Aquatic Field Survey Photos

Photo 1: LaPlanche River, 5 m upstream from the bridge

Photo 2: LaPlanche River, facing tributary

Photo 3: Tributary to the right of LaPlanche River at 977m upstream from bridge, facing culvert, note: white foam in stream

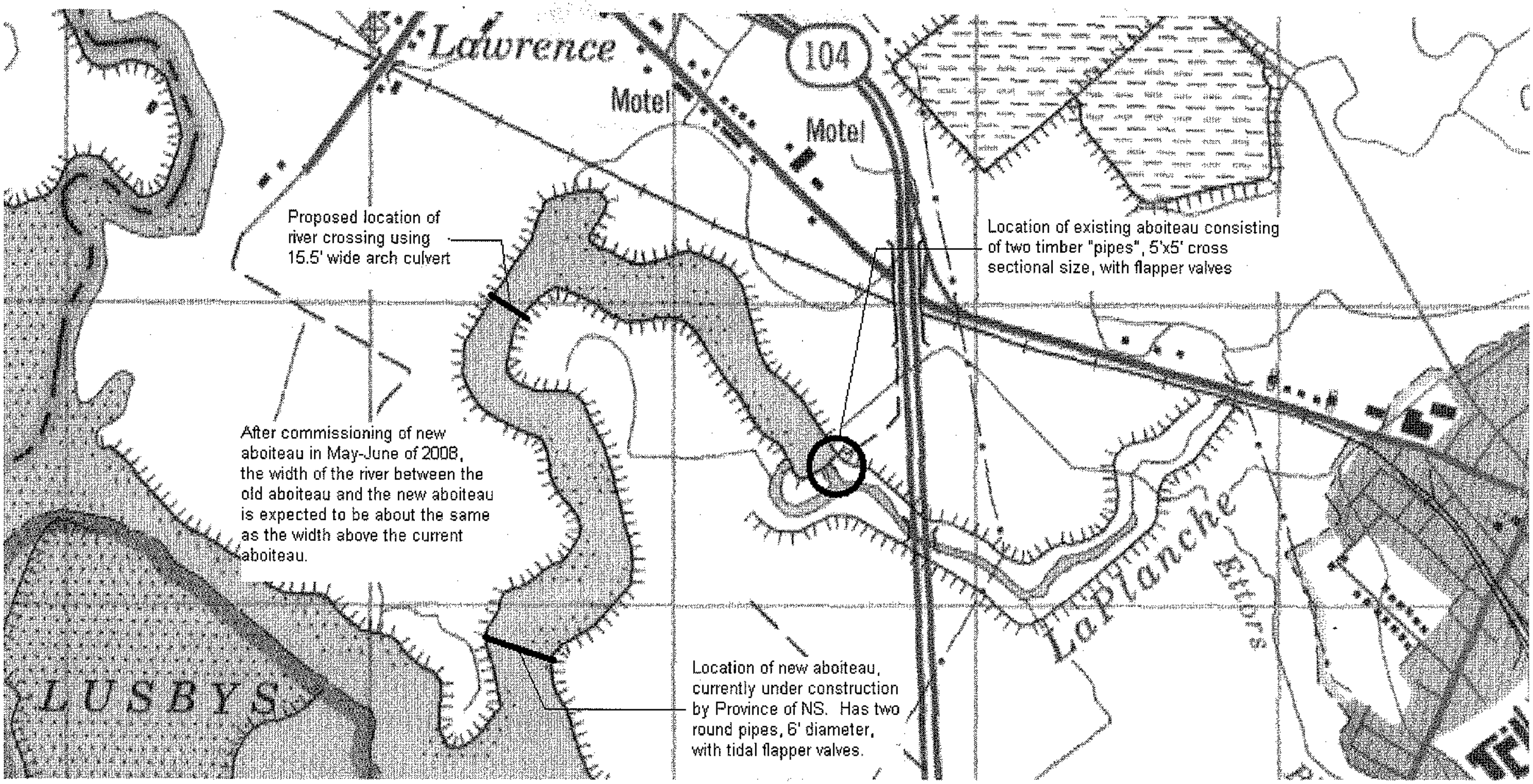
Photo 4: Wooden culvert of tributary, 977m upstream LaPlanche River from bridge

