

PRELIMINARY DESIGN REPORT – SOUTH MAIN STREET BRIDGE & PEDESTRIAN LINKAGE



Project No.: RFP 2019-120 / 19-8007

Prepared for:



City of Thorold
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1.0 INTRODUCTION

The City of Thorold (City) has retained McIntosh Perry Consulting Engineers Ltd. (McIntosh Perry) to carry out a Municipal Class Environmental Assessment (Class EA) Study to address concerns related to the South Main Street Bridge and Pedestrian Linkage in the Port Robinson area. The Class EA Study is being carried out in accordance with Schedule ‘B’ of the Municipal Class Environmental Assessment document (October 2000, amended 2007, 2011 and 2015) under the *Ontario Environmental Assessment Act*.

Based on the 2018 inspection report, the South Main Street Pedestrian Bridge is in poor condition. The structure was previously closed by the City to vehicular traffic at an unknown date but is known to be frequently used by pedestrians. McIntosh Perry has been retained by the City to proceed with this Class Environmental Assessment Study to address the need to provide a safe and reliable pedestrian linkage between South Main Street and Cross Street in the Port Robinson area.

The South Main Street Pedestrian Bridge serves as an important connection between Port Robinson and the residential development south of the bridge. This Class EA will address active transportation connectivity within the historic, rural and established community of Port Robinson.

1.1 Location

The South Main Street Bridge is located in the Port Robinson area in the City of Thorold, approximately 0.2 km north of Rosedale Avenue. A key map of the structure location is provided in Figure 1.

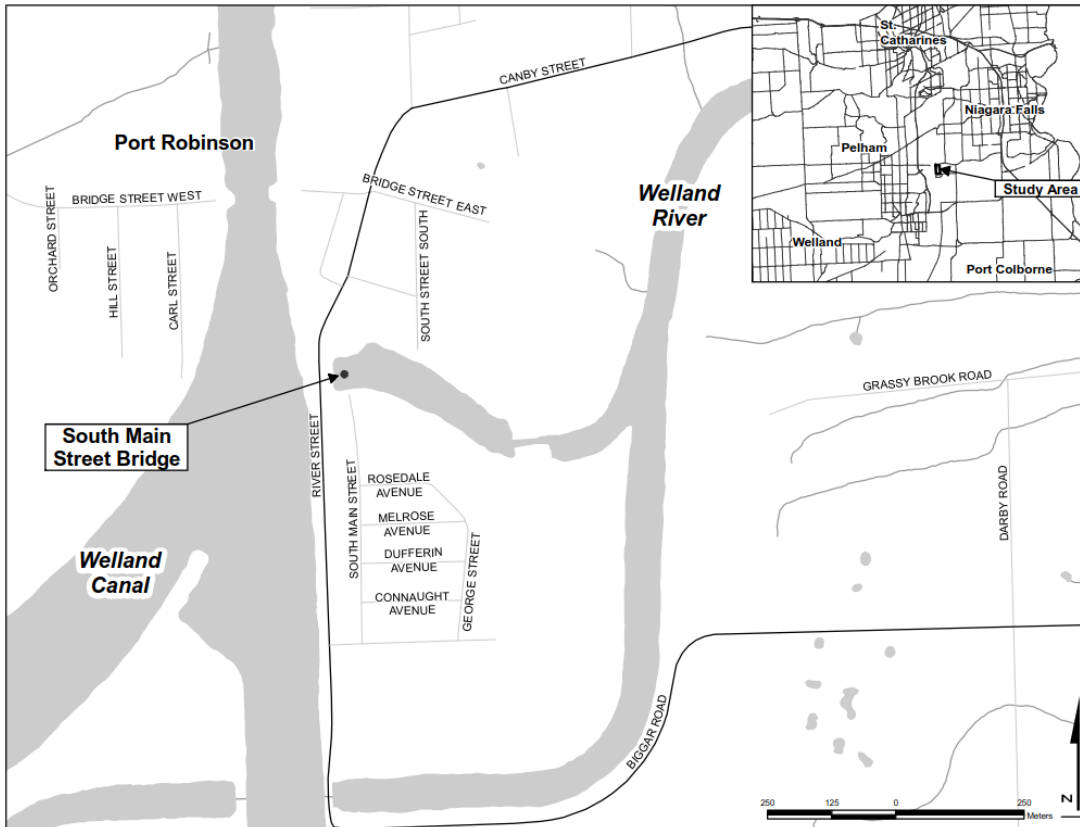


Figure 1 – South Main Street Bridge Location

1.2 Available Information

The following reference material was provided by the City of Thorold:

