Purpose

This is the second of three information sheets on critical pieces of work related to the preliminary design and business plan development for the proposed Third Crossing. This information sheet looks at the technical feasibility of the project and provides an overview of the work guiding the preliminary design including: the evolution of the design from the concept stage; and the updated project cost estimates for the Third Crossing.

The updated cost estimate for the Third Crossing is $180 million (in 2019 dollars - based on the anticipated year of construction).
Introduction

The preliminary design report prepared by the lead engineering consultant J.L. Richards recaps the development of the conceptual design as part of the environmental assessment (EA) and traces the progression of the design through the preliminary design phase. Public input has been an important component in the development of the preliminary design and has helped shape and guide the evolution of the design from the concept developed in the 2012 EA.

There has been tremendous interest and public engagement on the Third Crossing, from the EA looking at the need for the crossing to the preliminary design and financial plan. Part of the engagement on the preliminary design and business plan included a public survey in 2016. When asked to consider the Third Crossing in the context of the natural environment and the city’s sustainability goals, the majority of residents who responded to the city’s survey indicated strong support for protection of the natural environment.

There was also an equally strong desire to see the bridge constructed in the most economical and practical way possible. Residents also wanted to have an aesthetically pleasing bridge design coupled with practical costs. This information sheet will outline the design evolution, changes in the design, an updated cost estimate and environmental considerations.

The project team has taken the public input received through the public survey, first public open house and other comments and reflected this information in a refined preliminary design that has optimized elements of the bridge, provided additional measures to protect the natural environment, and aimed to minimize overall project lifecycle costs to the maximum extent possible without compromising the features important to the community.
The Third Crossing Environmental Assessment (EA) focused on three bridge design concepts, shoreland road and landscape designs, and capital and maintenance costs, which were reported in the final Environmental Study Report (ESR) for the project.

The final report recommended the arch with V-piers bridge design that focused on the use of contemporary geometry, materials and detailing. Key aspects of the design included:

- The double V-piers that reduce in-water effects with a slender, open look that minimizes visual impacts.
- The 150 metre (m) pier-to-pier distance of the arch span that provides unencumbered through-navigation for the Rideau Canal’s navigable channel and the adjacent rowing lanes.
- The arch over the navigable channel and adjacent rowing lanes that highlights the bridge as a 21st century ‘gateway’ to-from the canal and the city’s Inner Harbour to the south.
- The bridge s-curve alignment that reduces noise and visual effects and provides a softer landscape for abutting residential lands on the east shore; and provides gradually shifting view perspectives for bridge users as they navigate the s-curve.
- The bridge clearance above the water accommodates existing topographic conditions on both shorelines and exceeds the canal’s minimum 6.7 m federally-regulated navigable requirement.
- A separated 3.6 m wide multi-use trail on the south side of the bridge for active transportation and 1.5 m wide commuter cycling lanes for westbound and eastbound travel.
- A series of observation look-out/interpretive areas provided along the south side of the bridge.
- Multi-use trail linkages to improve active transportation network connectivity north and south of the bridge including extensive landscaping and observation look-out or interpretive areas provided near-shore.
- Signalized intersections at John Counter Boulevard-Montreal Street; Gore Road-Point St. Mark Drive-Gore Road Library entrance; and Gore Road-Highway 15, and a two-way stop sign controlled intersection at John Counter Boulevard-Ascot Lane and associated turning lanes at the intersections noted above.

The ESR also identified dredging a channel for construction barge access as the preferred solution to facilitate in-water bridge construction, based on:

- The excavated channel could introduce a different habitat to a marine environment that is currently dominated by Milfoil, a type of submerged vegetation.
- Dredging would reduce capital costs in comparison to the temporary work bridge option which was also assessed during the EA.
- Dredging could accommodate a potential east-west watermain within the excavated channel, which was being planned by Utilities Kingston (UK) during the EA.
- Dredging would require only one in-water disturbance and one related set of mitigation measures as part of its installation, since it was anticipated that the excavated channel would not be backfilled in order to accommodate the watermain.

