REPORT FOR ACTION

Unwin Avenue Bailey Bridge Replacement Study

Date: April 23, 2025
To: Infrastructure and Environment Committee
From: General Manager, Transportation Services
Wards: Ward 14 - Toronto-Danforth

SUMMARY

Transportation Services, in partnership with Engineering and Construction Services, has completed a Replacement Study for the Unwin Avenue Bailey Bridge. The purpose of the study was to evaluate a range of conceptual design alternatives for the replacement of the existing temporary, single-lane modular bridge spanning over the R.L. Hearn circulation channel and provide a recommendation on the preferred bridge replacement option, to be carried forward to detailed design.

The existing Unwin Avenue bridge was constructed in 2008 and is now 17 years old. In 2024, the closure of the Ship Channel bridge for emergency repairs restricted access to the lands south of the Ship Channel and placed significant pressure on the existing single-lane Bailey bridge on Unwin Avenue. In keeping with the need to modernize Port Lands infrastructure to better accommodate both existing and future traffic demands, this study will provide near-term improvements in advance of a future realignment of Unwin Avenue, as established in the 2017 Council-endorsed Port Lands and South of Eastern Transportation and Servicing Master Plan (TSMP).

The study was conducted using a decision-making matrix to rank the performance of three conceptual bridge alternatives based on several key factors and both qualitative and quantitative scoring criteria. The evaluation was further supported by a structural and civil capital cost estimate to assess the short-term capital needs of each alternative.

Based on the point-based evaluation and ranking, Alternative 2, the complete replacement of the existing bridge with a two-lane, heavy-duty modular bridge was identified as the preferred replacement option. This alternative offered the best balance between constructability, technical performance, durability, and cost. Supporting technical studies, including topographic surveys, subsurface utility engineering, geotechnical investigations, and arborist studies were also completed as part of the study to help inform the evaluation and detailed design.

RECOMMENDATIONS

The General Manager, Transportation Services recommends that:

1. City Council endorse the replacement of the existing single-lane Bailey bridge on Unwin Avenue with the Alternative 2 bridge replacement option, as described in the report dated April 23, 2025, from the General Manager, Transportation Services, to inform advancement of detailed design and construction of the recommended bridge replacement option.

FINANCIAL IMPACT

A preliminary capital cost estimate of approximately $5.23 million (in 2025 dollars and excluding HST) for construction of the Unwin Avenue Bailey Bridge replacement has been identified as part of this study for the bridge replacement option recommended in this report.

Subject to Council's approval of this report, staff will advance to the detailed design phase of the recommended option. Funding for detailed design is estimated at $1 million and is included in the 2025-2026 Capital Budget.

The Deputy City Manager and Chief Financial Officer have reviewed this report and agree with the financial impact information.

DECISION HISTORY

On November 27, 2024, staff provided an update to the Infrastructure and Environment Committee on the status of the Unwin Avenue Bridge Replacement Study, indicating as part of the next steps within the report that another update would be provided in early 2025 when a preferred bridge replacement option was identified.
https://secure.toronto.ca/council/agenda-item.do?item=2024.IE18.4

On July 3, 2024, the Infrastructure and Environment Committee directed the Deputy City Manager, Infrastructure Services, to report on the timelines and next steps for improving or replacing the Unwin Avenue Bailey bridge.
https://secure.toronto.ca/council/agenda-item.do?item=2024.IE15.11

COMMENTS

Study Area and Bridge Overview

Unwin Avenue is a two-lane, east-west street located south of the Ship Channel, providing a connection between Leslie Street and Cherry Street and access to the South Port area (Attachment 1). The section of Unwin Avenue east of the R.L. Hearn Generating Station is a private street owned by the City through the Toronto Port Lands

Company (now CreateTO) and to the east, a single-lane Bailey bridge provides access across the Hearn's circulating channel.

