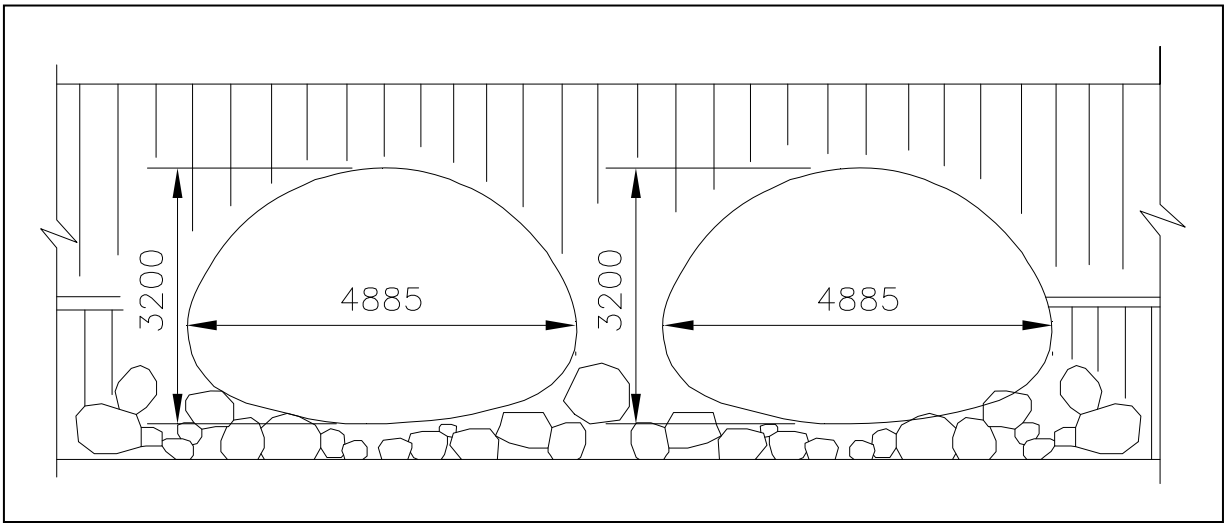
Tetsa Creek Bridge-Culvert No. 4
Alaska Highway km 595.3



ELEVATION

Description:

1. Two pipe arch galvanized corrugated steel plate culverts
2. Galvanized, corrugated steel binwalls at inlets and outlets

