TRANSPORTATION ENVIRONMENTAL STUDY REPORT

Volume II

Preliminary Design and Environmental Assessment for the Rehabilitation / Replacement of Ottawa Queensway Mid-town Bridges from Holland Avenue to O'Connor Street

GWP 4075-11-00

City of Ottawa

April 2016

Transportation Environmental Study Report

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SUMMARY OF ENVIRONMENTAL CONDITIONS REPORT

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Stage 1 Archaeological Assessment for Ontario Ministry of Transportation of 23 Bridge Rehabilitations/ Replacements from Holland Avenue to O'Connor Street along Highway 417, City of Ottawa (GWP 4075-11-00),

(Lots 36-40, Con. 1 On Ottawa River, Lots F-G, Con. C, Geo. Twp. Nepean)

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ACKNOWLEDGEMENTS

Morrison Hershfield Limited provided project limit plans for all of the study areas. Ontario Ministry of Tourism, Culture and Sport provided the archaeological sites data and some of the report titles for this project. Additional report information was provided by Morrison Hershfield, Brenda Kennett for Past Recovery Archaeological Services, Hugh Daeschel for Golder Associates Limited and Colin Varley, for Stantec.

EXECUTIVE SUMMARY

This report discusses the rationale, methods and results of the Stage 1 archaeological assessment for the rehabilitation/ replacement of 23 bridges from Holland Avenue to O’Connor Street along Highway 417 (Queensway) through the City of Ottawa. This assessment was undertaken as part of an environmental assessment under the *Environmental Assessment Act* and triggered by the *Class Environmental Assessment for Provincial Transportation Facilities (2000).* The purpose of this study is to identify archaeological potential for the location of any Aboriginal and Euro-Canadian archaeological sites that may be impacted by possible changes to the bridge structures and assess these areas. The archaeological assessment was conducted for Morrison Hershfield Limited on behalf of the Ministry of Transportation.

The project limits includes 12 irregular shaped study areas around the following 23 overpass bridges carrying eastbound and westbound traffic along Highway 417 (Figure 1): Holland Avenue (2); Parkdale Avenue (2); Fairmont Avenue (2); Bayswater Avenue (2); O-Train (2); Preston Street (2); Rochester Street (2); Booth Street (2); Bronson Avenue (2); Percy Street (2); Bank Street (2); and O’Connor Street (1). The project is completely within the current limits of the City of Ottawa (Lots 36-40, Con. 1, Lots F-G, Con. C, Geographic Township of Nepean, Carleton County).

The proximity to water indicated that four of the 12 study areas including Bank and O’Connor Street bridges possibly near Patterson Creek, and Bayswater Avenue and O-Train near Dow’s Great Swamp, had potential for pre-contact archaeological remains prior to development. Historic maps and documents indicate that nineteenth century development around the highway did not begin until the construction of the Canadian Atlantic Railway in 1879. Some residential development followed in the late nineteenth century near the Rochester, Booth and Bronson bridge study areas. However, the secondary development around these study areas and the construction of the existing Highway 417 has intensively and extensively disturbed all of the bridge study areas. This was confirmed by a site visit made on April 19th, 2013. No portions of the study lands required for the 23 Highway 417 bridge rehabilitation/ replacements has potential for significant archaeological remains.

Based on the above information, the following recommendation has been made:

1. The 23 bridge rehabilitations/ replacements at 12 study areas from Holland Avenue to O'Connor Street along Highway 417 have no archaeological potential due to intensive and extensive disturbances. No further archaeological assessment is required.

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1.0 PROJECT CONTEXT

1.1 Development Context

This report discusses the rationale, methods and results of the Stage 1 archaeological assessment for the rehabilitation/ replacement of 23 bridges from Holland Avenue to O'Connor Street along Highway 417 (Queensway) through the City of Ottawa. This assessment was undertaken as part of an environmental assessment under the *Environmental Assessment Act* and triggered by the *Class Environmental Assessment for Provincial Transportation Facilities (2000).* The purpose of this study is to identify archaeological potential for the location of any Aboriginal and Euro-Canadian archaeological sites that may be impacted by possible changes to the bridge structures and assess these areas. The archaeological assessment was conducted for Morrison Hershfield Limited on behalf of the Ministry of Transportation.

All archaeological assessment activities were performed according to the *Standards and Guidelines for Consultant Archaeologists* (MTC 2011). All work was done under the archaeological consulting license, P035, issued to Andrew Murray of A. M. Archaeological Associates under the *Ontario Heritage Act*. All records and artifacts pertaining to this project will be curated at the offices of A. M. Archaeological Associates. All of the property inspection was conducted from public thoroughfares and no permission to enter was required.

The project limits includes 12 irregular shaped study areas around the following 23 overpass bridges carrying eastbound and westbound traffic along Highway 417 (Figure 1): Holland Avenue (2); Parkdale Avenue (2); Fairmont Avenue (2); Bayswater Avenue (2); O-Train (2); Preston Street (2); Rochester Street (2); Booth Street (2); Bronson Avenue (2); Percy Street (2); Bank Street (2); and O'Connor Street (1). The project is completely within the current limits of the City of Ottawa (Lots 36-40, Con. 1, Lots F-G, Con. C, Geographic Township of Nepean, Carleton County).

1.2 Historic Context

1.2.1 General Area

1.2.1.1 Pre-contact Occupation

The earliest period of occupation in Ontario is the Palaeo-Indian period (c. 11,000-8,000 Before Present) but it is poorly represented in the Ottawa Valley. The importance of the Ottawa River as the main transportation route from east to west becomes more apparent in the subsequent Archaic period. Archaeologists generally divide northeastern Ontario's pre-contact history into the following generalized temporal/cultural sequences:

Late Palaeo (c. 11,000-8,000 Before Present)

- Fluted point technology. No sites have been currently identified during the period that the Mattawa River - Ottawa River served as main outlet for glacial Lake Algonquin.

Shield Archaic (c. 8,000 - 3,000 B.P.)

- Rich diversity of flaked and ground stone tools, bone tools, copper tools and decorative items. Extensive use of Ottawa River and fishing and nut exploitation become important.