The TSMP completed in 2017 identified the need to realign and upgrade Unwin Avenue in order to remove the two existing 90-degree bends east of the circulation channel and to transform the current rural cross-section into a complete street with sidewalks, bikeways, and some on-street parking. The need to remove and replace the existing one-lane bridge was also noted, depending on the design of the final road realignment.

The existing Bailey bridge is a single-lane, prefabricated modular structure with a span of approximately 33.5 metres (m), an overall width of 6.5 m, and a roadway platform width of 4.2 m. The superstructure is a modular steel panel system set on bearings seated on two cast-in-place concrete abutments. The substructure is contained within a structural steel seawall system along the channel, connected by a single layer of tie-rods. The existing single-lane Bailey bridge on Unwin Avenue is aging, providing insufficient capacity across the circulating channel.

Constructed in 2008, the bridge experienced significant additional traffic during the 2024 emergency closure period for the Ship Channel bascule bridge, which further deteriorated its condition. Over four days in July 2024 the Bailey bridge was closed for pre-planned capital repairs, in close coordination with PortsToronto's work on the Ship Channel bascule bridge, in order to maintain vehicle and pedestrian access to the South Port area via Cherry Street. The capital repairs included deck panel replacements to address fatigue issues observed through routine inspections and new waterproofing applied to the deck surface.

Bridge Replacement Study Process

To ensure the safe continued operation of the crossing until Unwin Avenue is realigned, and to improve traffic conveyance and access within the area south of the Ship Channel, a more robust interim bridge replacement solution is required.

The study was conducted using a decision-making matrix to rank the performance of three conceptual bridge alternatives, based on several key factors using both qualitative and quantitative scoring criteria. The evaluation was supported by a structural and civil capital cost estimate and value analysis for each alternative.

Three conceptual bridge alternatives were developed and brought forward for comparative analysis based on a set of project constraints and considerations that also helped inform the evaluation criteria, including:

- Future realignment: The bridge selected and built through this study will be removed and replaced by a permanent bridge in a new location when Unwin Avenue is realigned in the future.

- Existing pedestrian and cycle crossings: The pedestrian and cycle bridge located to the south of the existing Unwin Avenue bridge must be considered in the design and placement of alternatives and remain open during construction.

- Navigational clearance: Any alternative must consider maintaining existing navigational clearances over the channel and any change to the deck elevation will have impacts on road grades at bridge approaches.

- Constructability challenges: Existing seawall sheet piles and tie-back anchors impose constraints on the new bridge foundation configuration, orientation, and span length, while the existing deep foundation may present a constraint on replacement options.

- Existing utilities: Overhead hydroelectric transmission lines and underground gas pipeline and regulators present within the project footprint complicate the design and alignment of the replacement bridge structure.

- Environmental site constraints: Lands classified as Environmentally Sensitive Areas (ESAs) are found directly south of Unwin Avenue, which may influence the design and placement of the alternative bridge and require mitigating measures to avoid or reduce any potential impacts.

Description of Alternatives

Alternative 1. A New Single-Lane Modular Bridge to the North and Replacement of Existing with New Single-Lane Bridge

Alternative 1 proposes the construction of a new single-lane light-duty modular bridge to the north of the existing bridge and replacement of the current modular bridge superstructure with a new one on the existing abutments and foundation system. Both bridges would have the same deck width, span length and depth as the existing temporary modular bridge. Light-duty modular bridges are typically designed for short durations, with a useful service life of around 15-20 years.

Construction of Alternative 1 would be completed in two stages, maintaining one lane of bi-directional traffic. The new bridge to the north would be built first and traffic would be moved to the newly constructed bridge while the existing bridge superstructure to the south is replaced. The exact spacing between the two bridges would be refined during detailed design, however this study has identified an offset of approximately 5 m to avoid conflicts with the existing foundation and protection systems and to ensure sufficient clearance for continued traffic conveyance.