- 2018 Biennial Inspection Report (McIntosh Perry, 2018)

1.3 Background

South Main Street Bridge is a six-span (12.5 m each) 75m long, slab on concrete T-Beam girder bridge. The structure bridge spans over a section of the Welland River, and has been closed to vehicular traffic with the installation of concrete blocks at each end. The bridge has an overall structural width of 8.40 m with a 0.2m curb on the east side and a 1.8m sidewalk on the west side.

The structure is supported on reinforced concrete abutments and five (5) piers. The superstructure is supported on the abutments and piers by means of bearings. The date of construction of the bridge is unknown, however aerial images from 1934 indicate that the bridge is over 85 years old. There is no known rehabilitation history. A condition survey was completed in September 2019 by Bridge Check Canada (BCC). The 2018 Bridge Condition Index (BCI) was 56.2.

2.0 STRUCTURAL INVESTIGATION

2.1 Existing Bridge Condition

A condition survey of the structure was performed by Bridge Check Canada Ltd. in September 2019 and was provided to McIntosh Perry for review. A summary of the findings are as follows:

2.1.1 Concrete Wearing Surface

The exposed concrete wearing surface was found to be generally in fair condition (495 m² surveyed area) with cracks (7.0 m), delaminations (10.9 m², 2.2%), spalls (3.80 m², 0.8%) and light scaling (481 m², 97%). Exposed corroded reinforcement was noted. The concrete cover ranged from 37 mm to 92 mm, with an average cover of 68 mm. There is no waterproofing and protection board or asphalt on the deck.

2.1.2 Soffit

The deck soffit was found to be in fair condition (670 m² surveyed area) with stained medium width cracks (5.0 m), delaminations (0.65 m², 0.1%), spalls (3.10 m², 0.5%), light scaling (30.50 m², 4.5%), wet areas (14.20 m², 2.2%) and staining. Birds nests were noted on the soffit.

2.1.3 Girders

The girders were found to be in fair condition (987 m² surveyed area) with delaminations (11.50 m², 1.2%), spalls (8.50 m², 0.9%), light scaling (4.0 m², 0.5%), wet areas (5.80 m², 0.6%) and staining. Spalls and delaminations were predominantly located at the girder ends and along the exterior girders. Birds nests were noted on the girders.

2.1.4 Bridge Approaches

The asphalt wearing surface on the bridge approaches was generally in poor condition with cracks, ravelling and erosion/minor settlement at the edges. The concrete end dams showed evidence of cracking, spalling and light scaling. Severe erosion was noted at the north and south sidewalk approaches. A tripping hazard at the deck/approach joint and a large depression at the south approach were noted.

2.1.5 Deck Drainage

Twelve steel drain pipes, six along each of the curb and sidewalk, each having a 150mm diameter. No catch basins were detected.

2.1.6 Barrier

The barrier system consists of concrete posts with metal hand rails overlain with a wire mesh. The concrete posts (18.0 m² surveyed area) were in poor condition, with delaminations (0.28 m², 1.6%), severe spalls (2.90 m², 16.1%) and severe section loss at several locations. Exposed corroded reinforcement was noted. The hand rails exhibited severe corrosion, flaking, missing sections, loose sections and deformed section.

2.1.7 Curb

The west concrete curb (46.32 m² surveyed area) was in fair condition, with delaminations (0.1 m², 0.2%), spalls (0.35 m², 0.8%), and light scaling (39.0 m², 84%). The concrete cover ranged from 50 mm to 80 mm, with an average cover of 62 mm.

2.1.8 Sidewalk

The east concrete sidewalk (119.45 m² surveyed area) was in fair condition, with delaminations (0.65 m², 0.5%), spalls (0.75 m², 0.6%) and light scaling (109.0 m², 91%). Exposed corroded reinforcement was noted. The concrete cover ranged from 42 mm to 88mm, with an average cover of 60 mm.