The ESR concluded that the anticipated cost to build the Third Crossing was $120 million (in 2011 dollars) and the cost to maintain the bridge was estimated to be $25,000 per year.
The proposed design and construction of the bridge has evolved from the conceptual work done in the EA phase. As highlighted below, this is due to updated transportation analyses; more in-depth fieldwork activities; optimizations of various bridge design elements; additional stakeholder consultations, public engagement; potential environmental impacts; and capital cost considerations. This design evolution is outlined in the sections below.

**BRIDGE ROADWAY COMPONENTS**

A rendering of the bridge deck is shown in Figure 1. The proposed width of the bridge deck is 16.5 m consisting of:

- Two lanes for vehicular traffic in response to the recommendation in the recent Kingston Transportation Master Plan update. Based on the current design speed (70 km/hr) and future posted speed (60 km/hr) on the bridge, the width of each lane will be 3.5 m.

- There will also be a two metre-wide shoulder adjacent to each vehicular traffic lane to assist with snow clearing and other maintenance activities and accommodate commuter cyclists.

- There is also a four-metre wide multi-use pathway on the south side of the bridge deck to provide for active transportation and look-out/interpretive areas. At the arch, the width of the multi-use pathway will increase to 9.5 m to provide a look-out/interpretive area over the navigation channel and adjacent rowing lanes.

- Three 0.5-metre wide separators with railings on the north side of the bridge between the roadway and the multi-use pathway, and on the south side of the bridge.
There will be two storm sewer pipes under the bridge deck, one along the north barrier and one along the barrier separating the roadway and the multi-use pathway. These storm sewer pipes, which will run from each side of the arch, drain storm water off the bridge into storm water management facilities on either shore, adjacent to the approach roadways.

**BRIDGE PROFILE AND PIER DESIGN**

- The proposed horizontal alignment of the bridge maintains the s-curve which has been modified to consist of two large horizontal curves, which will preclude the need for costly super-elevation (banking) on the bridge.

- The proposed vertical profile of the bridge was also refined compared to the conceptual design. The crest of the bridge has been centred on the arch span with the low points located off the bridge. This will make the arch the focal point of the bridge and it will also better facilitate storm water management and optimize the number of deck drains needed on the bridge. In addition, the vertical profile will be lowered by 2.8 m at the crest, which will reduce capital costs by requiring lower pier heights and reduced embankment fill requirements on the approaches.

- The initial preferred pier design consisted of two separate concrete V-piers with two tie beams. The V-piers would be supported by a large pier cap at the base of the pier, from which several large diameter caissons would be drilled into bedrock. As noted later, the pier design was revisited in response to bridge constructability, capital cost and environmental mitigation considerations.

- The proposed arch will be a pair of outward tilting tied arches. Each arch will have 18 multi-strand cables connected to the transverse floor beams, which will support the bridge deck. The proposed arch top chord is shaped elegantly with shaped parallel cross struts between the arch chords and parallel hangers (see Figure 1).

**IMPROVEMENTS AT APPROACHES TO BRIDGE AND BRIDGE CORRIDOR**

The design of the approach roadways has not changed significantly from the conceptual design stage. However, the John Counter Boulevard-Ascot Lane intersection has been designed to accommodate future traffic signals, should they be required based on traffic monitoring by the City. As well, the intersection of Point St. Mark Drive at Gore Road will include traffic-calming measures to prevent short-cutting through the Point St. Mark neighbourhood. These measures will be developed in consultation with neighbourhood residents. In addition, the roadway lighting will be simple and contemporary in appearance with accent lighting that highlights key bridge corridor components in a subtle, yet aesthetically pleasing effect at night.

Best management practices will be used to protect, restore, and enhance the cultural and natural heritage landscape within the bridge corridor both during and after construction. Focusing on post-construction design measures and consistent with the approved environmental assessment:

- The on-shore look-out/interpretive areas and active travel/commuter cycling provisions will be carried forward.

- The surrounding lands and shorelines will be extensively restored and enhanced using native plant materials to create both a natural and parkway setting.

- On-land wildlife micro-habitats such as bat and duck boxes, turtle-nesting areas and snake hibernating places will be provided.

