Appendix A

TOWN OF KINGSVILLE

CAPITAL MANAGEMENT PLAN (2019)

September 23, 2019

AUE Structural Inc.

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Ottawa, Ontario
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1.0 INTRODUCTION

The Town of Kingsville has retained AUE Structural Inc. to complete the OSIM Inspections and to develop an Capital Management Plan for sixty three (63) structures owned and maintained by the Town.

Each structure was visually inspected in accordance with the guidelines of the Ministry of Transportation's (MTO) Ontario Structure Inspection Manual (OSIM) in the spring of 2019. The inspection findings for each structure are included in the OSIM inspection reports (attached in Appendix E).

Each inspection report details the:

- observations from the visual site inspection,
- results from the tactile inspection,
- performance deficiencies identified,
- recommendation for rehabilitation / repair,
- maintenance needs,
- additional investigations required,
- timeline for additional investigations, rehabilitation and maintenance, and
- benchmark costs for capital works planning and budgeting.

The following report provides an overview of the Town's structure inventory, highlights the observations and recommendations of the inspection forms and provides a structure priority list for the Town's capital works and maintenance planning and budgeting.

2.0 STRUCTURE INSPECTIONS

2.1 Inspection Methodology and Forms

During an OSIM inspection, elements of a bridge or culvert are inspected for visual signs of deterioration. Additionally, tactile inspections of accessible concrete elements, such as concrete sounding, are undertaken during an inspection. The tactile inspection uncovers deterioration that is not visually noticeable.

The inspection manual provides guidelines for the calculation of the overall quantity of an element. Element quantities are based on the element type and are in units for area (m^2), linear distance (m), units (each), etc.

Deterioration noted during the visual and tactile inspection provides the basis for rating an element. The deterioration is quantified and the element quantity is proportioned based on its severity. The severity of deterioration determines the quantities in each of the following condition states: excellent, good, fair and poor. Comments rationalizing the ratings for each element are provided in the inspection reports.

The inspection report notes element-specific performance deficiencies, provides recommendations for rehabilitation and repair with associated benchmark costs, maintenance needs and additional investigations. Photographs obtained during the inspections are also included in the inspection report.

2.2 Bridge Condition Index (BCI)

The Bridge Condition Index (BCI) is a single value that provides an overview of the overall condition of each structure. It is calculated as per the Ministry of Transportation's (MTO) methodology based on the remaining economic worth of the structure by considering the current and replacement values of the elements.

MTO assigns a unit replacement cost for each element which is utilized in the computation. The current element value is the depreciated value based on the quantity proportioned during the inspection to the four (4) condition states of excellent, good, fair and poor. The replacement element value is based on the total quantity (i.e. new condition). The following table provides the weight factor used for the condition states:

Condition State	Weight Factor
Excellent	1.00
Good	0.75
Fair	0.40
Poor	0.00

The Bridge Condition Index originates at 100 when the structure has been newly constructed and gradually declines as the elements deteriorate due to the severity of their exposure. Typically, the structure with the lowest BCI will require short-term rehabilitation as the BCI for the other structures in the inventory decline. Rehabilitation of a structure provides a boost to the BCI and moves it back down the priority list. The following table provides the structure's condition rating and capital works needs based on different BCI ranges:

BCI Range	Rating	Capital Works
70 - 100	Good	Not usually required within the next five (5) years
60 - 70	Fair	Usually scheduled within the next five (5) years
< 60	Poor	Usually scheduled within the next one (1) year

The BCI is used to plan repairs and maintenance and does not indicate the safety of a structure.

2.3 Capital Works

Rehabilitation, repair or replacement recommendations are provided in the inspection reports. For each element, a scope of work, based on the severity of deterioration at the time of inspection, and a benchmark cost are indicated. Additionally, one of the following standard priorities for the work is identified: less than one (1) year, one (1) to five (5) years and six (6) to ten (10) years.

The estimated capital works costs are computed based on the benchmark unit cost and element quantity in poor condition. Benchmark unit costs are estimated from AUE Structural's recent experience with construction projects of similar scope and are expected to vary based on market forces at the time of rehabilitation.

Rehabilitation where major structural repairs are necessary (i.e. deck replacement) will cause road closures and necessitate detour and traffic control at the structure location. The cost estimates are included in the Associated Works section in the inspection report.