2.1.9 Abutments

The north abutment (16.5 m² surveyed area) and south abutment (17.4 m² surveyed area) were found to be in poor condition, with clean/stained medium width cracks (11.0 m), delaminations (1.2 m², 7.3%), and spalls (0.25 m², 1.5%) on the north abutment, and with clean/stained medium width cracks (6.0 m), delaminations (2.95 m², 18%), spalls (0.65 m², 4%), and wet areas on the south abutment.

Bearings at the abutments were not visible and it is uncertain at this time if bearings are present.

2.1.10 Ballast Walls and Bearing Seats

The north ballast wall (4.15 m² surveyed area) and south ballast wall (4.15 m² surveyed area) were found to be in fair condition, with clean medium width cracks (2.0 m), delaminations (0.1 m², 2.4%), and spalls (0.1 m², 2.4%) on the north ballast wall, and clean/stained medium width cracks (3.0 m), delaminations (0.25 m², 6%), and spalls (0.65 m², 15.6%) on the south ballast wall.

The north bearing seat (4.2 m² surveyed area) and south bearing seat (4.2 m² surveyed area) were found to be in fair to good condition, with delaminations (0.15 m², 3.6%), and spalls (0.1 m², 2.4%) on the north bearing seat, and clean medium width cracks (1.0 m) on the south bearing seat.

2.1.11 Wingwalls

The wingwalls (46.8 m² surveyed area) were found to be in poor condition, with clean/stained medium width cracks (21.0 m), clean wide width cracks (1.0 m), delaminations (4.3 m², 9.2%), spalls (3.9 m², 8.3%) and efflorescence staining. Section loss was noted at the north west wingwall.

2.1.12 Piers

The piers (360.0 m² surveyed area) were found to be in poor condition with clean/stained medium width cracks (177.0 m), clean wide width cracks (64.0 m), pattern cracks (9.4 m², 2.6%), delaminations (59.5 m², 16.5%), spalls (19.5 m², 5.4%), light scaling (45.2 m², 12.6%), wet areas (7.4 m², 2.1%) and efflorescence staining. Severe delamination and spalling resulting in bearing loss was noted on the east and west exterior girders.

3.0 ALTERNATIVE DESIGNS

In consultation with the City, McIntosh Perry developed four (4) options for South Main Street Bridge and Pedestrian Linkage. The four (4) options that were considered are as follows:

- Option 1 – Remove the South Main Street Bridge and construct a multi-use pathway along River Street, connecting River Street to South Main Street;
- Option 2 – Rehabilitate the South Main Street Bridge;
- Option 3 – Replace South Main Street Bridge superstructure and rehabilitate the existing substructure, and
- Option 4 – Full replacement of the structure with a new pedestrian bridge.

Structural Risks

As previously noted, there are no original or rehabilitation drawings available for this structure. Due to this lack of information, the steel reinforcement details of all concrete elements cannot be confirmed, thus they cannot be evaluated for their structural capacity. The visual inspection and condition survey were restricted to the condition above the waterline.

The lack of reinforcement information of the concrete piers is a particular point of concern from a bridge engineering perspective. The concrete piers exhibit significant deterioration and would require extensive rehabilitation or reconstruction. This rehabilitation would be costly due to access challenges faced to avoid significant impacts on the environment. Additionally, the repair would require that the superstructure be jacked and temporarily supported. Due to the condition of the pier face and lack of information, the ability for the piers to support the jacking loads cannot be confirmed.

Due to the risks associated with the lack of information available, some alternatives will be eliminated from consideration below.

3.1 Option 1 – Remove the bridge and construct a multi-use pathway along River Street

Option 1 involves the complete closure and removal of the existing structure in the current location and providing a multi-use-pathway (MUP) along River Street that connects with South Main Street. This multi-use-pathway could be used by both pedestrians and cyclists. The scope of work for Option 1 would include, but not be limited to:

- Removal of the existing superstructure and substructure, including portion of the piers;
- Grading along River Street to provide adequate width for MUP;
- Paving of pathway, and
- Installation of pedestrian barriers, as necessary.