Early Woodland (c. 3000 - 1500 B.P.)

- Introduction of cord or fabric impressed pottery; near complete pot found by Barry Mitchell at CaGi-1 160 km upstream along Ottawa River.

Middle Woodland (c. 1,500 - 1,000 B.P.)

- Laurel artifact assemblage is characterized by distinctive side notched projectile points, small blade knives, great numbers of scrapers, some bone harpoons, and some use of native copper. Laurel pottery is finely made, thin ware with numerous rows of a variety of stamped patterns decorating the shoulders, necks, and/or collars of the conically shaped vessels. Seasonal gatherings of people for subsistence and social purposes occur including large villages at prime fishing locations.

Late Woodland (c. 1,000 B.P. - contact)

- Artifact assemblage is characterized by small triangular and side-notched projectile points, use of relatively unmodified greywacke flake or spall tools and flat slate knives. Clay smoking pipes indicate introduction of tobacco use. Settled village life associated with adoption of corn, bean squash horticulture becomes prevalent.

1.2.1.2 Post contact Occupation

The earliest European contact with the indigenous people of the Ottawa area was during Étienne Brûlé's trip through the area in 1610 and Champlain's trip in 1613. Together these visits ushered in a period of exploration and trade through the region that would last two hundred years before permanent European settlement began. The early explorers and traders met Algonquin peoples including Weskarini, Onontchataronon, Keinouche, Kichesipirini, Matouweskarini, and

Otaguottouemins throughout the Ottawa Valley (Trigger 1976:279). The period of French-Algonquin alliance rapidly diminished after the fall of New France to the British in 1759.

The area became part of Lunenburg District in 1788 and the Eastern District in 1792 before the establishment of Nepean Township, Carleton County in the Dalhousie District in 1798 (Rayburn 1997). Nepean Township was surveyed in 1798 but did not receive its first Euro-Canadian settler, Ira Honeywell, until 1810 (Gourlay 1896). The early community on the south shore of the Ottawa River remained quite small and land ownership was clustered around the juncture of the Ottawa and Rideau Rivers until the construction of the Rideau Canal began in 1828 (Belden 1879; Gourlay 1896) (Figure 2). The canal was completed by 1832 but early mapping indicates that the section through Nepean and Ottawa may have been open as early as 1830 (By 1830) (Figure 3). Bytown was laid out by Colonel John By during the canal project near the Ottawa River. Bytown was incorporated as the City of Ottawa in 1854 and was selected as the capital of the United Province of Canada in 1857 because it was further from the United States and nearly equidistant between the population centres of Quebec City and Toronto (Belden 1879a). The study areas remained on the fringe of Ottawa through the nineteenth century and only became amalgamated with the City between 1889 and 1907.

1.2.2 Project Specific History

The earliest landowner for a portion of the Highway 417 corridor study area was Thomas Fraser who was granted Lots F and G in 1801 (AO: Inst. # RO 545). Although the grant was in Thomas Fraser's name, his sons actually settled on the lands in 1812. An 1830 map still shows William Fraser's name on the lot but in 1826 George Patterson, chief of the Canal Commissariat, acquired Lot G (AO: Inst. #RO 690) (Figure 3). In 1814, Abraham Dow purchased Lot H of Concession B (Dow's Lake area west of Bronson). Although this lot is not part of the study area, it was Dow's name that became associated with the linear tract of swamp that once connected the Dow's Lake area to the Ottawa River (Figures 2 and 3). The Walling map (1863) shows R. Reid on Lot 36, George Bain on Lot 37 and John Kelly on Lot G but there is still no development within any of the bridge locations (Walling 1863) (Figure 4).

Ottawa had grown substantially by 1879 when mapping of Nepean Township and Ottawa shows greater detail around the study areas (Belden 1879b) (Figures 5 and 6). The Ottawa and Prescott Railway (later the St. Lawrence & Ottawa Railway) opened in 1851through the present O-Train location but the branch from Dow's Lake to LeBreton Flats did not open until 1871

(Mitchell 1864; Belden 1879a&b). Lots 36, 37 and 38 are depicted with houses belonging to R. J. Hinten, Robert Reid and H. McLean but they are not within 100 metres of any of the eastern study areas. At this time, the present Highway 417 corridor fell within the limits of several towns separate from Ottawa including Bayswater, Rochesterville, Mount Sherwood and Stewarton. A more detailed map of Ottawa, also from the 1879 Belden Carleton County Atlas, shows subdivided properties within these towns but does not depict any buildings within any of the study area limits (Belden 1879b) (Figures 5 and 6).

Lumber baron J. R. Booth built the Canadian Atlantic Railway between 1879 and 1896 to provide faster transportion for his vast timber and other holdings to the west to markets in the eastern U.S. Several of the Highway 417 Queensway bridges (O-Train, Preston, Rochester and Booth) are located across a large tract of land that was utilized as the Fraserfield lumber and rail yards (Figure 7). Several buildings are shown on Goad Insurance maps of the area within the footprints of the Rochester, Booth and Bronson bridges. The 1901 Ottawa City Directory lists Mrs Sarah Little at 375 Rochester and Mrs Lydia Payne at number 385 between Kenney and Lydia Streets (Might 1901). Division Street (now Booth Street) is listed with two houses on the east side and two houses on the west. Concession Road (now Bronson Avenue) has three houses at numbers 592, 596 and 602 as early as 1891 (Figure 7). A bird’s eye view of Ottawa from 1895 does not show any structures in these areas so they may not have been substantial buildings. J. R. Booth sold his railway to the Grand Trunk Railway in 1904 which was acquired by Canadian National Railways in 1923 (Toronto Lithographing Co. 1895) (Figure 8). Topographic mapping from 1919 and 1958 indicates that the railway expanded to completely cover these areas by the mid-twentieth century (Figures 9-10). The railway was no longer in use by 1957 when the line was utilized for the new highway. The highway was built in stages and the bridge study areas were constructed between 1961 and 1965.