Photo 5: LaPlanche River, at aboiteau area (to the right)

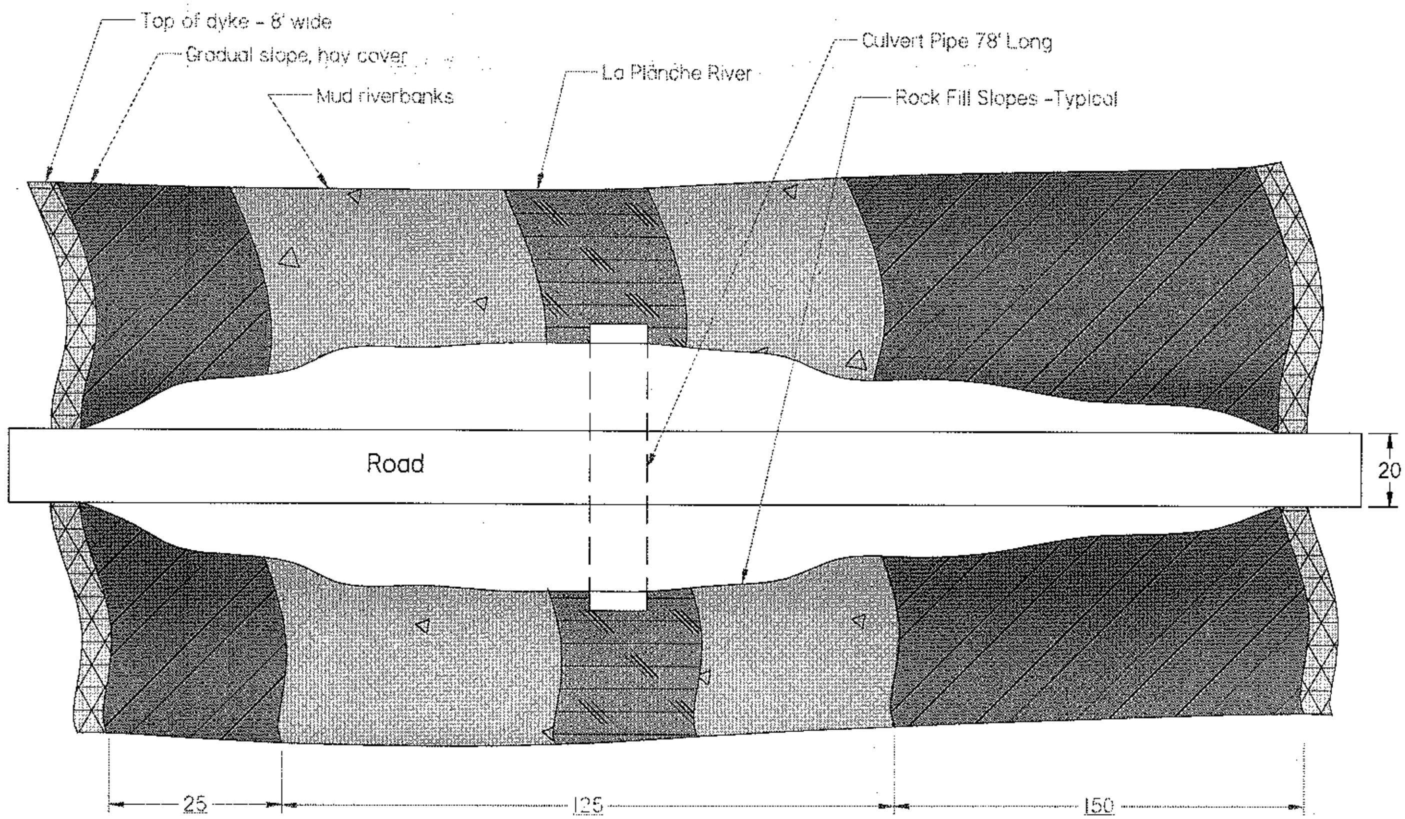
Photo 6: Estuary leading to the Bay of Fundy, other side of aboiteau from LaPlanche River