3.2 Option 2 – Rehabilitation of existing structure

Option 2 would attempt to extend the service life of the structure by 10-15 years by removing and replacing concrete that is found to be deteriorated. The scope of work for Option 2 could include, but not be limited to:

- Concrete patch repairs on deck top, girders, soffit, abutments, piers, and wingwalls;
- Replace curb and sidewalk with curb on either side;
- Replace existing barrier railing system with new standard pedestrian railing;
- Jack structure and replace bearings at abutments and replace steel plate bearings at piers, and
- Replace deck drains.

Due to the substantial structural engineering risks associated with this option as described above, Option 2 was not carried forward for consideration.

3.3 Option 3 – Replace superstructure and patch repair the existing substructure

Option 3 involves the removal and replacement of the existing superstructure of the bridge (girders and deck) and rehabilitation of the substructure. This would attempt to extend the service life of the bridge by up to 20 years. The existing substructure would be rehabilitated using concrete patch repair or reconstruction techniques. Various types of new superstructures could be considered, but the recommendation would be to utilize a steel truss type so to reduce the dead load on the substructure. The scope of work for Option 3 could include, but not be limited to:

- Removal of the existing superstructure;
- Concrete patch repairs or reconstruction on abutment walls, ballast walls, pier and wingwalls;
- Installation of new bearings;
- Install new bridge superstructure, and
- Install new pedestrian railing.

3.4 Option 4 – Full replacement of structure with new pedestrian bridge

Option 4 involves the complete removal and replacement of the existing structure in the current location. The service life of the new bridge will be 75 years. As the intention is to provide a pedestrian linkage at this location, a pedestrian bridge with lesser dead load compared to the existing bridge is recommended, such as a pedestrian truss bridge or a narrower pedestrian girder bridge. The scope of work for Option 4 could include, but not be limited to:

- Removal and disposal of the existing superstructure and substructure;
- Install dewatering system;
- Construct bridge foundations and abutments;
- Install bearings;
- Construct or install new superstructure that is compliant with the *Accessibility for Ontarians with Disabilities Act (AODA)*;
- Grading around bridge, and
- Install new pedestrian railing.

4.0 ASSESSMENT CRITERIA

The following criteria were used for the qualitative evaluation of the options under Section 3.0.

4.1 Extension of Service Life

An extension of service life will be realized with all options. The amount of extension will vary significantly between the options considered.

4.2 Construction Staging and Traffic Management

Since the structure does not accommodate vehicles at this time, traffic staging is not required. During all construction options, any pedestrian access across the structure would be closed, and pedestrians would be directed to the sidewalk along River Street while construction proceeds. If Option 1 is selected, then the multi-use-pathway should be constructed first to provide pedestrian and cyclists to cross while the construction work on the bridge proceeds.

4.3 Construction Duration

The construction duration of the options will vary based on the detail design. For comparison, it is anticipated that the duration of construction for Options 1, 3 and 4 will be approximately 12 weeks, 16 weeks, and 20 weeks, respectively. The estimated construction duration for each option is dependent on contractor scheduling, resources and final design.

4.4 Hydrology/Hydraulics

It should be noted that a hydrologic and hydraulic study was not conducted within this stage of the assignment. The hydraulic capacity of the structure crossing shall be maintained or improved wherever feasible. Option 1 would remove the structure entirely and a hydraulic study would not be required. Option 3 would retain the same span but allow for the clearance to be adjusted if determined necessary by a hydraulic study. Option 4 would allow for design of a substructure and superstructure that maintains or improves the existing hydraulic capacity.

It is recommended that a hydrologic and hydraulic study be completed during detailed design in order to determine the appropriate requirements for the preferred option.

4.5 Utilities

McIntosh Perry initiated an Ontario One Call and the following utilities were noted to be in the area of potential construction work:

- Niagara Region Sanitary Force Main running along the west side of River Street;
- City of Thorold Water main that crosses River Street and South Main Street ;
- Hydro poles to the North and the South of the structure;
- Aerial power lines to the east and west of the structure that belong to Hydro One, and
- One steel utility, running along the soffit of the bridge, remains unidentified.

4.6 Impacts to Natural Environment

The McIntosh Perry Natural Sciences Team conducted an Existing Environmental Conditions survey to provide a synopsis of the existing environmental conditions of the study area.