- In recognition of the impact area from the permanent bridge on the structure and function of the Greater Cataraqui Marsh Provincially Significant Wetland (PSW), there will be provisions for wetland rehabilitation of the near-shore area on the west side of the bridge corridor. These provisions include the installation of habitat enhancements (e.g. reptile basking structures, submerged and emergent logs) and in-water re-vegetation using dominant wetland species.
BRIDGE CONSTRUCTABILITY

Based on the above considerations, as well as extensive bridge constructability assessments by the project team in consultation with city staff, the current project would recommend the temporary work bridge as the preferred in-water bridge construction option. Utilities Kingston has an alternative route for the proposed water main that was originally intended to be within the dredged channel. Secondly, the 4.3 ha impact area from the dredging option is significantly larger than the new proposed 0.6 ha impact area resulting from the use of a temporary work bridge. This option would also lower the risk concerning the potential long-term effects from a temporary work bridge on the Cataraqui River sediments, vegetation, habitat, and water quality. The temporary work bridge will be approximately 11 m wide, and supported on piles every 10 to 12 m. It would be advanced incrementally in conjunction with the construction of the permanent bridge from shore to the navigation channel on both sides. Targeted dredging would still be required at each pier location, but the overall impact footprint will still be significantly minimized. The temporary work bridge piles could either be removed completely or cut below the top of the riverbed and left in place after construction.

ENVIRONMENTAL IMPACT CONSIDERATIONS

The original recommendation from the EA that selected dredging as the preferred in-water bridge construction option has also evolved, as highlighted below:

- Based on more in-depth fieldwork activities, it has been determined that the composition of the dredged material could lead to suspension and sloughing of in-river sediment and potential mobilization of contaminants during construction; and changes in sediment dynamics and increased turbidity in the water column after construction.
- Specific consultations with Parks Canada during the preliminary design work provided more clarity on the sensitivity of the Greater Cataraqui Marsh PSW ecosystem, particularly its role as a coastal wetland, and its status as one of Parks Canada’s larger protected heritage areas.
- Another construction option that was explored during the EA, a temporary work bridge, can provide a significant reduction to the coastal wetland impacts (0.6 ha) when compared to the dredged channel option (4.3 ha).

DESIGN INNOVATION

The project team considered alternatives that would help reduce overall project costs, maintain the bridge aesthetics and be practical to construct. These were important messages from the public input the team received on the preliminary design which shaped the proposed design shown in Figure 3.
ALTERNATE PIER DESIGN = COST SAVINGS

This alternative pier design yields a significant cost savings compared to the original V-pier design. Since the temporary work bridge is the preferred construction method instead of the dredged channel from an environmental impact perspective, the reduction in cost associated with the alternative pier design helps offset the cost increase associated with the use of the temporary work bridge. From an aesthetic perspective, the alternative pier design would still provide a cohesive overall rhythm towards the arch span as the focal point of the bridge. As a result, the alternative pier design has been advanced as the preferred structural arrangement for the current project. The bridge would be supported on 92 conventional pot bearings, 88 for the plate girder approach spans up to the arch and four for the arch itself. To minimize maintenance and operation costs and increase durability, the bridge will have only four expansion joints. To the east of the arch, the expansion joints would be strip seal joints; to the west of the arch, the expansion joints would be multi-cell modular joints.

The U-frame piers will consist of two 1800 mm diameter caissons rock socketed into the bedrock with a steel liner. The V-piers at the arch will be supported on eight 2100 mm caissons with a footing. With the high ice loading that can develop on the arch pier footing, a pier nosing will be installed on the ends of the footings to break up the ice.

SUPPLEMENTAL INNOVATION CONSIDERATIONS

Some additional innovative features have also been incorporated into the design of the proposed Third Crossing. Flexibility in the design of the bridge would allow different methods for assembly of the arch and the approach spans, depending on the means and methods of construction selected by the bridge contractor.

In addition, bridge service life considerations, which focus on the overall life cycle of the bridge and optimization of performance and related operations/maintenance/rehabilitation costs, include:

- Designing the arch components from completely sealed components to enhance the long-term life and durability of the structure.
- Structural health monitoring system (SHMS) provisions, such as, but not limited to, a weather station; permanent displacement survey prisms; displacement sensors; GPS sensors; accelerometers; and leak detection systems.
- A hanger system comprised of multi-strand cables and anchorages with adjustment nuts, which would enable quick and easy adjustment (and replacement) of the cable forces throughout the life of the bridge.
- The use for alternative reinforcing steel such as stainless, glass fiber reinforced polymer, or galvanized steel rather than carbon steel in areas prone to high corrosion.
- Employing a four-coat system and the potential metalizing of the arch components.
- The use of LED light fixtures to reduce energy consumption, and optimize associated maintenance and replacement costs.
- The use of sustainable de-icing and anti-icing systems.
PROPERTY IMPACTS

Property considerations and impacts were identified in the EA in three locations with respect to the bridge and approach roadways: the east approach (on land); the bridge span (over water); and the west approach (on land).