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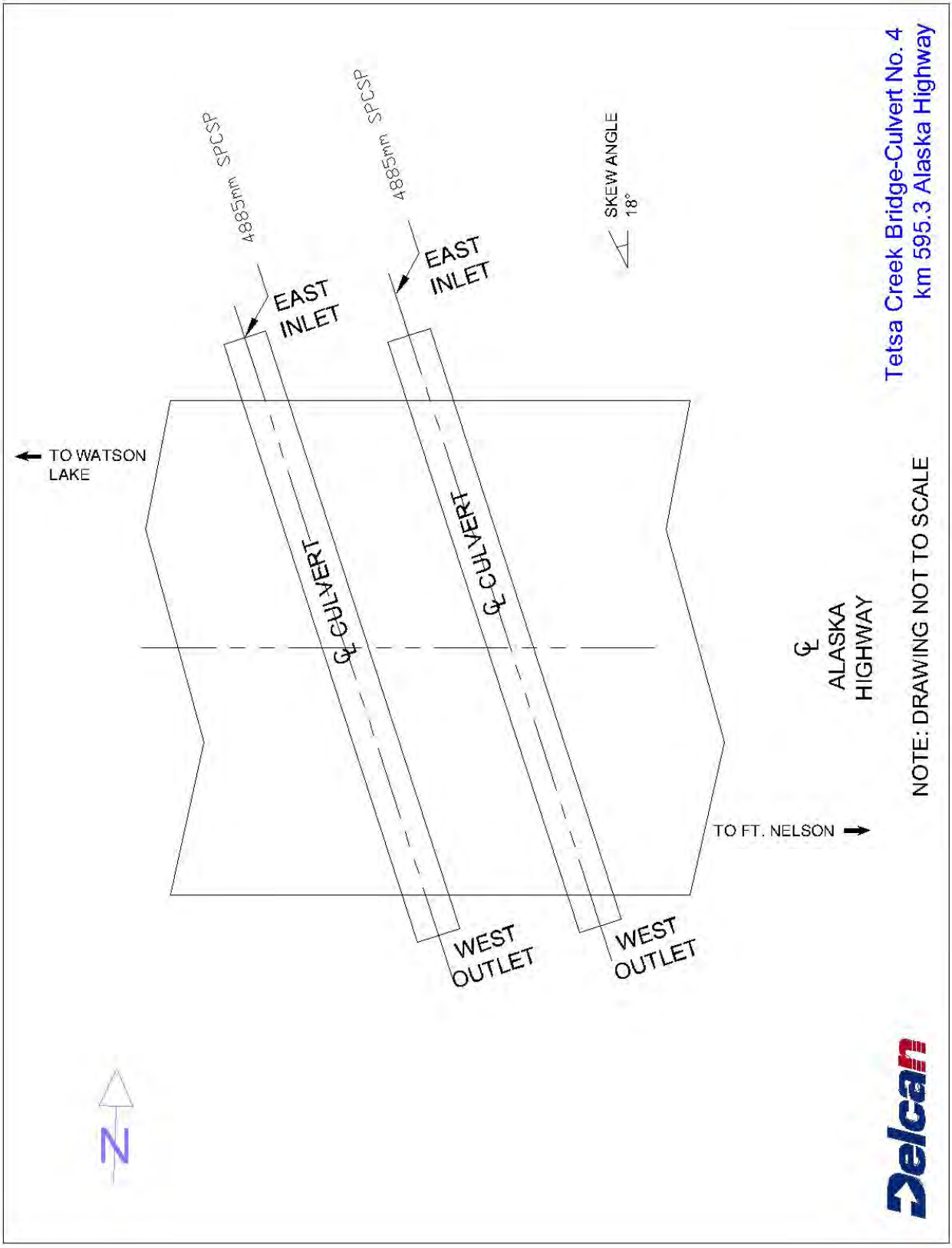

Tetsa Creek Bridge-Culvert No. 4
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Year Constructed:	1960's
Original Design:	PWGSC
Drawings Available:	No
Previous C Inspection Report for 2007:	Delcan – Stan Reimer, P.Eng.
Previous G Inspection Report for 2008:	PWGSC – Alex Taheri, P.Eng., Pei-Chin Tsai, E.I.T. and Jeff Downing, P.Eng.
Current Inspection Date:	August 16, 2011
Inspectors:	Delcan Corporation Stan Reimer, P.Eng. Grant Waldie, E.I.T.
Temperature:	10°C
Weather:	Overcast
Equipment:	Standard Inspection Equipment, Laser Distancer, Chest Waders
2009 Structural Condition Rating:	3
2009 Functional Rating:	6
2010 Structural Condition Rating:	3
2010 Functional Rating:	6
2011 Structural Condition Rating:	**3 (barrel condition)**
2011 Functional Rating:	**6**
Estimated Remaining Life:	10 years
Estimated Replacement Cost:	$2.1 million (2011 dollars)
GPS Coordinates:	N 58°-39'-20.9", W 124°-36'-58.6"

Ten Year Plan - Cost Estimate (2011 dollars)

Recommended Work	Priority Code	Units	Qty	Unit Cost	Within 1 Yr	Within 3 Yrs	Within 5 Yrs	Within 10 Yrs	Maint.
1. Install concrete lip below south barrel	A	lump	1	$8,000	$8,000				
2. Remove large boulders from both barrels	M	lump	2	$1,500					$3,000
3. Rehabilitate both barrels with CSP liner	10	m^2	342	$2,230				$762,660	
Construction/Maintenance Cost Subtotals:					$8,000	$0	$0	$762,660	$3,000
Enineering Costs (20% of construction cost):					$1,600	$0	$0	$152,532	
20% Contingency:					$1,600	$0	$0	$152,532	$600
Note: Costs do not include: mobilization or flagging — Subtotals:					$11,200	$0	$0	$1,067,724	$3,600
Total Cost Estimate:					**$1,082,524**				