Photo 7: Tributary of LaPlanche River

Photo 8: Tributaries of LaPlanche River

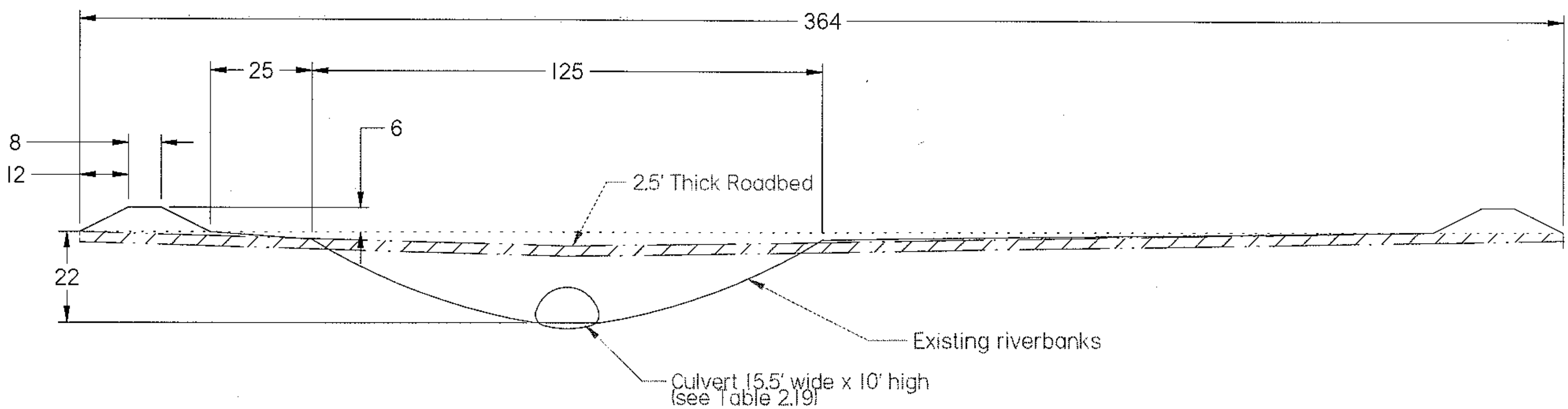

Lawrence
104
Motel
Motel
Proposed location of river crossing using 15.5' wide arch culvert
Location of existing aboiteau consisting of two timber "pipes", 5'x5' cross sectional size, with flapper valves
After commissioning of new aboiteau in May-June of 2008, the width of the river between the old aboiteau and the new aboiteau is expected to be about the same as the width above the current aboiteau.
Laplanche
Ettors
LUSBYS
Location of new aboiteau, currently under construction by Province of NS. Has two round pipes, 6' diameter, with tidal flapper valves.

Plan view of proposed culvert



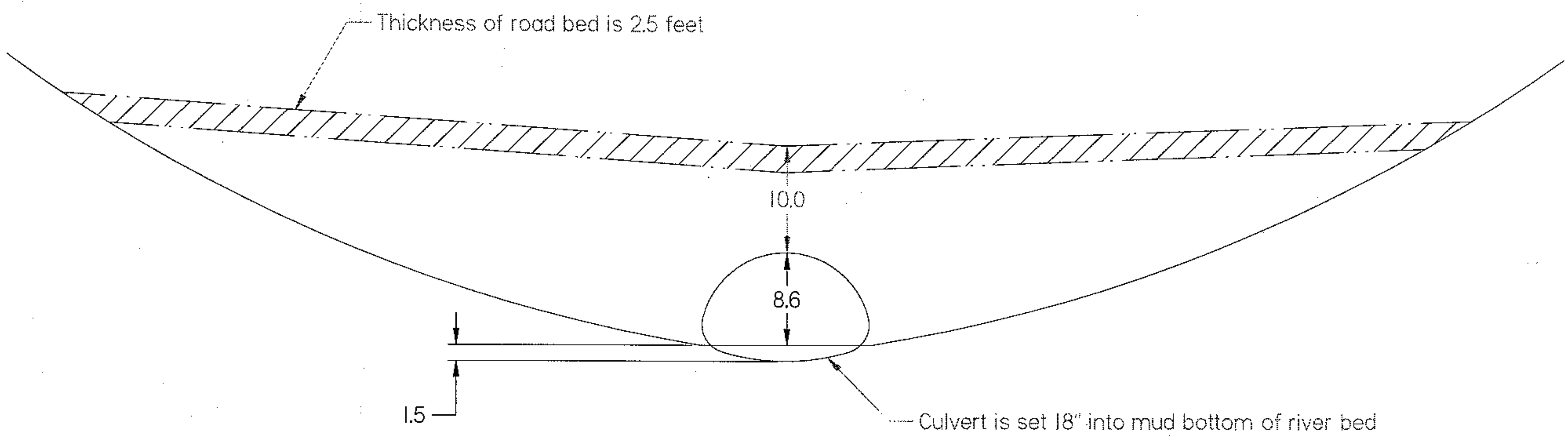
1. Distances are in feet and are approximate.