The east side of the bridge corridor would use an unopened road allowance at the west end of Gore Road (north of the Point St. Mark neighbourhood) and the City-owned Gore Road library property at the northwest corner of Highway 15 and Gore Road. All east side lands that would be required for the construction and operation of the approach roadway, active transportation provisions and landscape works, embankment leading to the bridge abutment, bridge footprint and storm-water management areas would be contained within existing City-owned property.

The Cataraqui River riverbed is owned by the federal government and managed by Parks Canada. It would be necessary to recognize the footprint of the bridge both within and over the river as well as the construction and operation of the bridge through agreement(s) with Parks Canada.

The west side of the bridge corridor would predominantly use an existing unopened road allowance at the east end of John Counter Boulevard. The City owns the former Music Marina property on the north side of the road allowance near-shore, up to the River Park Subdivision. This property would partially accommodate construction staging and laydown area requirements as well as future storm water management provisions. Additional lands would also be required:

- On the south side of the road allowance to accommodate construction staging and laydown areas, the re-located John Counter-Boulevard-Ascot Lane intersection as well as active transportation and landscape works.
- At the John Counter Boulevard-Montreal Street intersection for widening John Counter Boulevard to accommodate eastbound turning and through lanes.

PERMITS

Parks Canada is responsible on behalf of the federal government for managing and protecting the Rideau Canal as a National Historic Site and Canadian Heritage River. Parks Canada is also responsible on behalf of the UNESCO World Heritage Committee for protecting the Canal as a UNESCO World Heritage Site.

Following the acceptance of the ESR by the Province in 2013, the Parks Canada ‘Directive on Impact Assessment’ was prepared in 2015. It outlines the legislative and policy requirements and accountabilities for the assessment of impacts of proposed projects within Parks Canada protected heritage places, which includes the Rideau Canal. In keeping with its mandated priorities, Parks Canada’s Environmental Impact Assessment (EIA) process examines how a project may lead to adverse effects on natural and cultural resources. In addition, the Parks Canada EIA process requires consideration of how the effects of a proposed project on natural resources may in turn cause:

- Adverse effects to characteristics of the environment important to visitor experience.
- Adverse effects to health and socio-economic conditions of First Nations and non-First Nations communities.
- Adverse effects to First Nations communities’ current use of lands and resources for traditional purposes.

The continuation of the Federal EIA process is part of the scope of this project. Given the nature of the proposed bridge project and the sensitivity of the project area, Parks Canada has determined that the Detailed Impact Analysis (DIA) framework is to be used for the Federal EIA. The DIA is the most comprehensive level of assessment, intended for complex projects that require applied analysis of
project interactions with valued components that may affect a particularly sensitive environmental setting or threaten one or more sensitive valued components. The City and project team are working with Parks Canada to achieve an agreement-in-principle regarding the DIA as part of the project.

Following formal approval of the DIA during the future final design phase, the City would be required to enter into agreements with the Government of Canada (represented by Parks Canada) to ultimately proceed to construct and subsequently operate the bridge for the duration of its life cycle, pursuant to the Federal Real Property and Federal Immovables Act.

In addition, there are also a number of permits and approvals that would be required from various regulatory authorities in support of the design work as it proceeds from the pre-design stage to the final design stage. Approvals are related to various non-passive fieldwork activities in support of the design work, which could also include authorizations pursuant to:

2. The Permit To Take Water requirements under the Ontario Water Resources Act. Ontario Regulation 148/06, Development, Interference with Wetlands and Alterations to Shorelines and Watercourses (Administered through the Cataraqui Region Conservation Authority).

SCHEDULE

Construction of the bridge could include different techniques for its various components depending on the means and methods of the contractor. It is estimated that it would take three years to build the bridge and road approaches. Provisions would be in place either preventing or limiting construction works during breeding, fish spawning and over-wintering seasons. In addition, in-water construction activities would have to accommodate boating traffic within the navigation channel and adjacent rowing lanes.