In order to accommodate the two structures, a localized portion of Unwin Avenue would need to be widened, requiring additional grading work. The modular assembly and launching would allow for a shorter construction window as compared to conventional methods, with an estimated schedule of approximately three to four months. When Unwin Avenue is realigned in the future, the twin single-lane bridges will be considered to have reached the end of their service life and removed.

Based on a conceptual level of design, structural and civil works are estimated at $4.38 million (M) and $1.69 M respectively, for a total combined cost of $6.07 M for Alternative 1.

Alternative 2. Two-Lane, Heavy-Duty Modular Bridge

Alternative 2 proposes the complete replacement of the existing bridge with a two-lane, heavy-duty permanent modular bridge that would meet CSA S6 standards for a 75-year service life. Based on a conceptual level of design, the proposed bridge would be supported on deep foundations within the seawall and could be built to include a 1.5 m wide cantilevered sidewalk on the south side of the structure.

The complete removal and replacement of the existing single-lane bridge with Alternative 2 would require the full closure of Unwin Avenue during construction and would need to be installed when the Ship Channel bascule bridge on Cherry Street is kept in an operational state, to permit vehicle and pedestrian access to the South Port area. As a modular bridge design, the anticipated duration of construction would be quicker than a conventional bridge and is estimated to take two to three months. However, the limited number of manufacturers designing and constructing heavy-duty modular bridges could impose some limitations on costs and part availability.

Due to the greater structural depth of the heavy-duty bridge, the finished grade of the bridge structure and road approach profile could be approximately 1.0 m higher than existing, to preserve the channel's navigational clearance. Based on conceptual design, it is anticipated that the centre line for Alternative 2 would require a minor shift to the north to accommodate a wider structure and provide additional clearance for the necessary protection system between the new bridge and existing pedestrian and cycle bridge to the south.

Similar to Alternative 1, this replacement option would be disassembled and removed when Unwin Avenue is realigned in the future. Based on a conceptual level of design, structural and civil works are estimated at $4.07 M and $1.16 M respectively, for a total combined cost of $5.23 M for Alternative 2.

Alternative 3. Permanent Steel Truss Bridge

Alternative 3 proposes replacing the existing bridge in its entirety with a new two-lane, permanent structural steel bridge. The bridge span would be similar to Alternative 2 at approximately 36 m and could also accommodate a 1.5 m wide sidewalk on the south side.

The construction duration of Alternative 3 would be typical for conventional bridge designs of this type, taking a full construction season of six to eight months. Unwin Avenue would be closed to traffic during this time and construction would require close coordination with the Ship Channel bascule bridge operations to ensure vehicle and pedestrian access via Cherry Street is maintained.

The bridge would be placed on the existing alignment, requiring a shift to the north slightly greater than that of Alternative 2 to accommodate the wider structure. It is anticipated that minor grade changes would be required for the bridge deck height and road approach profiles and the bridge would be demolished as part of any future realignment for Unwin Avenue.

Based on a conceptual level of design, structural and civil works are estimated at $5.82 M and $1.19 M respectively, for a total combined cost of $7.01 M for Alternative 3.

Alternative Evaluation: Methodology, Criteria, and Scoring

Once alternatives were identified, a set of weighted decision-making criteria and sub-criteria was developed and used to identify the recommended alternative. Scores were calculated by summing up the points earned for each alternative, based on its performance within each criteria category. The full evaluation criteria and weighting table is included in Attachment 2, with the primary decision-making criteria headings described as follows:

- Bridge Engineering: Evaluates critical aspects of the structural performance and design of alternatives. It considers factors such as span efficiency, level of design effort, durability, maintenance requirements, and the longevity of its intended design and service life.

- Constructability: Evaluates the ease and duration of construction for each alternative and considers the complexity of the construction process, including staging and equipment needs and impacts to traffic flow.

- Civil Engineering: Evaluates the high-level impacts of each alternative to civil infrastructure, including roadway alignment, profile, and grading, as well as the extent of impacts to utilities and adjacent properties.

- Cost: Assesses the overall cost and value of each alternative. It considers the estimated capital costs for structural and civil components, including contingency and engineering support.