1.3 Archaeological Context

The project involves the preliminary design to determine the preferred alternative for the rehabilitation and/or replacement of 23 structures at 12 sites on Highway 417 (Ottawa Queensway) from Holland Avenue to O'Connor Street, approximately 3.6 kilometres (Figure 1). The individual study areas are mostly within existing MTO right-of-way with the exception of the O-Train bridges study area that extends further to the north and south. The study areas (typically to MTO right-of-way limits) range in size from 0.33 hectares (Bank) to 4.3 hectares

(O-Train) (Figure 12). A larger study area was used for the O-Train to consider the potential effects of the future twin tracking of the rail line and potential site access options.

1.3.1 Environmental Setting

There are a number of environmental factors such as water sources, soil types, physiographic features, vegetation and lithic resources that will influence settlement and the archaeological potential of an area. These regional features would have influenced transportation routes, gathering places, food sources, climate (microenvironments), overall vegetation patterns, and soil formation.

1.3.1.1 Physiographic Features and Soils

Landforms and soils can play a role in determining settlement patterns and human behaviour. In particular, elevated areas that are well drained are preferred areas for settlement.

The 23 Highway 417 bridges are within the Ottawa Valley Clay Plain physiographic region (Chapman and Putnam 2007). The Ottawa Valley Clay Plain is a large region consisting of clay plains interrupted by ridges of rock or sand (Chapman and Putnam 1984). Holland, Parkdale and Fairmont Avenue bridges are within a drumlinized till plain and the remaining bridges are on a limestone plain (Chapman and Putnam 2007). The elevation is between 68 and 74 metres.

The City of Ottawa grew around the Highway 417 area prior to methodical mapping of soil types but the surrounding area is typified by Rideau Clay, sand spot phase (Rc-s) described as “small areas of sand knolls less than three feet deep over clay intermixed with areas of Rideau clay” (Department of Agriculture 1944; Hills, Richards and Morwick 1944:53) (Figure 11).

1.3.1.2 Water Sources

The Rideau River is 1.1 km east of the O’Connor Street bridges and was the major water source through the general area prior to the construction of the Rideau Canal (Figure 12). The Rideau Canal construction began in 1832 and made major changes to the drainage across the general area. A small remnant of Patterson Creek joins the Rideau Canal just 400 metres south of Highway 417. The exact location of the creek prior to canal construction is difficult to determine but 1827 mapping suggests that it was close to the Bank and O’Connor Street bridges (Figure 2). The early mapping also indicates that the Bayswater Avenue and O-Train bridges were within an area labelled as "Dow's Great Swamp" (Colonel By 1827) (Figures 2 and 3). This was a low area that drained overflow from the Rideau River in wet weather through the area that is now Dow's Lake to the Ottawa River.

1.3.1.3 Vegetation

The city lands around the existing highway are heavily urbanized so the original forest cover immediately around the highway is not definitively known. However, the Ottawa region is within the Great Lakes-St. Lawrence Forest Region and would have had stands of Elm, Pine and Maple (Hills, Richards and Morwick 1944).

1.3.1.4 Lithic Sources

There are no known primary lithic sources directly on or near the study areas.

1.3.2 Registered Archaeological Sites

A search of the archaeological sites database at the Ministry of Tourism, Culture and Recreation indicated that there are no registered sites within one kilometre of any of the 23 bridges. This scarcity of registered sites reflects the absence of methodical assessment in the area prior to the extensive development of the City of Ottawa and Township of Nepean and does not necessarily represent the site density occupation in the area throughout pre-historic times.

1.3.3 Past Projects

The existing Highway 417 right-of-way was subject to Stage 1 and Stage 2 archaeological assessment by C. R. Murphy in 2002 and 2004 (Murphy 2002, 2004). Although these reports pre-date the formatting specified by the current *Standards and Guidelines for Consultant Archaeologists, 2011*, the content of the reports is sufficiently detailed to meet these standards. The Stage 1 report covered the section of Highway 417 from Highway 416 easterly to Anderson Road and concluded that all lands within the Highway 417 right-of-way, as it existed in 2002, were extensively disturbed and did not require further archaeological assessment.

Heritage Quest Inc. completed a Stage 1 archaeological assessment of the proposed North-South Light Rail Transit Corridor including the O-Train bridge study area (Kennett 2005). The report determined that the railway corridor was intensively and extensively disturbed and did not require further archaeological assessment.

2.0 METHODOLOGY

2.1 GIS Methods

In the absence of detailed survey plans, mapping information was used from the Ministry of Natural Resources 1:10,000 scale Ontario Basic Map (OBM) downloaded from the Geography Network Canada and ortho-imagery from ESRI (Figure 12). These sources were also used to delineate wetland or water saturated soils. Nineteenth and twentieth century maps were georeferenced and relevant features were digitized (Figures 11 and 10). The georeferenced study limits, contours and other geographic details were uploaded to a handheld GPS (WAAS enabled ASUS a696 PDA using CMT-Field GIS v.9) to assist with the determination of the study limits in the field.

2.2 Field Methods

A. M. Archaeological Associates conducted a field visit for the Stage 1 archaeological assessment for the project, which consisted of a walking, visual inspection of the 12 study areas in order to assess the terrain and archaeological potential factors identified during the background research.

Current conditions for the study area were photographed and the locations were logged by GPS (Figures 12-17; Plates 1-52). The property inspection was carried out on April 19th, 2013 under cloudy skies and temperature around 21ºC.

2.3 Property Inspection and Assessment

The 12 Highway 417 Queensway study areas include the bridges carrying both eastbound and westbound traffic, typically encompassing the highway right-of-way with a width between 55 and 160 metres. The study areas range in size from 0.36 hectares to 4.3 hectares. The highway itself has an elevated roadbed and associated steep embankments and vertical retaining walls, paved shoulders, artificial drainage and interchange ramps. The O'Connor Street bridge is the only bridge in the study area, which carries all eastbound and westbound traffic in a single span. All of the bridges were originally constructed in the early 1960s. The Queensway is bordered by high-density commercial and residential development with several large structures situated directly north and south of the highway right-of-way as well as paved municipal roads and parking lots (Figure 1).