Rationale for the benchmark costs and associated costs are included in Section 3.0 of this report. It should be noted that the cost estimates do not include costs associated with engineering design, property acquisition, utility relocation, site inspection or construction administration services. Typically this value is 20% of the construction costs.

2.4 Routine Maintenance

Routine maintenance is a low-cost way to increase the service life of a structure. During the inspections, various maintenance needs were identified in the inspection reports. Overall routine maintenance needs will vary depending on the type of structure, size of structure, location, winter maintenance program (i.e. salt vs. sand), traffic volumes and previous rehabilitation and maintenance.

A program of routine maintenance should be implemented and adhered to for all the structures. The routine maintenance program will assist in minimizing the potential for premature structural deterioration and, when combined with a bridge rehabilitation program, will assist in maximizing the useful service life of the structure inventory.

The following are routine maintenance operations that are applicable for the structures:

- Asphalt Surface Repair / Rout and seal: This annual operation would be carried out after winter operations have concluded and it would include cold patch asphalt repairs of potholes as well as rout and seal of medium and wide asphalt cracks.
- Bridge Cleaning: This annual operation would be carried out after winter operations have concluded. Structure components exposed to roadway traffic would be power-washed to eliminate adverse remnants of the winter operations and to remove debris at expansion joints, abutment wall bearing seats, etc. In some cases, an increase in the frequency of cleaning may be required.
- Bridge Deck Drainage: This annual operation would be carried out after winter operations have concluded to ensure that deck drains are un-clogged and free of debris.
- Concrete Spot Repairs: This maintenance operation would be carried out on a as-needed basis to complete localized patches of light concrete spalls and delaminations in order to prevent the accelerated ingress of chlorides at the deteriorated areas.
- Erosion Control: This maintenance operation would be carried out on a as-needed basis to re-instate embankments and place rip rap for slope protection.
- Flow Obstruction Removal: This annual operation would be carried out after the spring run-off period to clear flow obstructions in the vicinity of the structure.
- Re-grade Approaches (Gravel): This annual or bi-annual operation would be carried out depending on the overall volume and type of traffic utilizing the road to place and grade granular material.

- Vegetation / Debris Removal: This maintenance operation would be carried out to remove vegetation and debris located in from of the approach guiderail. It is mainly a safety measure to ensure the proper performance of the guiderail and to prolong its service life (i.e. limits, timber post rot).

2.5 Additional Investigations

Following the guidelines of the OSIM manual, recommendations for additional investigations are provided in the inspection reports. A benchmark cost is indicated for each additional investigation and one of the following standard priorities for the work is identified: none, normal and urgent. The rationale for the benchmark costs is included in Section 3.0 of this report.

A rehabilitation / replacement study is typically recommended when replacement or substantial repairs are identified during the inspection. The study provides a detailed assessment of the existing structure and considers various replacement or rehabilitation alternatives to provide a cost-efficient structural rehabilitation strategy and an increase to the service life.

For structures where the inspectors deemed the roadside safety measures to be substandard, a rehabilitation / replacement study for roadside safety has been recommended. Section 2.6 of this report discusses the roadside safety aspect of the OSIM inspection.

The most commonly recommended additional investigations include:

- detailed deck condition survey,
- rehabilitation / replacement study,
- structure evaluation,
- underwater investigation, and
- monitoring of deformations, settlements and movements.

2.6 Roadside Safety

Roadside safety is based on the MTO's Roadside Safety Manual guidelines. The road class, traffic data, posted speed and truck percentages are primary factors in determining the adequacy of roadside safety systems. A roadside safety review / calculations are outside the scope of work for an OSIM inspection. During an inspection, the adequacy of the existing roadside safety system is considered based on familiarity with approved standards and previous experience with similar structures. When deemed inconclusive, a comment indicating that the adequacy of the existing barrier should be considered is included in the inspection report. MTO recognizes that a railing system constructed to relevant standards at that time can remain in service for as long as that system is maintained in good serviceable condition until a major rehabilitation is undertaken.

When the existing roadside safety system is deemed inadequate, a rehabilitation / replacement study for roadside safety is recommended, along with benchmark replacement costs. The substandard system could be a result of the approach guiderail end treatment, inadequate guiderail height, approach guiderail length of need, connection of approach guiderail to barrier over structure and/or existing barrier over structure. The rehabilitation / replacement study will identify the hazards at the structure and provide recommendations as to the length of need for approach guiderail, end treatments and barrier type over the structure.