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Significant Inspection Concerns	1. Both barrels are in poor condition with significant distortion and significant cracking along plate seams. The south barrel has a maximum of 15.4% vertical distortion and 10 of 15 rings cracked with as little as 50 mm remaining steel plate between cracks. The north barrel has a maximum of 12.7% vertical distortion and 7 of 15 rings cracked with as little as 23 mm remaining steel plate between cracks (down from 35 mm in 2005 but unchanged from 2009) (see Photo P17). Both barrels have historically cantilevered (gun barreled) out of the highway embankment a few metres. The eroded gap below the outlet barrels has been backfilled periodically over the years and cycles between the backfilled and scoured state. The barrels are currently well backfilled with riprap at the outlet. Both barrels have drooped at the outlets with the bottom plates in the last few rings dropping as much as 400 mm. There are two large (200 mm) dents in roof the south barrel at rings 5 and 14. The bottom corrugations are flattened by rock flow in both barrels. These barrels (particularly the north barrel) have a relatively short 10 years of estimated remaining life, therefore, an investment in floor armouring probably doesn't make sense prior to lining or replacement. 2. Although this culvert has a Structural Condition Rating of just 3, no major repair actions are warranted until barrels are lined in 10 years. 3. Some flow is piping below the south barrel inlet and squirting in through bolt holes in ring 1.

Element	2009 MCR	2009 PCR	2009 Priority	2011 MCR	2011 PCR	2011 Priority	Observations	Photo References
Primary Components								
Watercourse	4	4	D	4	4	D	The Tetsa Creek is a fast flowing braided watercourse that enters the inlets on an angle. A berm of heavy riprap protects the SE inlet embankment and diverts the stream into the twin barrels. There are rocks strewn along both culvert barrels.	2,21
Soil – Steel Structures	3	3	M	3	3	M 10	Both barrels are in poor condition with significant distortion and significant cracking along plate seams. The south barrel has a maximum of 15.4% vertical distortion and 10 of 15 rings cracked with as little as 50 mm remaining steel plate between cracks. The north barrel has a maximum of 12.7% vertical distortion and 7 of 15 rings cracked with as little as 23 mm remaining steel plate between cracks (down from 35 mm in 2005 but unchanged from 2009). Both barrels have historically cantilevered (gun barreled) out of the highway embankment a few metres. The eroded gap below	5-17

Element	2009			2011			Observations	Photo References
	MCR	PCR	Priority	MCR	PCR	Priority		
							the outlet barrels has been backfilled periodically over the years and cycles between the backfilled and scoured state. The barrels are currently well backfilled with riprap at the outlet. Both barrels have drooped at the outlets with the bottom plates in the last few rings dropping as much as 400 mm. There are two large (200 mm) dents in roof the south barrel at rings 5 and 14. The bottom corrugations are flattened by rock flow in both barrels. These barrels (particularly the north barrel) have a relatively short 10 years of estimated remaining life, therefore, an investment in floor armouring probably doesn't make sense prior to lining or replacement.	
Inlet	4	4	A	4	4	A	The inlets both have minor collision damage. There are some large rocks blocking the north barrel inlet. Some flow is piping below the south barrel inlet and squirting in through bolt holes in ring 1.	3,4
Outlet	3	4	D	3	4	D	Both barrels have historically cantilevered (gun barreled) out of the highway embankment a few metres. The eroded gap below the outlet barrels has been backfilled periodically over the years and cycles between the backfilled and scoured state. The barrels are currently well backfilled with riprap. Both barrels have drooped at the outlets with the bottom plates in the last few rings dropping as much as 400 mm. Both outlets have minor collision damage.	18,19, 20
Secondary Components								
Embankments	5	5	D	5	5	D	The embankments below the outlets have been undermined and have settled significantly resulting in deformation of both barrels. Otherwise, embankments are well covered with river rock and there is little evidence of erosion.	3-5, 10-12, 18
Retaining Walls	4	4	D	4	4	D	There are binwalls at the inlets only. Binwalls have some collision damage.	3-5
Approaches	5	5	D	5	5	D	Approach roadways have a BST wearing surface and are in good condition.	1
Galvanizing	5	5	D	5	5	D	The galvanizing is in surprisingly good condition with corrosion limited to the bottom of both barrels where galvanizing has been largely removed by stream abrasion.	5-17
Auxiliary Components								