The study area is dominated by the Welland River East Wetland Complex, designated as a Provincially Significant Wetland (PSW), forested area and residential properties with manicured lawns and planted trees. Forested area consists mainly of opportunist tree communities dominated by Black Walnut, Balsm Poplar and Norway Maple. The PSW was noted to be an open-marsh type during the field investigation.

During the field investigation, migratory bird nests of the following species were confirmed to be present on the bridge structure, including: Cliff Swallow, American Robin, and Barn Swallow. In addition, northern raccoon tracks were observed at both bridge abutments.

The watercourse associated with the South Main Street Pedestrian Bridge study area is an abandoned portion of the Welland River, which still maintains a downstream (east) connection to the Welland River through a structural culvert under the railroad and the west Welland Canal with a small diameter corrugated steel pipe culvert. Land Information Ontario (LIO) and Aquatic Resource Area (ARA) mapping has indicated the Welland River as a coolwater watercourse known to contain a wide variety of fish species.

The study area contains habitat for a wide variety of both aquatic and terrestrial species at risk. Snapping Turtle and Monarch were observed during the field investigations, which are both special concern species provincially and do not receive habitat protection. Additionally, approximately fourteen (14) inactive Barn Swallow nests were observed on the existing South Main Street Pedestrian Bridge. Barn Swallows are a threatened species provincially, and federally, and receive habitat protection under the *Endangered Species Act*.

For details related to the natural environment surrounding the South Main Street Bridge, refer to the *Summary of Existing Environmental Conditions Report*, prepared by McIntosh Perry, dated October 10, 2019.

5.0 CONSTRUCTION COST ESTIMATE

The estimated costs for each option are detailed in Appendix A. The estimates are based on supplier prices, and recent McIntosh Perry projects with clients of similar size to the City. The costs are in 2019 dollars and include contingency costs (20%). It should be noted that the prices do not include taxes, detail design, contract administration, or construction inflation. It should be noted that option 3 and option 4 were assumed to be replaced along the same alignment as existing for cost estimation purposes.

6.0 LIFE CYCLE COST ANALYSIS

6.1 Detailed Financial Analysis

A level 2 analysis was carried out in accordance with the Ontario Structural Financial Analysis Manual. The goal of the financial analysis was to make a rational choice regarding the competing options. The main objective is to attain the most economical solution for rehabilitation or replacement and to ensure that funds are spent effectively. A time period of 50 years was considered for the financial analysis.

The parameters used for the financial analysis were set as the following:

- The life cycle period for the structure is 50 years,
- Option 1 involves removing the bridge entirely,
- The life cycle for Option 3A is 50 years after renewal,
- The life cycle for Option 3B is 50 years after renewal,
- The life cycle for Option 4A is 75 years after replacement,
- The life cycle for Option 4B is 75 years after replacement,
- A discount rate of 5% was used,
- A sensitivity analysis using discount rates of 3% and 7% was also included,

For the purpose of the financial analysis, 2020 was chose as year 0.

6.2 Evaluation of Options

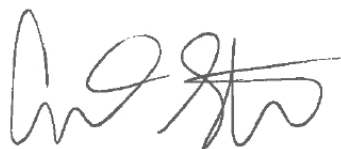
A qualitative approach was used for the assessment of the options. Table 1 provides the definition of the performance ratings for the criteria.

Table 1: Performance Rating Criteria	
Performance Criteria	Relative Rating
Preferred in Comparison	Good
Neutral in Comparison	Fair
Least Preferred in Comparison	Poor

A qualitative evaluation of each option is presented in Table 2.