2.3.1 Holland Avenue

The two Highway 417 bridge spans at Holland Avenue include a 0.36 hectare study area around bridge Site No. 3-050.1 and Site No. 3-050.2 (Figure 12).The structures carry eight lanes of Highway 417 traffic over Holland Avenue. The study area includes minor amounts of green space in the NE, SW and SE quadrants. The green space consists of steep embankments that are highly landscaped and are extensively and intensively disturbed (Plates 1-4). The NW quadrant consists of a paved parking lot around a school. There is no archaeological potential within the study area of the Highway 417/ Holland Avenue bridges.

2.3.2 Parkdale Avenue

The two Highway 417 bridge spans at Parkdale Avenue include a 0.63 hectare study area around bridge Sites No. 3-051.1 and 3-051.2 (Figure 12). The structures carry eight lanes of Highway 417 traffic over Parkdale Avenue. The study area includes minor amounts of green space at all four quadrants. The NW quadrant includes the small area immediately north of the westbound on-ramp which was determined to be highly disturbed by existing services and a steep embankment between the highway and on-ramp (Plate 5). The NE quadrant was determined to be highly disturbed by a steep embankment and roadway. Additionally, aerial imagery indicates that the land immediately adjacent to the NE quadrant was occupied by several houses until 2011 when they were removed to facilitate Highway 417 ramp construction (Figure 12; Plate 6). The SW quadrant includes a steep bank south of the Parkdale Avenue exit ramp that has been highly landscaped as well as the embankment between the highway and exit ramp (Plate 7). The SE quadrant includes a steep embankment at the edge of the highway and the landscaped wall around a church south of the Parkdale Avenue eastbound on-ramp (Plate 8). All of the Parkdale Avenue bridge study area has been extensively and intensively disturbed by past construction and landscaping and does not have archaeological potential.

2.3.3 Fairmont Avenue

The two Highway 417 bridge spans at Fairmont Avenue include a 0.48 hectare study area around bridge Site No. 3-052.1 and Site No. 3-052.2. The study area includes minor amounts of green space in the NW, NE, and SE quadrants (Figure 13). The green space consists of steep embankments that are associated with the original highway construction and indicate extensive

and intensive disturbance (Plates 9-12). There is no archaeological potential within the study area of the Highway 417/ Fairmount Avenue bridges.

2.3.4 Bayswater Avenue

The two Highway 417 bridge spans at Bayswater Avenue include a 0.41 hectare study area around bridge Site No. 3-053.1 and Site No. 3-053.2. The study area includes minor amounts of green space in the NW, NE, SW and SE quadrants (Figure 13). The green space consists of steep embankments that are associated with the original highway construction and indicate extensive and intensive disturbance (Plates 13-16). There is no archaeological potential within the study area of the Highway 417/ Bayswater Avenue bridges.

2.3.5 O-Train

The O-Train Overpass carries ten lanes of eastbound and westbound traffic (including two speed change lanes) and includes a 4.3 hectare study area around bridge Site No. 03-054.1 and Site No. 03-054.2 and an extended area on the east and west side of the O-Train corridor running 195 metres north of the existing bridge and 250 metres to the south (Figure 14). The bridge structures were originally built in the early 1960s and the O-Train was opened in 2001. The lands along the west side of the rail line to the north of the highway are extensively landscaped from the adjacent industrial lands to the rail trench (Plates 17-18). The east side of the rail line has also been intensively and extensively landscaped from past construction and recent improvements to a bike path as well as paved parking lots (Plates 19-20). The lands immediately adjacent to the Highway 417/ O-Train bridge SW quadrant are currently occupied by a large industrial building (Plate 21). The SE quadrant includes the steep embankment immediately adjacent to the highway as well as a portion of the Young Street cul-de-sac (Plate 22). The lands immediately adjacent to the east and west sides of the O-Train corridor from the Highway 417 bridge south to Beech Street have been highly landscaped. There are residential properties along the west side of Railway Street immediately west of the O-Train corridor (Plate 23). On the east side, the bike path runs along a berm between the slope to the O-Train corridor and residential properties to the east (Plate 24). There is no archaeological potential within the study area of the Highway 417/ O-Train bridges.

2.3.6 Preston Street

The two Highway 417 bridge spans at Preston Street include a 0.48 hectare study area around bridge Site No. 03-055.1 and Site No. 03-055.2. The study area includes minor amounts of green space in the NW, NE, SW and SE quadrants (Figure 14). The green space consists of steep embankments that are associated with the original highway construction and indicate extensive and intensive disturbance (Plates 25-28). There is no archaeological potential within the study area of the Highway 417/ Preston Street bridges.

2.3.7 Rochester Street

The two Highway 417 bridge spans at Rochester Street include a 0.85 hectare study area around bridge Site No. 03-056.1 and Site No. 03-056.2. The study area includes of minor amounts of green space in the NE and SE quadrants and slightly larger areas around ramps at the NW and SW quadrants (Figure 15). The green space consists of steep embankments that are associated with the original highway construction and indicate extensive and intensive disturbance (Plates 29-32). The NW quadrant includes a small portion of a steep embankment to a commercial parking lot north of the westbound highway on-ramp. The SW quadrant includes an embankment and ditch south of the eastbound highway exit ramp. There is no archaeological potential within the study area of the Highway 417/ Rochester Street bridges.

2.3.8 Booth Street

The two Highway 417 bridge spans at Booth Street include a 0.41 hectare study area around bridge Site No. 03-057.1 and Site No. 03-057.2. The study area includes minor amounts of green space in the NW, NE, SW and SE quadrants (Figure 15). The green space consists of steep embankments that are associated with the original highway construction and indicate extensive and intensive disturbance (Plates 33-36). There is no archaeological potential within the study area of the Highway 417/ Booth Street bridges.