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Element	2009 MCR	2009 PCR	2009 Priority	2011 MCR	2011 PCR	2011 Priority	Observations	Photo References
Slope Protection	5	5	D	5	5	D	Embankments are well covered with river rock and there is little evidence of erosion. A berm of heavy riprap protects the SE inlet embankment and diverts the stream into the twin barrels.	3,18
Signs	5	5	D	5	5	D	Creek name signs present on both approaches.	1

Tetsa Creek Multiplate 4 - Barrel 1 - km 595.3

South Barrel - Geometric Data

Span (mm)	4890 mm	Skew	18 degrees
Rise (mm)	3200 mm	Slope	1.50%
Length (m)	35.0 m	Est. Cover (m)	1.3 m
Corrugations	152 x 51 mm	Inlet Bevel	None
Flow Direction	East to west	Outlet Bevel	None

Barrel Measurements and Condition

Ring #	Length (m)	Stn. (m)	Span (mm)	Defl. %	Rise (mm)	Sag %	#	Long. Cracks	Min. Steel	Comments
1	1.8	0.9	4814	-1.6%	3018	5.7%				
2	1.8	2.7	4878	-0.2%	2906	9.2%				
3	1.8	4.6	4937	1.0%	2878	10.1%				
4	2.4	7.0	4923	0.7%	2771	13.4%	1	4:30	55	Monitor cracking along one plate splice
5	2.4	9.5	4963	1.5%	2856	10.8%	1	4:30	65	Monitor cracking along one plate splice
6	2.4	11.9	4969	1.6%	2855	10.8%	1	4:30	105	Monitor cracking along one plate splice
7	2.4	14.3	4951	1.2%	2856	10.8%	1	4:30	140	Monitor cracking along one plate splice
8	2.4	16.8	5027	2.8%	2780	13.1%	1	4:30	110	Monitor cracking along one plate splice
9	2.4	19.2	5060	3.5%	2731	14.7%				
10	2.4	21.6	5075	3.8%	-	-	1	4:30	125	Monitor cracking along one plate splice
11	2.4	24.1	5109	4.5%	-	-	1	4:30	110	Monitor cracking along one plate splice
12	2.4	26.5	5076	3.8%	-	-	1	4:30	90	Monitor cracking along one plate splice
13	2.4	29.0	5115	4.6%	2708	15.4%	1	4:30	**50**	Worst cracking along plate splice
14	2.4	31.4	5069	3.7%	2839	11.3%	1	4:30	57	Bottom has settled approximately 400 mm
15	2.4	33.8	4826	-1.3%	3271	-2.2%				Bottom has settled approximately 400 mm

Ring #	Number of rings denoted by the bolted circumferential seam starting from upstream end
Length	Length of ring from inlet circumferential seam to outlet circumferential seam
Station	Measured from inlet end of barrel, station is location where span and rise were taken
Span	The horizontal measured distance from inside crest to inside crest
Deflection	Deflection % = (measured span - design span) / (design span)
Rise	The vertical measured distance from inside crest to inside crest
Sag	Sag % = (design rise - measured rise) / (design rise)
# of Cracks	The number of cracked seams in a given ring
Logitudinal Cracks	The location of longitudinal cracks is given in a 12 hour clock format looking downstream
Minimum Steel	The minimum longitudinal distance of remaining steel between two adjacent longitudinal cracks

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Tetsa Creek Multiplate 4 - Barrel 2 - km 595.3