Table 2: Qualitative Evaluation of Options						
Factor		Option 1 – Demolish bridge and Construct MUP	Option 3A – Replace superstructure with Pedestrian Truss	Option 3B – Replace superstructure with Slab on Girder	Option 4A – Full replacement with Pedestrian Truss	Option 4B – Full replacement with Slab on Girder
Estimated Capital Cost		\$1,018,000	\$1,880,000	\$1,864,000	\$2,222,000	\$ 2,056,000
Ranking at discount rate, r	3%	[1]	[4]	[2]	[5]	[3]
	5%	[1]	[3]	[2]	[5]	[4]
	7%	[1]	[3]	[2]	[5]	[4]
Hydraulic Requirements		Best - H/H Not Required	Good - H/H Same or Improved	Good - H/H Same or Improved	Fair - H/H Required	Fair - H/H Required
Roadway Geometry/Profile		Good	Good	Good	Good	Good
Construction Staging, Traffic, and Pedestrian Management		Best (Pedestrian access provided at all times)	Good (Pedestrian Impacts during Construction)	Good (Pedestrian Impacts during Construction)	Good (Pedestrian Impacts during Construction)	Good (Pedestrian Impacts during Construction)
Construction Methods		Good (Standard)	Good (Standard)	Good (Standard)	Fair (In-water works expected)	Fair (In-water works expected)
Estimated Construction Duration		12 weeks	16 weeks	16 weeks	20 weeks	20 weeks
Durability		Good (Removal of Structure)	Fair (Improvement of Superstructure Only)	Fair (Improvement of Superstructure Only)	Good (Extends Service Life by 75 years)	Good (Extends Service Life by 75 years)
Impacts to Natural Environment		Good	Good	Good	Fair (In-water works expected)	Fair (In-water works expected)
Extension of Service Life		-	~50	50	75	75

Report Prepared By:



Curtis Stewart, P. Eng.

McIntosh Perry Consulting Engineers Ltd.

APPENDIX A

Cost Estimates

McINTOSH PERRY

Option 1 MUP

Project: OBM-19-8007
 Name: South Main Street 231
 Subject: Quantity Estimate
 By: AP Date: 180618
 Sheet: 1 Chk'd:

COST ESTIMATE - Bridge

Item Code	Title	Unit	Quantity	Item Price (\$)	Item Total (\$)
Structural - Bridge Rehabilitation					
0313-1373	Superpave 12.5	t	166.05	\$ 300.00	\$ 49,900.00
0314-0071	Granular A (Roadbase)	t	900.00	\$ 70.00	\$ 63,000.00
0510-5528	Removal of steel beam guiderail	m	105.00	\$ 25.00	\$ 2,700.00
0510-9010	Removal of Bridge Structure	m3	620.46	\$ 600.00	\$ 372,300.00
0706-0010	Mobilization, Demobilization and Traffic Control	LS	1.00	\$ 62,000.00	\$ 62,000.00
0710-0010	Pavement Markings	m	250.00	\$ 25.00	\$ 6,300.00
0721-0060	Single Rail Steel Beam Guide Rail	m	110.00	\$ 260.00	\$ 28,600.00
0902-0010	Earth Excavation for Structure	m3	375.00	\$ 90.00	\$ 33,800.00
0908-0010	Pedestrian Railing	m	100.00	\$ 500.00	\$ 50,000.00
0928-0055	Access to Work Area, Work Platform and Scaffolding	LS	1.00	\$ 75,000.00	\$ 75,000.00

<i>Sub-Total</i>	\$ 744,000.00
<i>20% Contingency</i>	\$ 148,800.00
SUB-TOTAL	\$893,000.00

McINTOSH PERRY

Project: OBM-19-8007

Name: South Main Street 231

Subject: Quantity Estimate

By: AP Date: 180618

Sheet: 3 Chk'd:

Option 3A 3m Pedestrian Truss

COST ESTIMATE - Bridge

Item Code	Title	Unit	Quantity	Item Price (\$)	Item Total (\$)
Structural - Bridge Rehabilitation					
0928-0055	Access to Work Area, Work Platform and Scaffolding	LS	1.00	\$ 66,000.00	\$ 66,000.00
0913-0010	Embedded Work in Structure (Ministry)	LS/m	75.00	\$ 40.00	\$ 3,000.00
0922-0010	Bearings	LS	72	\$ 1,000.00	\$ 72,000.00
	Pedestrian Truss Bridge (3 m)	LS/m	1.00	\$ 850,000.00	\$ 850,000.00
0902-0010	Earth Excavation for Structure	m3	30.00	\$ 84.00	\$ 2,520.00
0510-9010	Removal of Bridge Structure	m3	322.25	\$ 600.00	\$ 193,400.00
0928-0070	Concrete Removal - Partial Depth - Type C	m3	15.00	\$ 7,000.00	\$ 105,000.00
0930-0151	Concrete Patches, Form and Pump	m3	15.00	\$ 10,000.00	\$ 150,000.00
0932-0010	Crack Injection	m	65.00	\$ 307.50	\$ 20,000.00
<i>Sub-Total</i>					\$ 1,462,000.00
<i>20% Contingency</i>					\$ 292,400.00
SUB-TOTAL					\$1,755,000.00