2.3.9 Bronson Avenue

The two Highway 417 bridge spans at Bronson Avenue include a 0.37 hectare study area around bridge Site No. 3-060.1 and Site No. 3-060.2. The study area includes minor amounts of green space in the NW and SW quadrants and only vertical retaining walls at the NE and SE quadrants (Figure 16). The NE quadrant is adjacent to a paved parking lot and the SE quadrant is

adjacent to a small piece of land in front of an existing building. The green space consists of steep embankments that are associated with the original highway construction and indicate extensive and intensive disturbance (Plates 37-40). There is no archaeological potential within the study area of the Highway 417/ Bronson Avenue bridges.

2.3.10 Percy Street

The two Highway 417 bridge spans at Percy Street include a 0.55 hectare study area around bridge Site No. 3-061.1 and Site No. 3-061.2. The study area includes minor amounts of green space in the SW and SE quadrants and only vertical retaining walls at the NW and NE quadrants (Figure 16). The green space consists of steep embankments that are associated with the original highway construction and indicate extensive and intensive disturbance (Plates 41-44). There is no archaeological potential within the study area of the Highway 417/ Percy Street bridges.

2.3.11 Bank Street

The two Highway 417 bridge spans at Bank Street include a 0.33 hectare study area around bridge Site No. 3-063.1 and Site No. 3-063.2. The study area includes minor amounts of green space in the NW and SW quadrants and only vertical retaining walls at the NE and SE quadrants (Figure 17). The green space consists of steep embankments that are associated with the original highway construction and indicate extensive and intensive disturbance (Plates 45-48). There is no archaeological potential within the study area of the Highway 417/ Bank Street bridges.

2.3.12 O'Connor Street

This single span Highway 417 bridge at O'Connor Street, Site No. 3-064, carries six lanes of traffic and includes a 0.52 hectare study area (Figure 17). The four quadrants include minor amounts of green space but also include on-ramps and exit ramps (Plates 49-52). The green space consists of steep embankments that are associated with the original highway construction and indicate extensive and intensive disturbance. There is no archaeological potential within the study area of the Highway 417/ O'Connor Street bridge.

2.4 Record of Finds

The documentary record of the project consists of one GPS track, 52 geo-tagged digital photographs, and one digital Stage 1 assessment form. The documentary record will be stored at the office of A. M. Archaeological Associates until they can be deposited at a long-term storage facility with the approval of the Ministry of Tourism, Culture and Sport.

3.0 ANALYSIS AND CONCLUSIONS

3.1 Archaeological Potential

The proximity to water indicated that four of the twelve study areas, including Bank and O'Connor Street bridges possibly near Patterson Creek, and Bayswater Avenue and O-Train near Dow's Great Swamp, had potential for pre-contact archaeological remains prior to development. Historic maps and documents indicate that nineteenth century development around the highway did not begin until the construction of the Canadian Atlantic Railway in 1879. This initial phase of development would have destroyed any pre-contact archaeological remains, which are more fragile than later archaeological sites. Some residential development followed in the late nineteenth century near the Rochester, Booth and Bronson bridge study areas. However, the secondary development around these study areas and the construction of the existing Highway 417 has intensively and extensively disturbed all of the bridge study areas.

3.2 Conclusions

Based on these findings, no portions of the 12 study areas encompassing 9.69 hectares required for the 23 Highway 417 bridge rehabilitation/ replacements have potential for significant archaeological remains. This concurs with the findings of the two previous reports that overlap with portions of this study (Murphy 2002; Kennett 2005). Intensive and extensive disturbance from the construction of the existing Highway 417 have removed any pre-contact Aboriginal or historic Euro-Canadian potential. No further archaeological assessment is required.

Based on this study and previous study of the Queensway corridor under GWP 663-93-00 (2007), it can be reasonably stated that potential areas that could be used for laydown or build sites for rapid lift bridges within 50 metres of the MTO right-of-way have no archaeological potential due to lack of archaeological features and prior disturbance and therefore require no

further archaeological work. If potential staging areas are identified further away from the MTO right-of-way (through this study or in future) they may require further archaeological work if the selected areas appear to be relatively undisturbed (e.g. parks or green areas). Areas capped by fill or hard paving, such as parking lots, not already assessed would not be anticipated to need any additional archaeological work if the laydown or building activities are not expected to disturb the underlying ground.

4.0 RECOMMENDATIONS

Based on the above information, the following recommendations can be made:

1. The 23 bridge rehabilitations/ replacements at 12 study areas from Holland Avenue to O'Connor Street along Highway 417 have no archaeological potential due to intensive and extensive disturbances. No further archaeological assessment is required.

5.0 ADVICE ON COMPLIANCE WITH LEGISLATION

1. Advice on compliance with legislation is not part of the archaeological record. However, for the benefit of the proponent and approval authority in the land use planning and development process, the report must include the following standard statements:

a. This report is submitted to the Minister of Culture as a condition of licensing in accordance with Part VI of the *Ontario Heritage Act*, R.S.O. 1990, c 0.18. The report is reviewed to ensure it complies with the standards and guidelines that are issued by the Minister, and that the archaeological fieldwork and report recommendations ensure the conservation, protection and preservation of the cultural heritage of Ontario. When all matters relating to archaeological sites within the project area of a development proposal have been addressed to the satisfaction of the Ministry of Tourism and Culture, a letter will be issued by the ministry stating that there are no further concerns with regard to alterations to archaeological sites by the proposed development.

b. It is an offence under Sections 48 and 69 of the *Ontario Heritage Act* for any party other than a licensed archaeologist to make any alteration to a known archaeological site or remove any artifact or other physical evidence of past human use or activity from the site, until such time as a licensed archaeologist has completed archaeological fieldwork on the site, submitted a report to the Minister stating that the site has no further cultural heritage value or interest, and the report has been field in the Ontario Public Register of Archaeological Reports referred to in Section 65.1 of the *Ontario Heritage Act.*

c. Should previously undocumented archaeological resources be discovered, they may be a new archaeological site and therefore subject to Section 48 (1) of the *Ontario Heritage Act*. The proponent or person discovering the archaeological resources must cease alteration of the site immediately and engage a licensed consultant archaeologist to carry out archaeological fieldwork, in compliance with sec. 48 (1) of the *Ontario Heritage Act*.

d. The Cemeteries Act, R.S.O. 1990 c. C.4 and the Funeral, Burial and Cremation Services Act, 2002, S.O. 2002, C.33 (when proclaimed in force) requires that any person discovering human remains must notify the police or coroner and the Registrar of Cemeteries at the Ministry of Consumer Services.