3.0 DETERMINATION OF COSTS

Benchmark costs were developed for repair, rehabilitation and replacement of the structures. Due to the superficial nature of an OSIM inspection, it is not possible to develop a detailed cost estimate for each structure. The benchmark costs, while not necessarily accurate for individual repairs or replacements, have proven to provide sufficient accuracy for budgeting purposes when dealing with a large number of structures.

Benchmark costs for the repair, rehabilitation and replacement are based on maintaining the existing structure dimensions (length and overall width) and geometry (alignment). Precise cost for each structure can be provided once further engineering investigations and design for repair, rehabilitation or replacement have been undertaken.

3.1 Structure Replacement Costs

The structure replacement costs are typically based on the deck surface area (m^2) for a roadway bridge. The following table provides the unit deck surface area cost that was used to determine the structure replacement cost based on the length (m) and overall width (m) of a structure:

Length (m)	Width (m)	Unit Cost (/m^2)
3 - 10	< 10	$ 7,000.00
	≥ 10	$ 6,500.00
10 - 20	< 10	$ 6,500.00
	≥ 10	$ 5,500.00
20 - 30	< 10	$ 5,500.00
	≥ 10	$ 4,500.00
> 30	< 10	$ 4,500.00
	≥ 10	$ 4,000.00

For a culvert, the deck surface area is based on the addition of one (1) meter to each of the length and overall width. The structure replacement cost for a culvert is generally less than the replacement cost for a bridge. Generally, the life span of a culvert is approximately half of that of a bridge. From a life cycle cost basis, it is valid to use the costs in the table above to determine the replacement cost of a culvert.

3.2 Capital Works Costs

The capital works costs for the recommended rehabilitation / repairs are computed based on the benchmark unit cost and element quantity in poor condition. Benchmark unit costs are estimated from AUE Structural's recent experience with construction projects of similar scope and are expected to vary based on market forces at the time of rehabilitation. The following table provides the benchmark cost for common repairs:

Capital Work	Cost
Approach Guiderail (New)	$ 250.00 / m
Barrier over Structure (Replace)	$ 1,500.00 / m
Bearing Replacement	$ 1,000.00 / ea
Concrete Repairs - Top of Structure	$ 1,000.00 / m^2
Concrete Repairs - Sides of Structure	$ 1,500.00 / m^2
Concrete Repairs - Underside of Structure	$ 2,000.00 / m^2
End Treatment (New)	$ 4,000.00 / ea
Re-Coat Structural Steel	$ 300.00 / m^2

For budgeting purposes, cost for structure rehabilitation are typically expressed as a percentage of the total replacement cost. The following table provides the rehabilitation costs categories:

Category	% of Replacement Cost
Minor Item Repair	< 5
Major Item Repair	5 - 25
Minor Bridge Rehabilitation	25 - 50
Major Bridge Rehabilitation	50 - 60

For corrugated steel culverts, replacement is usually recommended when significant deterioration has occurred or when a performance deficiency is noted. However, the installation of a culvert liner is a possibility subject to hydraulic considerations and is estimated to be less than 50% of the replacement cost of the culvert.

3.3 Associated Works Costs

The following items provide an overview and benchmark costs for the most common Associated Works recommended as part of the OSIM inspection reports.

Approaches

For the benchmark costs, approaches are considered to be thirty (30) meters at each end of a structure for a total of sixty (60) meters. The following table provides the benchmark cost for approach road work:

Capital Works	Cost
Crack Sealing	$ 5,000.00
Minor Repairs (Cracks & Surface Sealing, Guiderail)	$ 15,000.00
Major Repairs (Partial / Complete Paving, Guiderail)	$ 30,000.00

Detours

Flow of traffic during construction work can be achieved by:

- staging the construction to allow for traffic use of the structure,
- closure of the structure and providing a detour route around the structure, or
- construction of a detour structure adjacent to the existing structure.

Closure of the structure and providing a detour route is the least expensive option; however, that solution is not always practical due to lengthy detour routes and / or inconvenience to residents adjacent to the structure. Construction of a detour structure adjacent to the existing structure is the most costly and least desirable option.