North Barrel - Geometric Data

Span (mm)	4890 mm	Skew	18 degrees
Rise (mm)	3200 mm	Slope	1.50%
Length (m)	35.0 m	Est. Cover (m)	1.3 m
Corrugations	152 x 51 mm	Inlet Bevel	None
Flow Direction	East to west	Outlet Bevel	None

Barrel Measurements and Condition

Ring #	Length (m)	Stn. (m)	Span (mm)	Defl. %	Rise (mm)	Sag %	#	Long. Cracks	Min. Steel	Comments
1	1.8	0.9	4899	0.2%	3070	4.1%	-	-	-	
2	1.8	2.7	4924	0.7%	2996	6.4%	1	4:30	70	Monitor cracking along one plate splice
3	1.8	4.6	4991	2.1%	2883	9.9%	1	4:30	55	Monitor cracking along one plate splice
4	2.4	7.0	4993	2.1%	2816	12.0%	1	4:30	**23**	Worst crack in plate splice
5	2.4	9.5	5026	2.8%	2835	11.4%	1	4:30	35	Monitor cracking along one plate splice
6	2.4	11.9	5009	2.4%	2816	12.0%	1	4:30	35	Monitor cracking along one plate splice
7	2.4	14.3	5017	2.6%	2795	12.7%	1	4:30	35	Monitor cracking along one plate splice
8	2.4	16.8	4977	1.8%	2858	10.7%	1	4:30	45	Monitor cracking along one plate splice
9	2.4	19.2	4964	1.5%	2858	10.7%	-	-	-	
10	2.4	21.6	4954	1.3%	2855	10.8%	-	-	-	
11	2.4	24.1	4943	1.1%	2872	10.3%	-	-	-	
12	2.4	26.5	4900	0.2%	2920	8.8%	-	-	-	
13	2.4	29.0	4880	-0.2%	2990	6.6%	-	-	-	
14	2.4	31.4	4822	-1.4%	3232	-1.0%	-	-	-	Bottom has settled approximately 400 mm
15	2.4	33.8	4726	-3.4%	-	-	-	-	-	Bottom has settled approximately 400 mm

Ring #	Number of rings denoted by the bolted circumferential seam starting from upstream end
Length	Length of ring from inlet circumferential seam to outlet circumferential seam
Station	Measured from inlet end of barrel, station is location where span and rise were taken
Span	The horizontal measured distance from inside crest to inside crest
Deflection	Deflection % = (measured span - design span) / (design span)
Rise	The vertical measured distance from inside crest to inside crest
Sag	Sag % = (design rise - measured rise) / (design rise)
# of Cracks	The number of cracked seams in a given ring
Logitudinal Cracks	The location of longitudinal cracks is given in a 12 hour clock format looking downstream
Minimum Steel	The minimum longitudinal distance of remaining steel between two adjacent longitudinal cracks

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P01 - Roadway Looking North

P02 - Upstream Watercourse to the East

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P03 - Inlets and East Embankment

P04 - South Barrel - Inlet and East Embankment

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P05 - South Barrel - Minor Collision Damage both Sides of Inlet Rim