Contacts: Heritage and Operations Unit, Ministry of Tourism and Culture: (416) 314-7148
Registrar of Cemeteries, Cemeteries Regulation Unit: Michael D'Mello (416) 326-8404 or (416)-326-8393

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7.0 IMAGES

Plate 1: West view along north side of highway west of Holland Avenue.

Plate 2: East view along north side of highway east of Holland Avenue.

Plate 3: West view hydro sub-station south of the Highway 417/ Holland Avenue bridge.

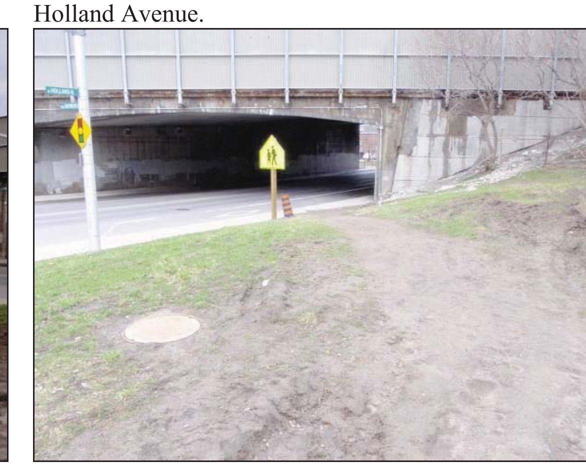

Plate 4: Northwest view of SE corner of Highway 417/ Holland Avenue bridge.

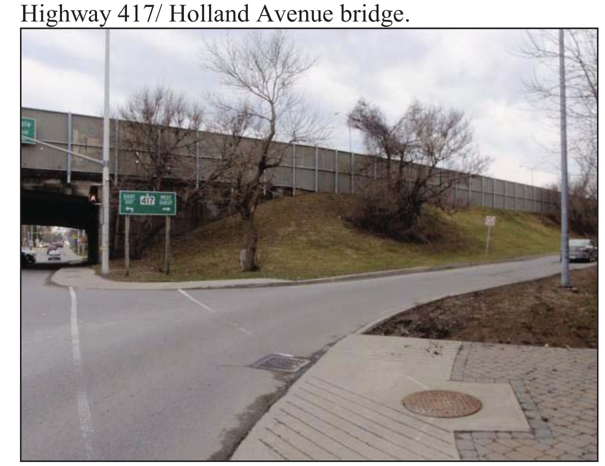

Plate 5: South view of NW corner of Highway 417/ Parkdale Avenue bridge.

Plate 6: Southeast view of NE corner of Highway 417/ Parkdale Avenue bridge.

Plate 7: West view along Parkdale Avenue exit ramp south of Highway 417.

Plate 8: Northeast view of Parkdale Avenue bridge SE quadrant.

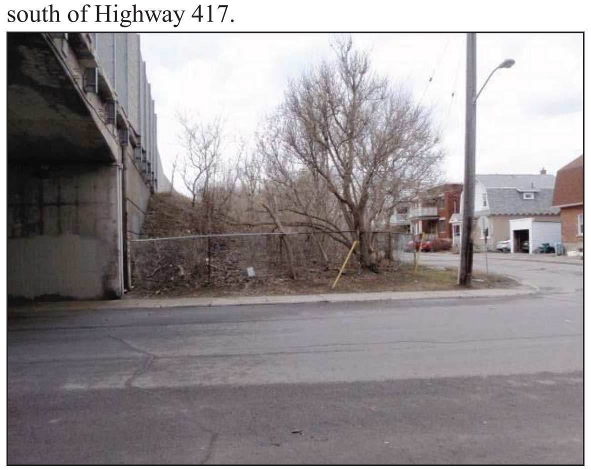

Plate 9: West view of NW quadrant of Highway 417/ Fairmont Avenue bridge.

Plate 10: East view of NE quadrant of Highway 417/ Fairmont Avenue bridge.

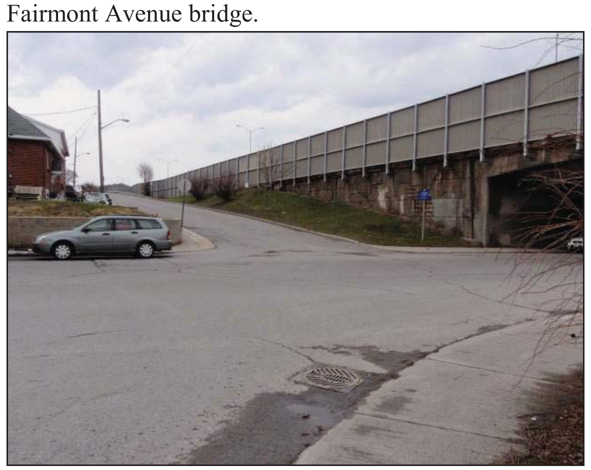

Plate 11: West view of SW quadrant of Highway 417/ Fairmont Avenue bridge.

Plate 12: West view of SE quadrant of Highway 417/ Fairmont Avenue bridge.

Plate 13: West view of NW quadrant of Highway 417/ Bayswater Avenue bridge.

Plate 14: East view of NE quadrant of Highway 417/ Bayswater Avenue bridge.

Plate 15: West view of SW quadrant of Highway 417/ Bayswater Avenue bridge.

Plate 16: East view of SE quadrant of Highway 417/ Bayswater Avenue bridge.