Staging the construction to allow for traffic use of the structure is the most frequently used option. The following table provides the benchmarks cost for a detour based on the scope of work:

Capital Works	Cost
Minor Rehabilitation / Culvert Replacement	$ 15,000.00
Major Rehabilitation / Bridge Replacement	$ 50,000.00

Traffic Control

The safety of traffic utilizing the structure during construction must also be ensured. The following table provides the benchmark cost for traffic control during staged construction:

Capital Works	Cost
Minor Rehabilitation	$ 15,000.00
Major Rehabilitation	$ 30,000.00

Environmental Study

A typical structure replacement / rehabilitation does not involve a change of waterway alignment or a reduction in clearance, and as such, are expected to fall under Schedule A or A+ of the Environmental Assessment (EA). These assessments do not require detailed environmental and mitigation plans; however, they require that approvals be obtained from the stakeholder government agencies (Fisheries and Oceans Canada, Ministry of Natural Resources, Ministry of the Environment and Climate Change, local conservation authority, etc.).

Based on the requirements for a Schedule A or A+ Environmental Assessment, the benchmark cost for the environmental study is $ 7,000.00.

3.4 Additional Investigations Costs

The inspection reports for some structures recommend the need for additional engineering investigations. The following table provides the benchmark costs for the most commonly recommended additional investigations:

Investigation	Structure Type	Cost
Detailed Deck Condition Survey	Exposed Deck	$ 8,000.00
	Asphalt Paved	$ 10,000.00
	Culvert (Fill Height < 0.5m)	$ 8,000.00
Rehabilitation / Replacement Study	Roadside Safety	$ 2,500.00
	Truss Bridge	$ 20,000.00
	Other Structures	$ 15,000.00
Monitoring of Deformations, Settlements and Movements	All Structures	$ 2,500.00
Structure Evaluation	Truss Bridge	$ 15,000.00
	Other Structures	$ 10,000.00
Underwater Investigation	All Structures	$ 10,000.00

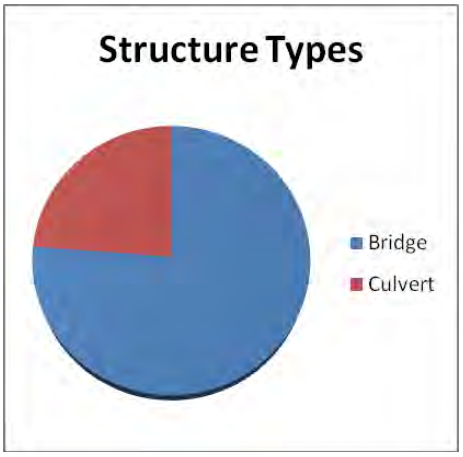
When undertaken simultaneously with a rehabilitation / replacement study, the benchmark costs for a detailed deck condition survey or a structure evaluation are reduced by 50% of the costs listed in the table above.

Additional engineering investigations that are not listed in the table above could be recommended by the inspecting engineer. Benchmark cost for those investigations are provided on a site-specific basis.

4.0 STRUCTURE INVENTORY OVERVIEW

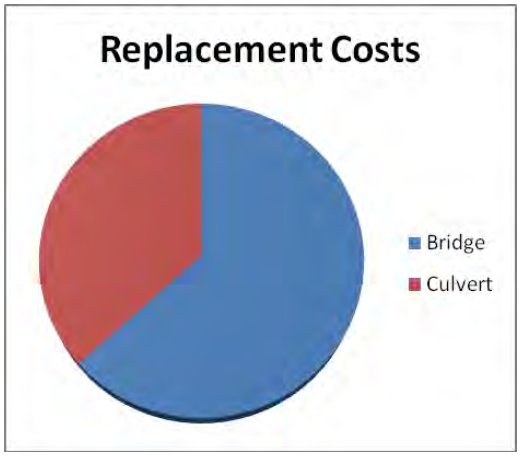
AUE Structural completed the OSIM inspections for sixty three (63) bridge and culvert structures owned and maintained by the Town in spring 2019. The structures are split between forty eight (48) bridge and fifteen (15) culvert structures as shown below:

Structure Type	Number	Percentage
Bridge	48	76.19 %
Culvert	15	23.81 %
Total	**63**	**100.00 %**



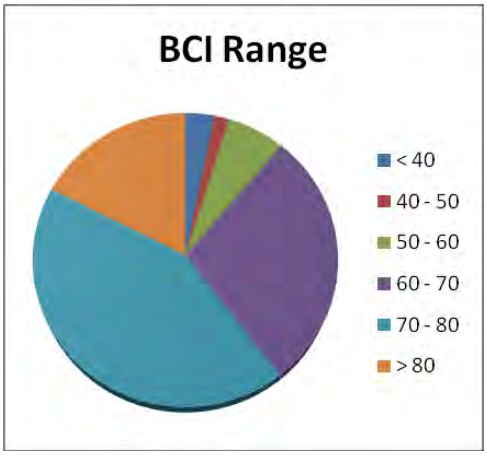
Structure replacement costs were computed as per the guidelines in Section 3.1 of this report. The replacement cost of the bridge and culvert structure inventory is included in Appendix A. The total replacement cost is approximately thirty eight million and six-hundred eighty two thousand dollars ($38,682,100) broken down as follows:

Structure Type	Cost	Percentage
Bridge	$ 24,461,900.00	63.24 %
Culvert	$ 14,220,200.00	36.76 %
Total	**$ 38,682,100.00**	**100.00 %**



In order to determine the overall condition of the structures in the transportation system, the number of bridges in each Bridge Condition Index (BCI) range was determined. This measure is more preferable than computing the average BCI value of all structure, which can be highly affected by the very new or very poor structure ratings. Based on the OSIM inspections, the following table provides a breakdown of the BCI values in each range:

BCI Range	Number	Percentage
< 40	2	3.17 %
40 - 50	1	1.59 %
50 - 60	4	6.35 %
60 - 70	18	28.57 %
70 - 80	27	42.86 %
> 80	11	17.46 %
Total	**63**	**100.00 %**

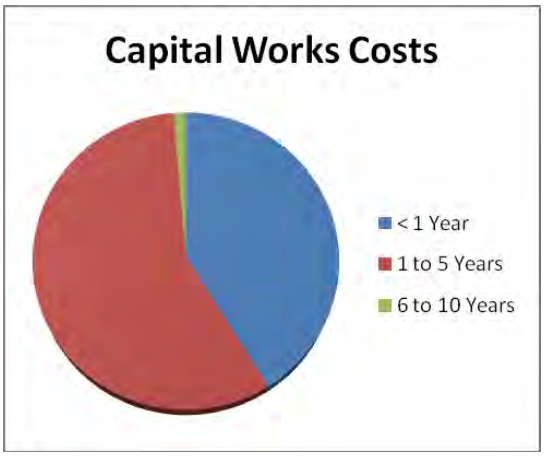


Of the sixty three (63) structures in the inventory, thirty-eight (38) structures have a BCI rating equal to or higher than 70. These structures, 60.32% of the Town's inventory, are considered to be in the 'Good' range as per the MTO guidelines outlined in Section 2.2 of the report.

The remaining twenty-five (25) structures, 39.68% of the Town's inventory, are considered to be in the 'Fair' to 'Poor' range. Structures in these ranges usually schedule capital works within the next five (5) years.

The total capital works costs of the bridge and culvert structure inventory is approximately four million and nine hundred fifty-five thousand dollars ($4,955,200) broken down into the repairs within one (1) year, repairs in the next one (1) to five (5) years and repairs in the next six (6) to ten (10) years. The following table provides the capital works costs:

Timeframe	Cost	Percentage
< 1 Year	$ 2,043,600.00	41.24 %
1 to 5 Years	$ 2,845,000.00	57.41 %
6 to 10 Years	$ 66,600.00	1.34 %
Total	**$ 4,955,200.00**	**100.00 %**

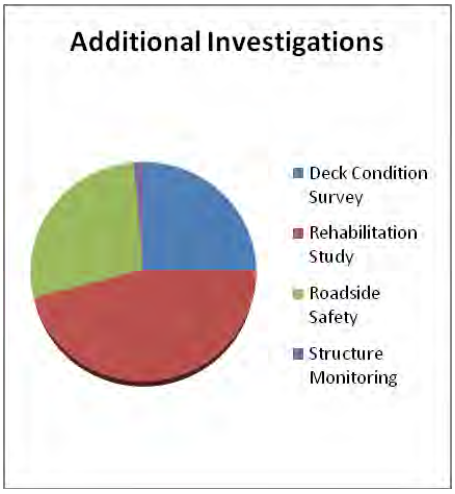


Capital works associated costs are a result of detours, traffic control and environmental study that are in addition to the costs associated with completing the structural repairs to a bridge or culvert. These costs have been included in their respective capital works timeframes in the table above.

Capital works costs and associated costs for each structure are included in Appendix B, while maintenance needs are included in Appendix C.