A summary of the points-based ranking is provided in Table 1 below, with a detailed evaluation matrix showing scores for each criterion, provided in Attachment 3.

Alternative 1 was identified as least favourable, as it had the greatest civil impact with the lowest overall durability and robustness. The footprint of Alternative 1 also encroached onto Provincial lands and may be in direct conflict with the gas mains and regulator, complicating design. Alternative 3 is slightly more favourable with the second lowest score that reflects its high capital cost, long construction timeline and lower overall value.

Alternative 2 ranked as most favourable as it has the lowest capital cost; providing greater durability, lower maintenance frequency and longer service, as compared to a light duty structure (Alternative 1). Potential property impacts can be avoided with Alternative 2, which also has the lowest overall impact to existing utilities, most notably the existing gas mains. A simpler and more cost-effective disassembly and removal process, as compared to Alternative 3, and better considers the future realignment of Unwin Avenue, while also requiring the shortest closure period of Unwin Avenue due to a faster construction schedule.

Table 1. Summary Evaluation Matrix

Criteria	Alternative 1	Alternative 2	Alternative 3
Bridge Engineering	9	15	20
Constructability	12	10	5
Civil Engineering	10	22	22
Cost	26	28	17
Total Score (100)	57	75	64

Recommended Alternative and Design Considerations

Based on the results of the evaluation, Alternative 2 was identified as the preferred replacement option as it offered the best balance between constructability, technical performance, impacts, value and cost, while considering the future construction of a permanent bridge at a new location, when Unwin Avenue is realigned.

The recommended alternative conceptual design proposes a heavy-duty modular bridge designed to carry two lanes of traffic with CL-625-ONT live loads that meets CHBDC S6 fatigue requirements. The proposed increase in the finished grade of the structure and road approaches is conservative and intended to capture the maximum potential impact at the conceptual level of design. Opportunities to reduce the bridge deck height will be explored during detailed design, including minimizing grading requirements on the road approaches where feasible (e.g., embanked grading or retaining structures). Replacement of the bridge under an anticipated 2–3-month full road closure would be required to allow for staging, laydown, and launching from both road approaches. Bridge design, construction methodology, and schedule will be developed during detailed design. Timing for road closures will be established in close coordination with other Port Lands initiatives and area landowners to minimize impacts to vehicular traffic and business operations.

Detailed design will consider opportunities to minimize or avoid impacts, such as the ESA to the south of Unwin Avenue. Removal of the proposed sidewalk on the south side of the structure will be considered to reduce its overall footprint, avoiding encroachment into the ESA in tandem with investigating opportunities to formalize existing informal connections between Unwin Avenue and the Martin Goodman Trail to improve accessibility to the trail system for pedestrians and cyclists to and from Unwin Avenue.

Next Steps

Subject to Council approval of this report, Transportation Services and Engineering and Construction Services will finalize the Unwin Avenue Bridge Replacement Study and supporting technical investigations and initiate detailed design in 2025.

The detailed design and implementation schedule will need to be coordinated with other infrastructure works and planned developments in the area. Price and construction schedule may be impacted due to a limited availability of suppliers for heavy-duty modular bridges. These items will be refined through detail design.

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ATTACHMENTS

Attachment 1: Location of the Unwin Avenue Bailey Bridge
Attachment 2: Criteria Used for Evaluation of Alternatives
Attachment 3: Scoring Matrix

