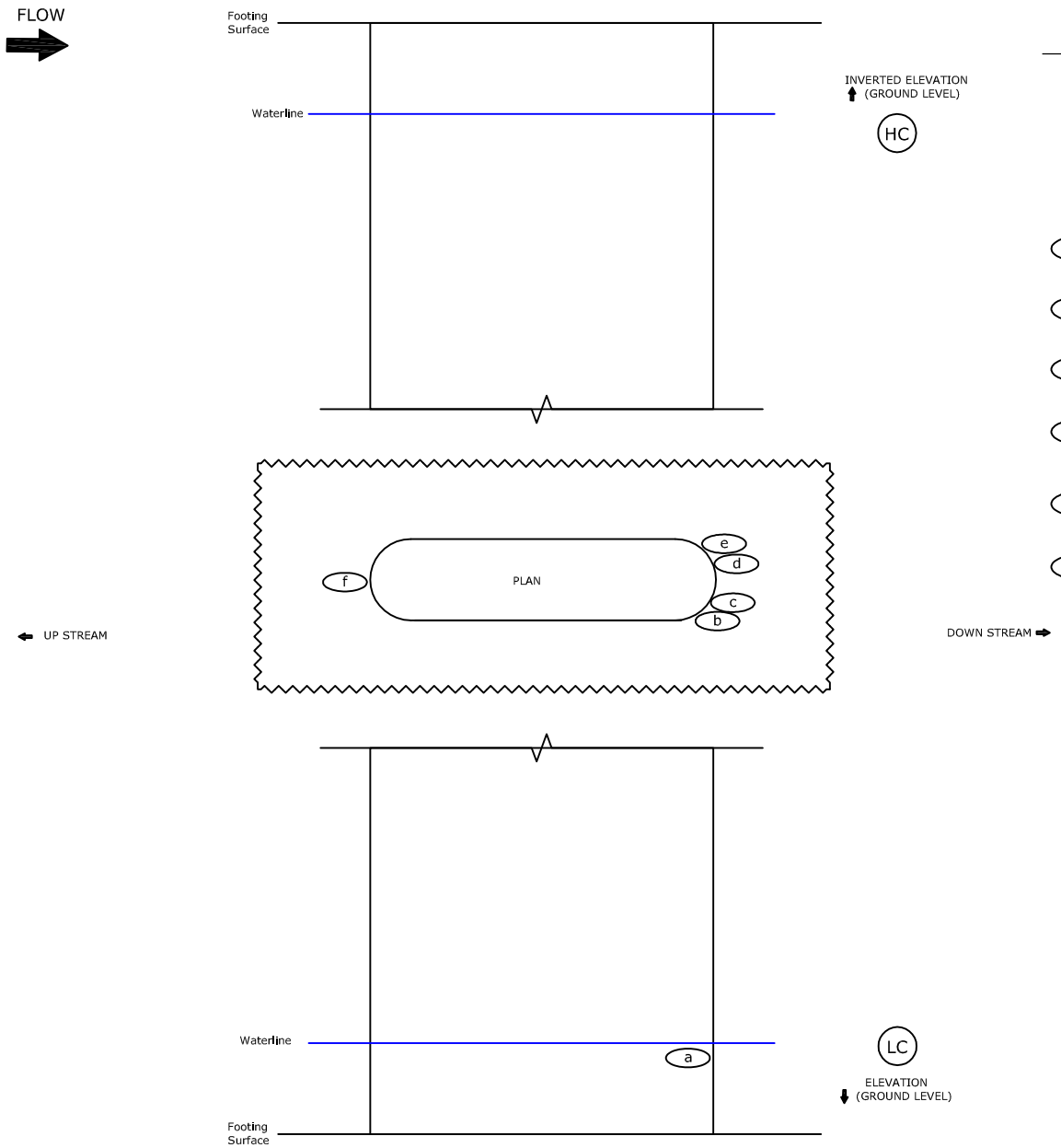
DRAWING NOTES

- Inspection date August 24th, 2011
- Pier No.3 measures 17.8m from deck to the waterline
- Wood Debris outline shown only on Depth inset for clarity

DRAWING LEGEND

HC	High Chain Side of Pier	-0.30m	Depth Measurement
LC	High Chain Side of Pier		Log & Stick Debris (-1.30m typ.)
	Steel Sheet Wall		

Client: Delcan	Drawn by: PELAGIC TECHNOLOGIES	Box 2049, Sechelt, B.C. V0N 3A0 604.885.3552 Tel. 604.885.4333 Fax info@pelagic.ca	Title: Muskwa Bridge Concrete Pier No. 3 Inspection Drawing	Draftsman: GH	Scale: 1:125
				Date: Nov. 15, 2011	No: 1254-11 / Page: 2/2



DRAWING NOTES

- Inspection date August 24th, 2011
- Footing shown for reference only
- Pier No.3 measures 17.8m from deck to the waterline

a — Gunshot spall area 381mm vertical x 610mm horizontal x 6mm penetration

b — Gunshot spall area 508mm vertical x 457mm horizontal x 6mm penetration (1.5m above footing, low chain side)

c — Gunshot spall area 2100mm vertical x 508mm horizontal x 12mm penetration (2.1m above footing, low chain side)

d — Gunshot spall area 255mm vertical x 508mm horizontal x 12mm penetration (2.0m above footing, high chain side)

e — Gunshot spall area 255mm vertical x 255mm horizontal x 12mm penetration (1.2m above footing, high chain side)

f — Gunshot spall area 610mm vertical x 965mm horizontal x 38mm penetration (2.3m above footing, center of nose)

DRAWING LEGEND

HC — High Chain Side of Pier

LC — High Chain Side of Pier

a — Spall Location

Log & Stick Debris (-1.30m typ.)

Steel Sheet Wall

Client: Delcan	Drawn by: PELAGIC TECHNOLOGIES	Box 2049, Sechelt, B.C. V0N 3A0 604.885.3552 Tel. 604.885.4333 Fax info@pelagic.ca	Title: Muskwa Bridge Concrete Pier No. 3 Inspection Drawing	Draftsman: GH	Scale: 1:175
				Date: Nov. 15, 2011	No: 1254-11 Page: 1/2

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Underwater Inspection Photos

UW01 - Overall view looking US

UW02 - Pier 3 DS nose

Muskwa River Bridge - Alaska Highway km 451.8
Underwater Inspection Photos

UW03 - Diver at DS nose LC face

UW04 - Pier 3 HC face

Muskwa River Bridge - Alaska Highway km 451.8
Underwater Inspection Photos

UW05 - Pier 3 US nose

UW06 - Pier 3 US nose 3

Muskwa River Bridge - Alaska Highway km 451.8
Underwater Inspection Photos

UW07 - Pier 3 LC face

UW08 - Pier 3 LC face 2