Side View of Proposed Culvert Looking South



1. Dimensions are in feet and are approximate
2. Dykes are same size and shape
3. Dykes are no longer required, and will be removed

Side View Culvert Detail



1. All units in feet unless otherwise specified

Figure 4. Rating Curve Plot for Crossing: Culvert arch pipe

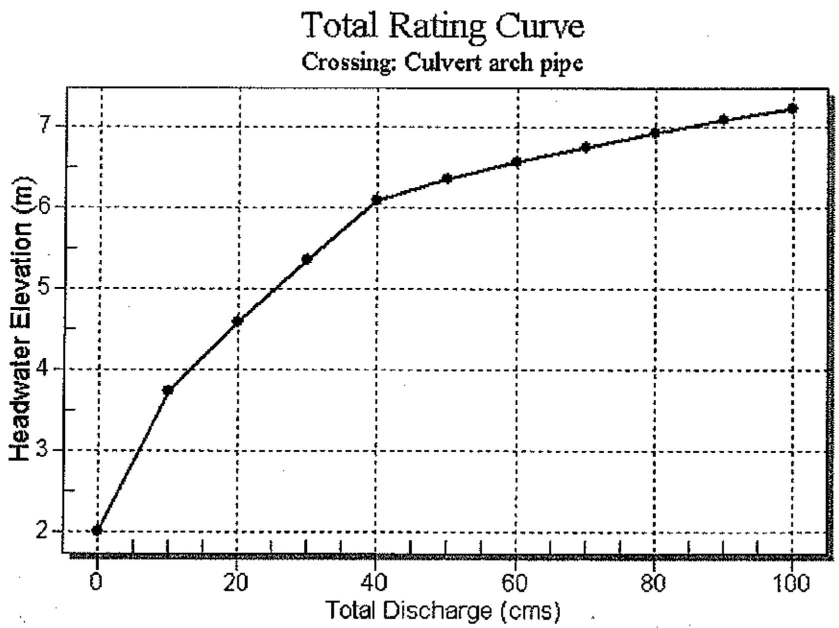
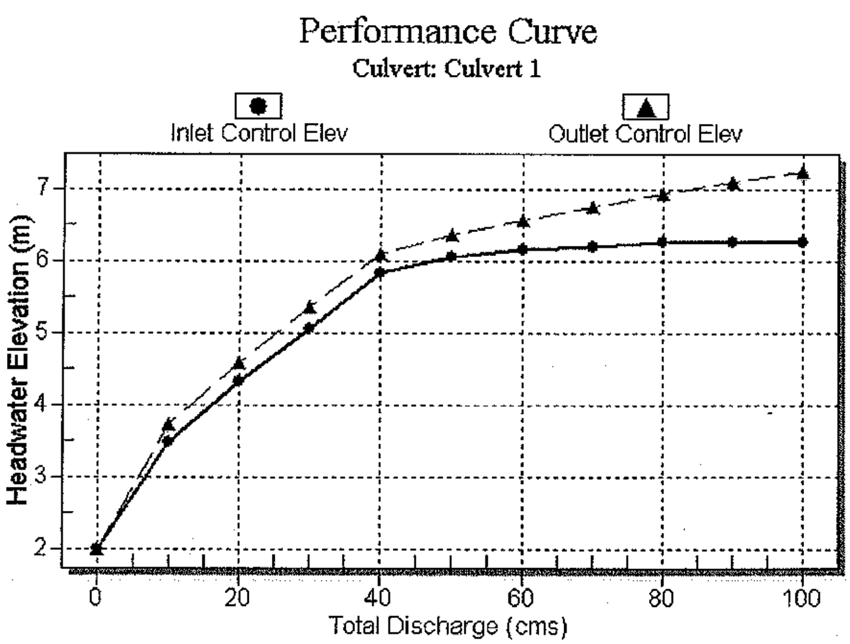