COST

The updated cost estimate for the proposed Third Crossing is $180M (in 2019 dollars, the anticipated year of construction). If construction doesn’t start in 2019, it is important to note this estimate will be adjusted for inflation each year. It is anticipated that the construction price adjustment that would be applied to the Third Crossing project would range between 2 to 5 per cent per year. Table 1 provides the Class ‘B’ construction cost estimate prepared for the refined design that includes the temporary work bridge construction method. This information shows that the current construction cost estimate for the proposed project is $180M (in 2019 dollars, the anticipated year of construction).

In comparison, the cost estimate for the project prepared as part of the EA was $120M (in 2011 dollars). Figure 6 shows the capital cost progression from the arch with V-piers design concept design in 2011 to the current refined bridge design in 2017.
### TABLE 1 - THIRD CROSSING COST ESTIMATE

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
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</thead>
<tbody>
<tr>
<td>Sub-Total for Structure Construction</td>
<td>$106,500,000</td>
</tr>
<tr>
<td>Sub-Total for Construction of Bridge Approaches</td>
<td>$11,500,000</td>
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<tr>
<td>Sub-Total for Landscaping</td>
<td>$3,400,000</td>
</tr>
<tr>
<td><strong>Sub-Total Construction Costs</strong></td>
<td><strong>$121,400,000</strong></td>
</tr>
<tr>
<td>Mobilization (3%)</td>
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</tr>
<tr>
<td>Engineering and Contract Administration (12.5%)</td>
<td>$15,200,000</td>
</tr>
<tr>
<td>Quality Management (3.0%, 2.5% Structural)</td>
<td>$3,100,000</td>
</tr>
<tr>
<td>Contingency (15%, 10% Landscape)</td>
<td>$18,000,000</td>
</tr>
<tr>
<td><strong>Total Estimated Cost (in 2017 dollars)</strong></td>
<td><strong>$161,300,000</strong></td>
</tr>
<tr>
<td>Land Acquisition</td>
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</tr>
<tr>
<td>Taxation (non-refundable HST 1.76%)</td>
<td>$2,800,000</td>
</tr>
<tr>
<td><strong>Sub-total Project Cost Estimate (in 2017 dollars, rounded)</strong></td>
<td><strong>$167,000,000</strong></td>
</tr>
<tr>
<td>Subject to Construction Price Adjustment (2017 – 2019)</td>
<td>$13,000,000</td>
</tr>
<tr>
<td><strong>Total Estimated Construction Cost (Round $1M)</strong></td>
<td><strong>$180,000,000</strong></td>
</tr>
</tbody>
</table>

Figure 4 shows that the overall cost of the proposed project has changed because of two main factors: (1) construction price inflation over the period from 2011 to 2017 and (2) the provision of the temporary work bridge as opposed to a dredged channel to support the construction of the Third Crossing. The proposed temporary work bridge is the result of discussions aimed at minimizing the impacts of the bridge construction on the provincially significant wetland. The temporary work bridge would be more expensive, but this method for the bridge construction would be preferred and have the least impact on the sensitive coastal wetland environment within which the Third Crossing would be located.
Conclusion

The project team is finalizing the preliminary design report for the Third Crossing that will be presented to Council in June 2017. Public input has helped shape the preliminary design evolution from the conceptual design as part of the EA approved in 2012 to the current design.

The project team, guided by this public input, has incorporated a number of design improvements to improve the function of the bridge, the user’s experience, the protection of the natural environment, and the minimization of life cycle costs.

The total cost estimate for the proposed project is $180M in 2019 dollars, the anticipated year of construction. This cost is attributed to two main factors: construction cost inflation from 2011 to 2017 and the use of a temporary work bridge to support construction instead of a dredged channel.

Information sheet three will go into more detail on the breakdown of the cost and the financial plan that supports the project. The financial plan includes information on the cost benefit analysis, economic impact analysis and environmental considerations for the project. It also outlines some of the major economic considerations in constructing this link across the Cataraqui River.

For more information, please visit the Third Crossing website: CityofKingston.ca/ThirdCrossing

The Third Crossing Team
thirdcrossing@cityofkingston.ca
Phone: 613-546-4291, Ext. 3130