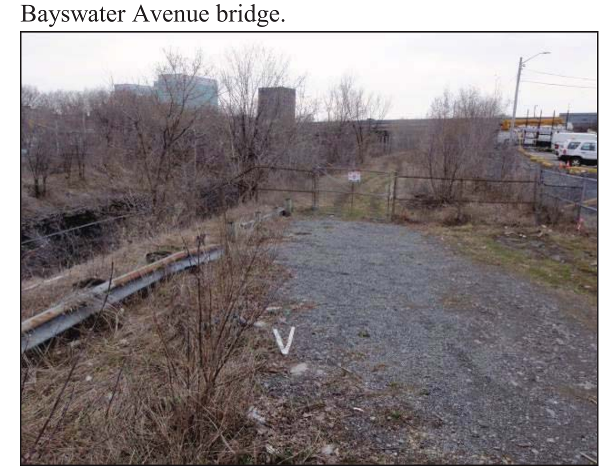

Plate 17: South view along west side of O-Train corridor towards Highway 417.

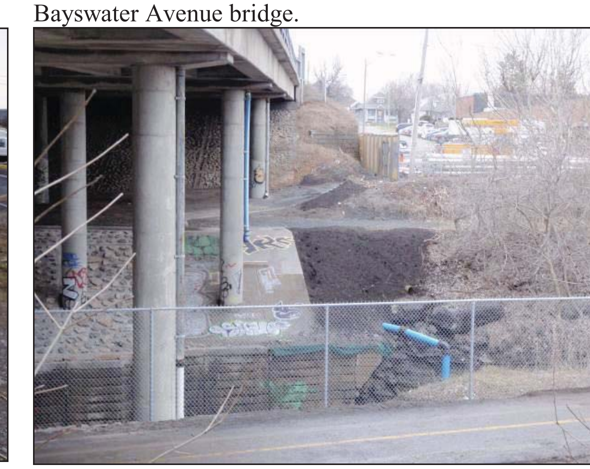

Plate 18: West view across O-Train corridor towards NW quadrant of Highway 417/ O-Train bridge.

Plate 19: North view along east side of O-Train corridor showing recent recreational path construction.

Plate 20: North view along east side of O-Train corridor showing recent recreational path construction.

Plate 21: West view of building at SW quadrant of Highway 417/ O-Train bridge from SE quadrant.

Plate 22: North view along east side of O-Train corridor south of highway showing recent recreational path construction.

Plate 23: North view along Railway Street immediately adjacent to O-train corridor.

Plate 24: North view along O-train corridor showing landscaping along east side.

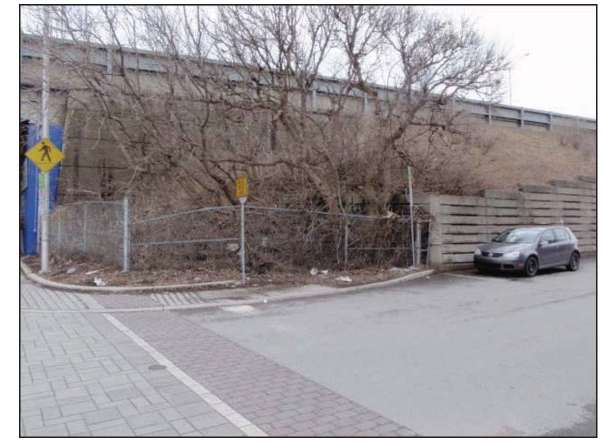

Plate 25: South view of NW quadrant of Highway 417/ Preston Street bridge.

Plate 26: Southeast view of NE quadrant of Highway 417/ Preston Street bridge.

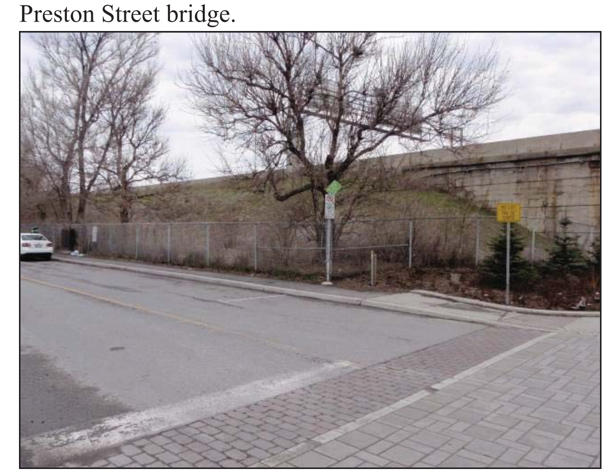

Plate 27: Northwest view of SW quadrant of Highway 417/ Preston Street bridge.

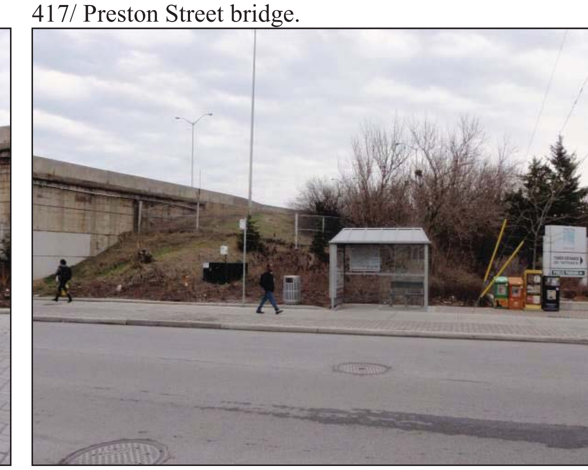

Plate 28: Southeast view of SE quadrant of Highway 417/ Preston Street bridge.

Plate 29: West view of NW quadrant of Highway 417/ Rochester Street bridge at WBL on-ramp.

Plate 30: East view of NE quadrant of Highway 417/ Rochester Street bridge at Raymond Street.


Plate 31: West view of SW quadrant of Highway 417/ Rochester Street bridge at EBL exit ramp.


Plate 32: North view of SE quadrant of Highway 417/ Rochester Street bridge at Orangeville Street.