Figure 5. Culvert Performance Curve Plot



HY-8 Culvert Analysis Report

1. Project Units: SI Units (Metric)

2. Summary of Culvert Flows at Crossing: Culvert arch pipe

Headwater Elevation (m)	Total Discharge (cms)	Culvert 1 Discharge (cms)	Roadway Discharge (cms)	Iterations
2.00	0.00	0.00	0.00	1
3.73	10.00	10.00	0.00	1
4.58	20.00	20.00	0.00	1
5.36	30.00	30.00	0.00	1
6.09	40.00	39.05	0.94	8
6.36	50.00	41.44	8.57	4
6.57	60.00	42.43	17.56	4
6.75	70.00	42.78	27.22	4
6.93	80.00	43.26	36.74	4
7.09	90.00	43.31	46.69	4
7.23	100.00	43.32	56.68	4

3. Culvert Summary Table

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	2.00	0.000	**0.000**	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
10.00	10.00	3.73	1.482	**1.734**	3-M2t	2.193	0.958	1.350	1.320	1.863	1.041
20.00	20.00	4.58	2.326	**2.583**	3-M2t	3.152	1.417	1.804	1.774	2.709	1.240
30.00	30.00	5.36	3.063	**3.356**	3-M2t	3.152	1.783	2.131	2.101	3.441	1.373
40.00	39.05	6.09	3.830	**4.088**	3-M2t	3.152	2.069	2.395	2.365	4.033	1.476
50.00	41.44	6.36	4.062	**4.362**	3-M2t	3.152	2.140	2.621	2.591	3.981	1.561
60.00	42.43	6.57	4.164	**4.570**	7-M2t	3.152	2.170	2.820	2.790	3.868	1.634
70.00	42.78	6.75	4.199	**4.754**	7-M2t	3.152	2.181	2.999	2.969	3.793	1.699
80.00	43.26	6.93	4.250	**4.932**	4-FFf	3.152	2.195	3.152	3.134	3.755	1.756
90.00	43.31	7.09	4.254	**5.088**	4-FFf	3.152	2.196	3.152	3.286	3.759	1.809
100.00	43.32	7.23	4.256	**5.231**	4-FFf	3.152	2.197	3.152	3.427	3.760	1.857

4. Downstream Channel Rating Curve (Crossing: Culvert arch pipe)

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
0.00	2.00	0.00	0.00	0.00	0.00
10.00	3.11	1.11	1.40	0.07	0.30
20.00	3.50	1.50	1.67	0.09	0.32
30.00	3.78	1.78	1.85	0.11	0.33
40.00	4.01	2.01	1.98	0.13	0.33
50.00	4.20	2.20	2.10	0.14	0.34
60.00	4.37	2.37	2.20	0.15	0.34
70.00	4.53	2.53	2.29	0.16	0.34
80.00	4.67	2.67	2.36	0.17	0.35
90.00	4.80	2.80	2.43	0.17	0.35
100.00	4.92	2.92	2.50	0.18	0.35

Table 1-7 Continued. Handling Weight of Round Corrugated Steel Pipe (152x51 mm)
(Estimated Average Masses—Not for Specification Use)

Inside Diam. (mm)	Waterway Area (m²)	Approximate Mass (kg/m) Bolts Incl. — Specified Wall Thickness — mm 3.0	4.0	5.0	6.0	7.0	Periphery (Hole Spaces) N
6160	29.79	680	889	1100	1309	1519	80N
6470	32.87	711	930	1150	1370	1589	84N
6780	35.10	743	978	1210	1440	[illegible]	88N
7090	39.48	779	1019	1260	1501	1741	92N
7400	43.01	809	1060	1311	1561	1812	96N
7710	46.70	846	1108	1370	1631	1893	100N
8020	50.53	877	1149	1421	1692	1963	104N

Dimensions shown not for specification purposes, subject to manufacturing tolerances.
N = 244 mm.