Option 3B Slab on Girder 3.6m

COST ESTIMATE - Bridge

Item Code	Title	Unit	Quantity	Item Price (\$)	Item Total (\$)
Structural - Bridge Rehabilitation					
0928-0055	Access to Work Area, Work Platform and Scaffolding	LS	1.00	\$ 66,000.00	\$ 66,000.00
0314-0071	Granular A (Roadbase)	t	30.00	\$ 46.00	\$ 1,400.00
0913-0010	Embedded Work in Structure (Ministry)	LS/m	75.00	\$ 40.00	\$ 3,000.00
0904-0075	Concrete in Structure	m3	15.00	\$ 2,500.00	\$ 37,500.00
0904-0105	Concrete in Deck	m3	33.75	\$ 2,000.00	\$ 67,500.00
0908-0050	Metal Traffic Barrier	m	150.00	\$ 932.00	\$ 139,800.00
0905-0025	Stainless Steel Reinforcing Bar	t	2.00	\$ 10,000.00	\$ 20,000.00
0922-0010	Bearings	LS	72	\$ 1,000.00	\$ 72,000.00
0909-0330	Prestressed Concrete Box Girders Fabrication	LS/M	225.00	\$ 1,530.00	\$ 344,300.00
0909-0340	Prestressed Concrete Box Girders Delivery	LS/M	225.00	\$ 219.00	\$ 49,300.00
0909-0350	Prestressed Concrete Box Girders Installation	LS/M	225.00	\$ 211.50	\$ 47,600.00
0902-0010	Earth Excavation for Structure	m3	30.00	\$ 84.00	\$ 2,600.00
0510-9010	Removal of Bridge Structure	m3	322.25	\$ 1,000.00	\$ 322,300.00
0928-0070	Concrete Removal - Partial Depth - Type C	m3	15.00	\$ 7,000.00	\$ 105,000.00
0930-0151	Concrete Patches, Form and Pump	m3	15.00	\$ 10,000.00	\$ 150,000.00
0932-0010	Crack Injection	m	65.00	\$ 307.50	\$ 20,000.00
<i>Sub-Total</i>					\$ 1,449,000.00
<i>20% Contingency</i>					\$ 289,800.00
SUB-TOTAL					\$1,739,000.00

McINTOSH PERRY

Project: OBM-19-8007

Name: South Main Street 231

Subject: Quantity Estimate

By: AP Date: 180618

Sheet: 4 Chk'd:

Option 4A Eagle Bridge

COST ESTIMATE - Bridge

Item Code	Title	Unit	Quantity	Item Price (\$)	Item Total (\$)
Structural - Bridge Rehabilitation					
0928-0055	Access to Work Area, Work Platform and Scaffolding	LS	1.00	\$ 66,000.00	\$ 66,000.00
0902-0030	Dewatering Structure Excavations	LS	1.00	\$ 300,000.00	\$ 300,000.00
0314-0071	Granular A (Roadbase)	t	30.00	\$ 46.00	\$ 1,400.00
0913-0010	Embedded Work in Structure (Ministry)	LS/m	75.00	\$ 40.00	\$ 3,000.00
0905-0010	Reinforcing Steel Bar	t	3.50	\$ 4,000.00	\$ 14,000.00
0922-0010	Bearings	LS	12	\$ 1,000.00	\$ 12,000.00
	Pedestrian Truss Bridge (Per Linear Metre)	LS/m	1.00	\$ 850,000.00	\$ 850,000.00
0902-0010	Earth Excavation for Structure	m3	30.00	\$ 84.00	\$ 2,600.00
0510-9010	Removal of Bridge Structure	m3	620.46	\$ 600.00	\$ 372,300.00
9999-0903	H-Piles - HP 310x132	m	96.00	\$ 300.00	\$ 28,800.00
0904-0085	Concrete in Substructure	m3	82.33	\$ 2,100.00	\$ 172,900.00
<i>Sub-Total</i>					\$ 1,823,000.00
<i>15% Contingency</i>					\$ 273,450.00
SUB-TOTAL					\$2,097,000.00