P06 - South Barrel - Inlet Watercourse to North of Inlet

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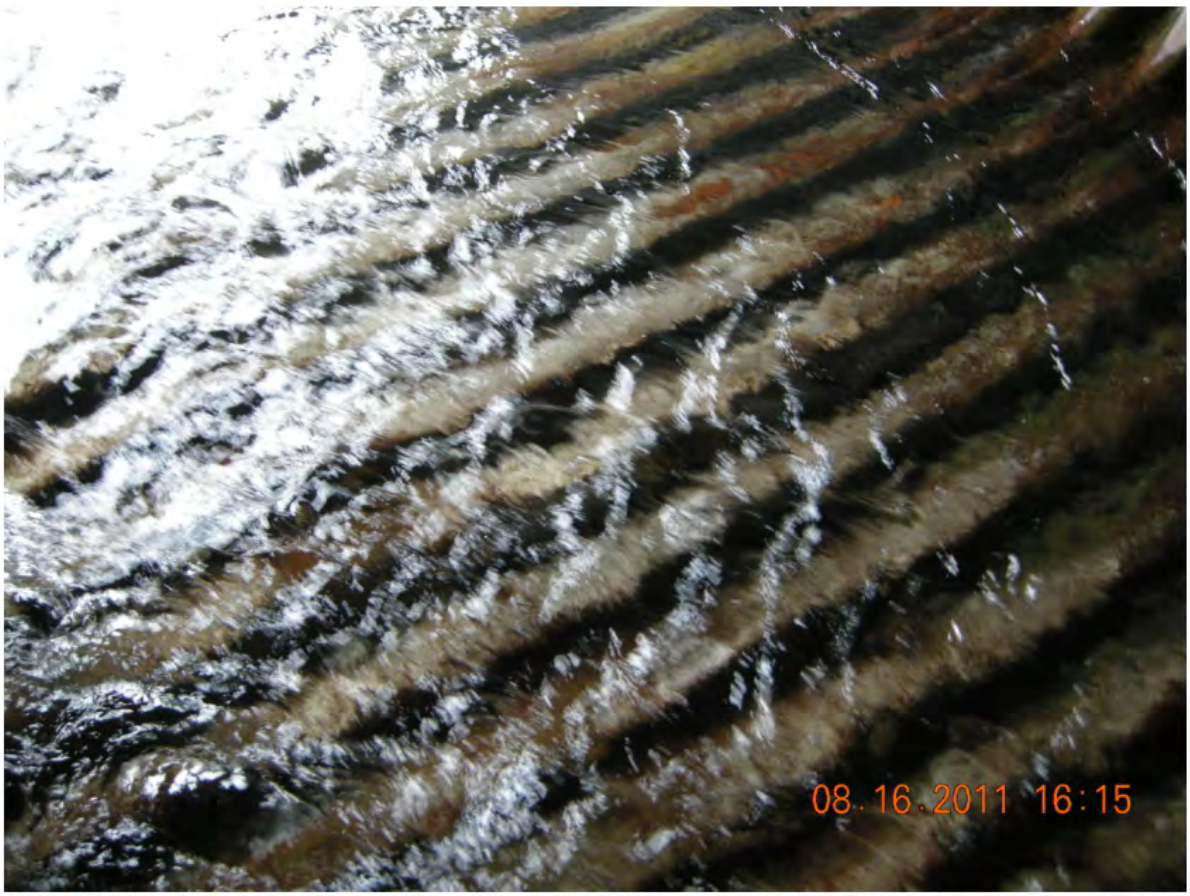
P07 - South Barrel - Looking Towards Outlet - Most Flow on South Side - Debris on North Side



P08 - South Barrel - Bottom Corrugations Folded Over Due to Rock Impact in Both Barrels

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P09 - South Barrel - Ring 5 - Roof Kinked Down ~150 mm

P10 - South Barrel - Floor has Drooped Down ~400 mm in Both Barrels - Collision Damage Kink in Roof at Ring 14

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P11 - South Barrel - Outlet - Floor has Drooped Down ~400 mm in Both Barrels Due to Erosion of Supporting Material Below Outlet in Past

P12 - North Barrel - Inlet Watercourse - Large Riprap in Watercourse

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P13 - North Barrel - Minor Collision Damage to Inlet Rim

P14 - North Barrel - Looking Towards Outlet

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P15 - North Barrel - Light Surface Corrosion to High Water Level

P16 - North Barrel - Floor has Drooped Down ~400 mm in Both Barrels

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P17 - North Barrel - Longitudinal Cracking in Both Barrels - Ring 4 @ 4:30 - 23 mm Remaining Section

P18 - North Barrel - Outlet - Floor has Drooped Down ~400 mm in Both Barrels

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P19 - North Barrel - Minor Collision Damage to Outlet Rim

P20 - Outlets and West Embankment

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P21 - Downstream Watercourse to the West