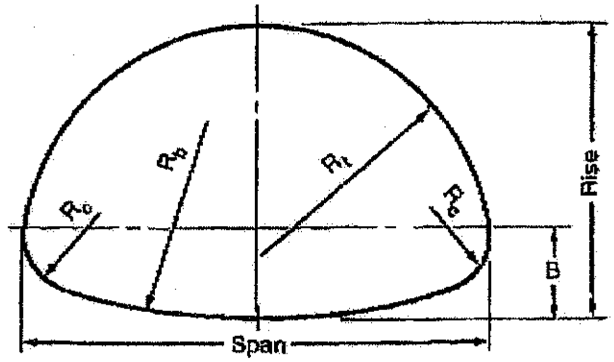


Table 1-8 Sizes and Layout Details—Structural Plate Pipe Arches Corrugation Profile: 152 x 51 mm

Dimensions: Span (mm)	Rise (mm)	Waterway Area (m²)	Layout Dimensions mm: B	R_t	R_c	R_b	Periphery (Hole Spaces) N
2060	1520	2.49	700	1130	660	1875	24N
2240	1630	2.90	680	1205	660	3370	26N
2440	1750	3.36	730	1305	685	2995	28N
2590	1880	3.87	735	1355	710	4420	30N
2690	2080	4.49	815	1380	785	4050	32N
3100	1980	4.83	790	1695	685	3850	34N
3400	2010	5.28	840	2000	660	3510	36N
3730	2290	6.61	900	2055	710	4045	40N
3890	2690	8.29	915	1975	815	6015	44N
4370	2870	9.76	1035	2265	815	4895	48N
4720	3070	11.38	1015	2425	815	6430	52N
5050	3330	13.24	1040	2570	840	7430	56N
5490	3530	15.10	1095	2790	840	7575	60N
5890	3710	17.07	1180	3020	840	7755	64N
6250	3910	19.18	1120	3175	840	9630	68N
7040	4060	22.48	1660	4090	1370	9650	74N
7620	4240	25.27	1750	4570	1370	9650	79N

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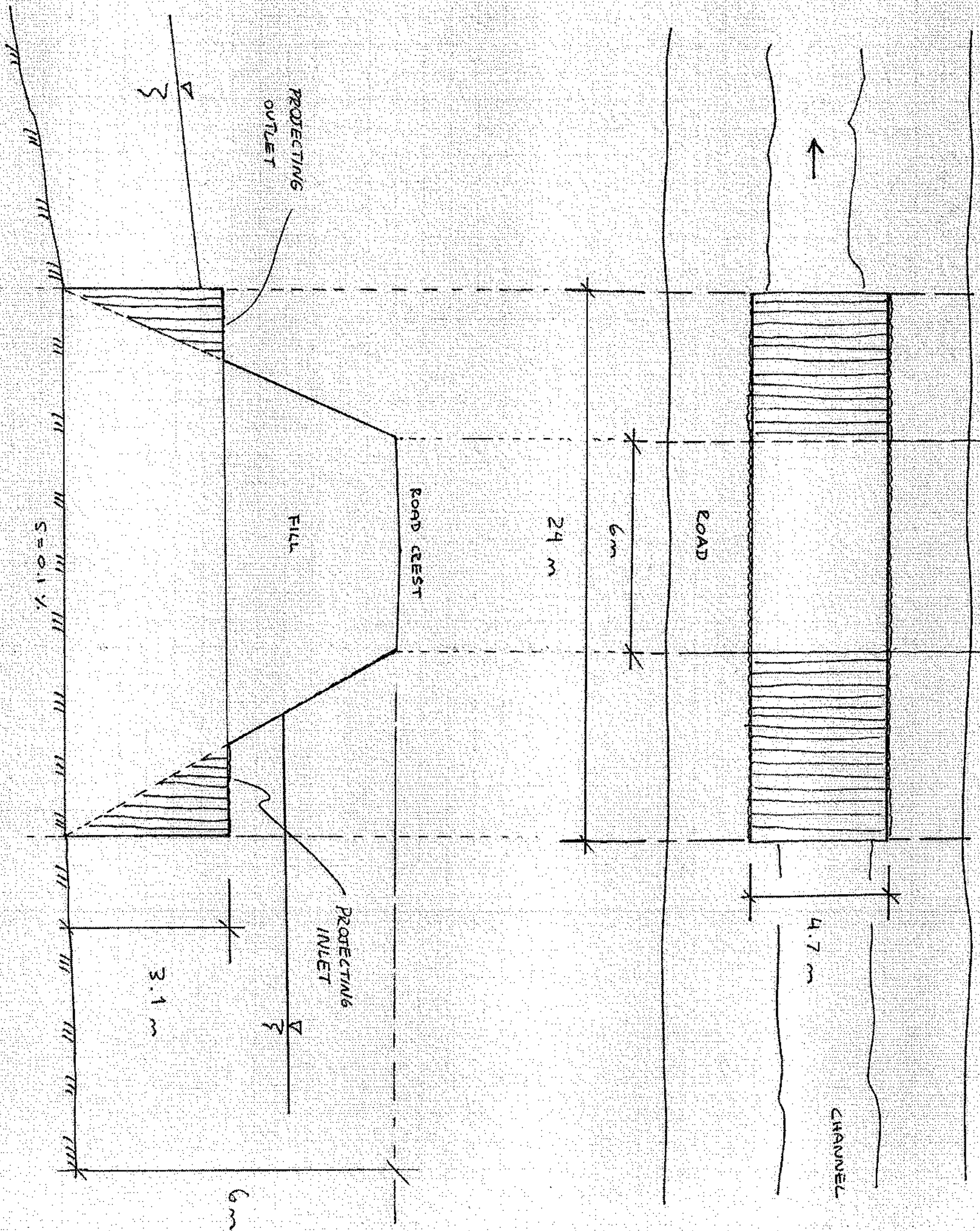
CHECKED BY
PROJECT No. 1005774
DATE
SHEET No. of