Attachment 1: Location of the Unwin Avenue Bailey Bridge

Attachment 2: Criteria Used for Evaluation of Alternatives

CRITERIA	MEASURE	POINTS (100)	RATIONALE FOR SELECTION
BRIDGE ENGINEERING (24 POINTS)			
Span Efficiency	Required span length to avoid site conflicts and provide adaptability	3	Bridge alternatives with span lengths that minimize site conflicts and offer flexibility to accommodate changes to the site's configuration will negate unnecessary span increases and will receive higher scores.
Design Complexity	Prefabricated systems are typically designed by the supplier, with design of substructure and coordination with suppliers upfront; Custom designs involve design of both superstructure and substructure upfront	3	Alternatives with greater quantities of prefabricated and pre-engineered elements will score higher, as designing a custom bridge will necessitate longer design schedules.
Durability	Grade, size, and finish of steel components; deck coating and wearing surface compatibility	3	Alternatives with greater durability and more resistance against corrosion from environmental conditions and traffic-induced wear will score higher.
Traffic Barrier	Type of selected barrier, and specifically whether provided barrier is crash tested.	1	Alternatives that include crash tested TL barriers incorporated into their design receive full score.
Maintenance	Frequency of periodic inspection and repairs	6	Higher scores will be assigned to alternatives requiring less frequent inspections and maintenance activities, favoring lower long-term maintenance costs, efforts, and frequencies.

CRITERIA	MEASURE	POINTS (100)	RATIONALE FOR SELECTION
Design and Service Life and Risk	Duration of the bridge expected to be in service	6	Alternatives offering a longer service life will score higher, favoring longevity and value over time.
Improvement Opportunity During Detailed design	Degree of customizability of the structures during detailed design phase.	2	Alternatives allowing greater flexibility for customization and improvement of structural components during the detailed design phase will receive a higher score.
CONSTRUCTABILITY (18 POINTS)			
Ease of Construction	Qualitative assessment based on staging, access, and equipment requirements	8	Bridge alternatives with simpler construction processes will score higher. The ideal alternative can be constructed without extensive use of specialty equipment or techniques for completing the superstructure, substructure, and foundation.
Construction Schedule	Total duration of construction schedule	6	Short timelines for the completion of the bridge alternative are favored and will be scored higher to alleviate overuse of the existing modular bridge, reduce Contract Administration costs, and minimize impacts to road users.
Construction Traffic Impact	Level of impact on the flow of vehicular traffic due to construction-related activities	4	Alternatives that cause less impact and disruption to vehicular traffic during construction will receive a higher score.
COST (28 POINTS)			
Capital Construction Cost	Comparative initial capital cost (in dollars) of each bridge alternative	14	Bridge alternatives that offer lower initial construction costs will score higher.

CRITERIA	MEASURE	POINTS (100)	RATIONALE FOR SELECTION
Life Cycle Cost	Life Cycle Cost analysis based on a 20-year projection	14	Alternatives with lower present value costs will receive higher scores
CIVIL ENGINEERING (30 POINTS)			
Roadway / Grading Impact	Degree of alteration required for the existing road alignment and profile to accommodate the alternative	10	Degree of alteration required for the existing road alignment and profile to accommodate the alternative
Utility Impacts	Extent of utility relocation or protection required	10	Extent of utility relocation or protection required
Property Impact	Degree of impact on nearby private properties	10	Degree of impact on nearby private properties

Attachment 3: Scoring Matrix

CRITERIA	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3
BRIDGE ENGINEERING (24 POINTS)			
Span Efficiency	2	1	3
Design Complexity	3	3	1
Durability	1	2	3
Traffic Barrier	0	1	1
Maintenance	1	3	5
Design/Service Life and Risk	2	4	5
Improvement Opp. During Detailed design	0	1	2
Subtotal Score	9	15	20
CONSTRUCTABILITY (18 POINTS)			
Ease of Construction	4	5	3
Construction Schedule	4	5	2
Construction Traffic Impact	4	0	0
Subtotal Score	12	10	5
COST (28 POINTS)			
Capital Construction Cost	13	14	8
Life Cycle Cost	13	14	9
Subtotal Score	12	10	5
CIVIL ENGINEERING (30 POINTS)			

CRITERIA	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3
Roadway / Grading Impact	3	6	7
Utility Impacts	5	8	8
Property Impact	2	8	7
Subtotal Score	12	10	5
TOTAL SCORE (100)	57	75	64