Option 4B Slab on Girder

COST ESTIMATE - Bridge

Item Code	Title	Unit	Quantity	Item Price (\$)	Item Total (\$)
Structural - Bridge Rehabilitation					
0928-0055	Access to Work Area, Work Platform and Scaffolding	LS	1.00	\$ 66,000.00	\$ 66,000.00
0902-0030	Dewatering Structure Excavations	LS	1.00	\$ 300,000.00	\$ 300,000.00
0314-0071	Granular A (Roadbase)	t	30.00	\$ 46.00	\$ 1,400.00
0913-0010	Embedded Work in Structure (Ministry)	LS/m	75.00	\$ 40.00	\$ 3,000.00
0904-0075	Concrete in Structure	m3	15.00	\$ 2,500.00	\$ 37,500.00
0904-0105	Concrete in Deck	m3	33.75	\$ 2,000.00	\$ 67,500.00
0905-0010	Reinforcing Steel Bar	t	3.50	\$ 4,000.00	\$ 14,000.00
0905-0025	Stainless Steel Reinforcing Bar	t	2.00	\$ 10,000.00	\$ 20,000.00
0908-0050	Metal Traffic Barrier	m	150.00	\$ 932.00	\$ 139,800.00
0922-0010	Bearings	LS	12	\$ 1,000.00	\$ 12,000.00
0909-0330	Prestressed Concrete Box Girders Fabrication	LS/M	225.00	\$ 1,530.00	\$ 344,300.00
0909-0340	Prestressed Concrete Box Girders Delivery	LS/M	225.00	\$ 219.00	\$ 49,300.00
0909-0350	Prestressed Concrete Box Girders Installation	LS/M	225.00	\$ 211.50	\$ 47,600.00
0902-0010	Earth Excavation for Structure	m3	30.00	\$ 84.00	\$ 2,600.00
0510-9010	Removal of Bridge Structure	m3	620.46	\$ 600.00	\$ 372,300.00
9999-0903	H-Piles - HP 310x132	m	96.00	\$ 300.00	\$ 28,800.00
0904-0085	Concrete in Substructure	m3	82.33	\$ 2,100.00	\$ 172,900.00
<i>Sub-Total</i>					\$ 1,679,000.00
<i>15% Contingency</i>					\$ 251,850.00
SUB-TOTAL					\$1,931,000.00

APPENDIX B

Life-Cycle Cost Analysis

Residual Value Calculations

Option	Replacement Year (2nd cycle)	Replacement Cost	Residual Years	Value at Year 50	Differential Value	Residual Value at Year 0
1						
3A	50	\$2,222,000.00	0	\$2,222,000.00	\$0.00	\$0.00
3B	75	\$2,056,000.00	25	\$607,142.50	\$1,448,857.50	\$126,000.00
4A	75	\$2,222,000.00	25	\$656,162.76	\$1,565,837.24	\$137,000.00
4B	75	\$2,056,000.00	25	\$607,142.50	\$1,448,857.50	\$126,000.00

Assumed Discount Rate = 0.05

Level 2 Analysis Results

Year	MUP		Rehab		Pedestrian Truss		Slab on Girder		Pedestrian Truss F/Rp		Slab on Girder F/RP	
	Cost	Present Value	Cost	Present Value	Cost	Present Value	Cost	Present Value	Cost	Present Value	Cost	Present Value
0	\$1,018,000	\$1,018,000	\$1,246,000	\$1,246,000	\$1,880,000	\$1,880,000	\$1,864,000	\$1,864,000	\$2,222,000	\$2,222,000	\$2,056,000	\$2,056,000
5												
10												
15			\$2,056,000	\$989,000								
20					\$370,000	\$139,500	\$370,000	\$139,500				
25												
30									\$370,000	\$85,700	\$370,000	\$85,700
35												
40												
45												
50												

Total Present Value:	\$1,018,000	\$2,235,000	\$2,020,000	\$2,004,000	\$2,308,000	\$2,142,000
Residual Value:	\$0	\$154,000	\$0	\$126,000	\$137,000	\$126,000
Net Present Value:	\$1,018,000	\$2,081,000	\$2,020,000	\$1,878,000	\$2,171,000	\$2,016,000