FIGURE3



* Not to scale

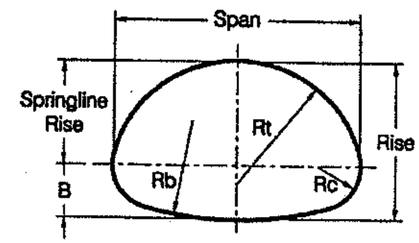


Table 2.19

Structural plate corrugated pipe-arch
152 x 51 mm corrugation profile
Standard dimensions and unit weight of structure (assembled)

Span, mm	Rise, mm	End Area, m²	Layout Dimensions* (to neutral axis), mm				Required N				Unit Weight of Structure, kg/m, Bolts Included — Specified Wall Thickness, mm				
			B	R_t	R_c	R_b	Top	Each Corner	Bottom	Total	3.0	4.0	5.0	6.0	7.0
2060	1520	2.49	700	1130	660	1875	9	5	5	24	210	274	339	403	467
2240	1630	2.90	680	1205	660	3370	11	5	5	26	232	302	373	443	513
2440	1750	3.36	730	1305	685	2995	12	5	6	28	248	323	398	473	548
2590	1880	3.87	735	1355	710	4420	14	5	6	30	263	343	423	503	583
2690	2080	4.49	815	1380	785	4050	16	5	6	32	285	371	458	544	630
3100	1980	4.83	790	1695	685	3850	15	5	9	34	294	384	474	564	654
3400	2010	5.28	840	2000	660	3510	15	5	11	36	316	412	508	604	700
3730	2290	6.61	900	2055	710	4045	18	5	12	40	346	452	559	665	771
3890	2690	8.29	915	1975	815	6015	23	5	11	44	384	501	618	735	852
4370	2870	9.76	1035	2265	815	4895	24	5	14	48	414	541	669	795	922
4720	3070	11.38	1015	2425	815	6430	27	5	15	52	445	582	719	856	993
5050	3330	13.24	1040	2570	840	7430	30	5	16	56	489	638	787	936	1085
5490	3530	15.10	1095	2790	840	7575	32	5	18	60	513	671	829	987	1145
5890	3710	17.07	1150	3020	840	7755	34	5	20	64	557	727	897	1067	1237
6250	3910	19.18	1120	3175	840	9630	37	5	21	68	588	767	948	1128	1308
7040	4060	22.48	1660	4090	1370	9650	31	11	21	74	653	851	1050	1248	1447
7620	4240	25.27	1750	4570	1370	9650	33	11	24	79	679	887	1096	1304	1513

*Refer to diagram above this table.

NOTES: Pipe-arch structures generally require more care in design and installation than round structures, particularly in the larger sizes.
All dimensions are inside unless otherwise noted.