During the inspections, the engineers identified the need for additional engineering investigations due to age of a structure, severity of deterioration and/or inability to have full visual access to all elements. The additional investigations recommended, mostly in the “Normal" priority and some in the “Urgent” priority, have a total cost of approximately three hundred sixty thousand dollars ($360,000). A list of additional investigations is included in Appendix D and the following table provides a breakdown of the costs:

Investigation	Cost	Percentage
Deck Condition Survey	$ 90,000.00	25.00 %
Rehabilitation Study	$ 165,000.00	45.83 %
Roadside Safety	$ 100,000.00	27.78 %
Structure Monitoring	$ 5,000.00	1.39 %
Total	**$ 360,000.00**	**100.00 %**



OSIM reports for bridge and culvert structures are included in Appendix E.

5.0 CAPITAL WORKS PRIORITY LIST

A priority list for capital works has been developed based on the inventory overview provided in Section 4.0. The priority list has considered various factors that include: location, age, structural integrity, BCI values, rehabilitation history, and urgency of capital works based on observed deterioration.

The following tables highlight the structures on the priority list:

1	**Number**	500	**Detailed Design**	2019
	Name	Road 11 Irwin Drain Culvert	**Capital Works**	2019
	Type	Ellipse Corrugated Steel Plate	**Capital Works Cost**	$ 926,000.00
	Scope	Replace Structure		

2	**Number**	046	**Detailed Design**	2019
	Name	South Talbot Road Old No. 5 Drain Bridge	**Capital Works**	2019
	Type	Frame, Vertical Legs	**Capital Works Cost**	$ 215,000.00
	Scope	Replace Structure		

3	**Number**	051	**Detailed Design**	2019
	Name	Frank Remark Trail Pedestrian Culvert	**Capital Works**	2020
	Type	Circular Corrugated Steel Plate	**Capital Works Cost**	$ 453,500.00
	Scope	Replace Structure		

4	**Number**	018	**Detailed Design**	2020
	Name	Road 11 Ruscom River Bridge	**Capital Works**	2021
	Type	Prestressed Solid Slab on Box Beams	**Capital Works Cost**	$ 787,600.00
	Scope	Replace Structure		

5	**Number**	502	**Detailed Design**	2020
	Name	Mill Creek Division Road Culvert	**Capital Works**	2021
	Type	Ellipse Corrugated Steel Plate	**Capital Works Cost**	$ 865,200.00
	Scope	Replace Structure		

6	**Number**	050	**Detailed Design**	2021
	Name	Mill Creek Bridge	**Capital Works**	2022
	Type	Timber Deck on Steel Beams	**Capital Works Cost**	$ 207,500.00
	Scope	Replace Structure		

7	**Number**	052	**Detailed Design**	2021
	Name	Jasperson Lane Bridge	**Capital Works**	2022
	Type	Frame, Vertical Legs	**Capital Works Cost**	$ 211,800.00
	Scope	Replace existing Barriers with Code Compliant Barriers Repave Wearing Surfaces Concrete Repairs Replace Southwest Wingwall		

8	**Number**	013	**Detailed Design**	2021
	Name	Centre Avenue Bridge	**Capital Works**	2022
	Type	Slab on Concrete Rectangular Girders	**Capital Works Cost**	$ 173,200.00
	Scope	Replace existing Barriers with Code Compliant Barriers Concrete Repairs Jack Structure and Replace Abutment Bearings		

9	**Number**	019	**Detailed Design**	2021
	Name	Road 11 Patterson Drain Bridge	**Capital Works**	2022
	Type	Rigid Frame	**Capital Works Cost**	$ 150,100.00
	Scope	Install Code Compliant Barriers over Structure and Approaches Concrete Repairs		

10	**Number**	025	**Detailed Design**	2021
	Name	Road 3 West Centre Branch 47 Drain Bridge	**Capital Works**	2022
	Type	Rigid Frame	**Capital Works Cost**	$ 152,900.00
	Scope	Install Code Compliant Barriers over Structure and Approaches Wearing Surfaces Repair Concrete Repairs		

Other structures requiring minor rehabilitation in the Town's inventory mostly require concrete repairs. The Town is more likely to obtain cost savings by bundling those projects together and having one contractor complete the capital works.

Additionally, a number of structures require roadside safety upgrades and it is recommended that the work be undertaken within the next one (1) year.

6.0 CLOSURE

We trust that this report meets your requirements. Please do not hesitate to contact the undersigned with any questions.

Respectfully submitted,

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Marek Stütz, P.Eng.	Mohamed El-Sarji, P.Eng.
Principal	Structural Engineer