Proposed Culvert Design Information

The proposed culvert would be a clear span culvert, installed in the dry (with water control in place) during a period between the middle of July and the end of September. It has been sized to ensure fish passage and will be installed in a crushed stone bed. The culvert will be embedded (30 %) to ensure confluence with the river bottom, so as not to create an impediment to fish passage. Culvert construction is planned for several months past the planned commissioning of the new aboiteau structure (currently planned for May, 2008) which would be downstream of the culvert.

The culvert design was originally proposed by Hank Kolstee, the Marshlands Administator (see attached figures) and was confirmed by Jacques Whitford, based on existing available flow information for LaPlanche River, namely a report done by Con Desplague (1983). Following the construction of the new aboiteaux, flow modelling will be conducted to confirm assumptions regarding the river and watershed characteristics utilized in the design of the culvert (flow data from 1983). Should the characteristics differ from assumptions used; current river characteristics established through flow modelling will be used to modify design.

The proposed culvert is a structural plate pipe arch (span 4720 mm, rise 3070 mm) with a length of 24 m and a bottom slope of 1% (based on client feedback). The geometric characteristics of the culvert are attached.

In addition, a new aboiteau structure will be commissioned downstream from the proposed culvert location. As a consequence, the Department of Fisheries and Oceans (DFO) made a request to the client to verify that the culvert size is appropriate.

Field data and required assumptions

All the available background information and assumptions are indicated below. These were made based on client feedback, aerial photographs, maps, and established hydraulic therories and practices.

The design flow was obtained from a report done by Mr. Con Desplague (1983). The document indicates that due to the large storage capacity within the LaPlanche River watershed, the 1:100 year peak flow is attenuated to a flow of 10 m^3/s. The culvert was analyzed for both flows (design flow of 10 m^3/s and maximum flow of 100 m^3/s).

As indicated previously, the proposed culvert has dimensions of 4720 mm x 3070 mm (span x rise) with a length of 24 m. The channel slope for the LaPlanche River was calculated based on the Desplague report that indicates a drop in elevation of 3.3 m in a distance of 7530 m for an average slope of 0.000438 (0.0438%). Since the report indicates variations in slope along the channel, a slope of 0.001 (0.1%) was assumed at the proposed location.

The tailwater channel was assumed to be trapezoidal with a bottom width of 2 m and a side slope of 4H:1V. The Manning's roughness coefficient was established at 0.024 and the channel bottom elevation was assumed at 2 m.

The roadway crest elevation was assumed at 6 m with a length of 50 m (approximate distance across the channel) and a top width of 6 m with a gravel surface.

Culvert characteristics were included and an inlet type was assumed (projecting inlet).

Finally, the inlet and outlet stations and elevations were also defined with a culvert slope of 0.001 (0.1)% which is considered to be appropriate for the site.

Methodology

The culvert design method requires checking for two main scenarios: inlet control and outlet control. Each flow regime has different requirements that are a function of many parameters (*i.e.,* culvert shape and size, slope, roughness coefficient, inlet type, etc).

For simple cases the design procedure can be carried out by hand with the aid of culvert design monographs and simple mathematical equations. However, due to the complexity of the culvert shape in this case is more efficient to design the culvert with the aid of computer software. The software that was utilized was developed by the U.S. Federal Highway Administration (USFHWA) and is called HY-8. The software allows for the input of all relevant parameters and calculates all possible scenarios for the specified flows.

The results of the HY-8 run for the proposed culvert are included in the following section.

Results

The rating curve and the performance curve for the culvert are attached.

Both figures indicate the expected culvert capacity under the design conditions. For a flow of 10 m^3/s the headwater elevation will be in order of 3.5 m (outlet control). As the flow increases the headwater elevation also increases until the roadway is overtopped. Road overtopping happens at 6 m with a flow rate of 40 m^3/s, however, the chance of overtopping can be minimized with a higher elevation of the road crest. The assumed elevation was set at 6 m, if a higher elevation is defined the culvert performance curve will be slightly different.

HY-8 also indicated that the culvert will be in outlet control between 0 m^3/s and 100 m^3/s, this means that the slope of the channel defines the amount of water that can flow through the culvert rather than the culvert inlet.

In summary, the culvert seems to be properly sized for a design flow of 10 m^3/s. A smaller culvert is not recommended due to the uncertainty with respect to the maximum peak in the channel.