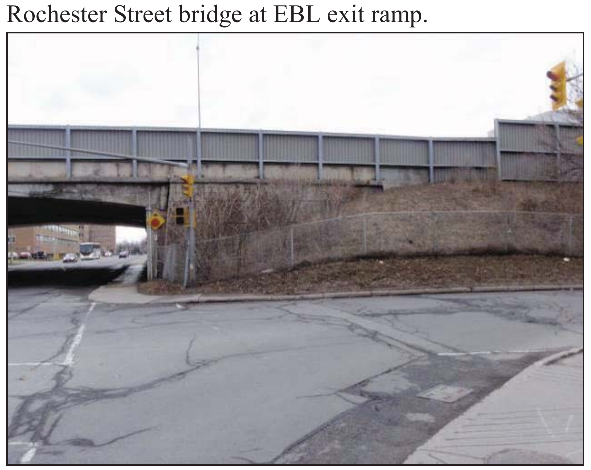
Plate 33: South view of NW quadrant of Highway 417/ Booth Street bridge.


Plate 34: East view of NE quadrant of Highway 417/ Booth Street bridge at Raymond Street.


Plate 35: Northeast view of SW quadrant of Highway 417/ Booth bridge along Orangeville Street.

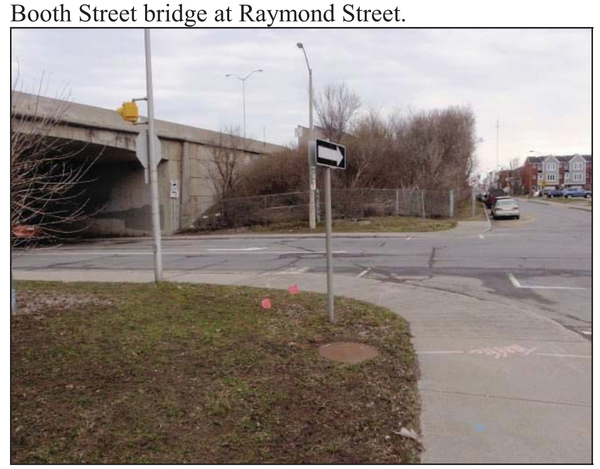
Plate 36: East view of SE quadrant of Highway 417/ Booth bridge along Orangeville Street.


Plate 37: West view of NW quadrant of Highway 417/ Bronson Avenue bridge.


Plate 38: South view of NE and NW quadrant of Highway 417/ Bronson Avenue bridge.

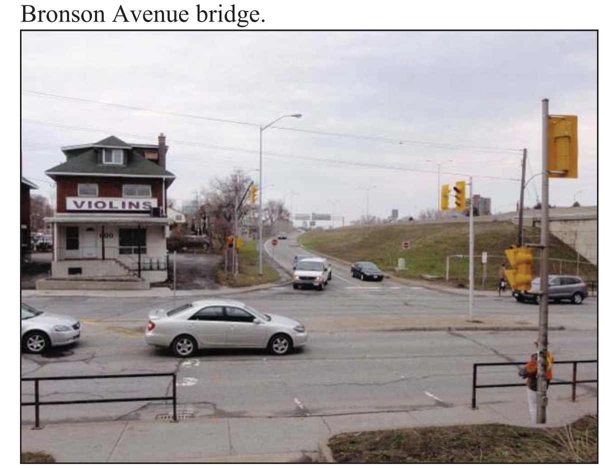

Plate 39: Northwest view of SW quadrant of Highway 417/ Bronson Avenue bridge.

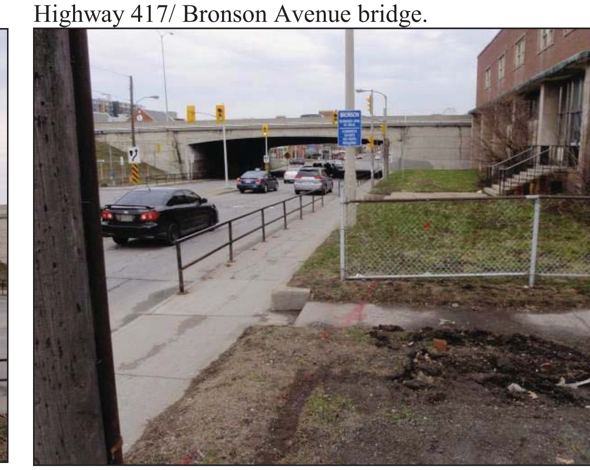
Plate 40: Southeast view of SE quadrant of Highway 417/ Bronson Avenue bridge.

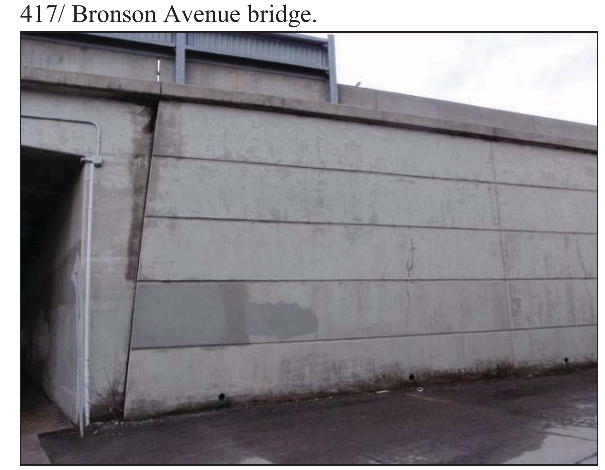
Plate 41: South view of NW quadrant of Highway 417/ Percy Street bridge

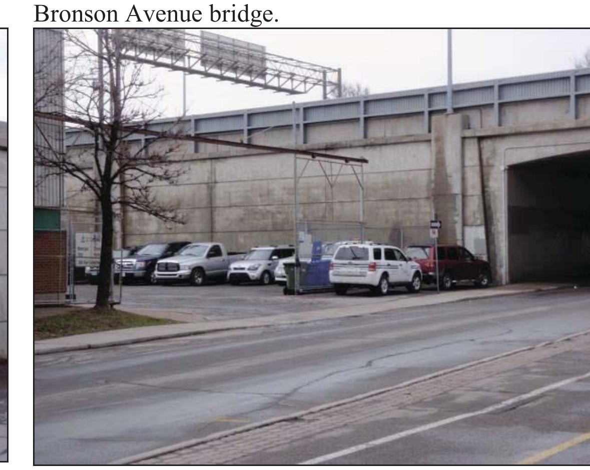
Plate 42: Southeast view of NE quadrant of Highway 417/ Percy Street.

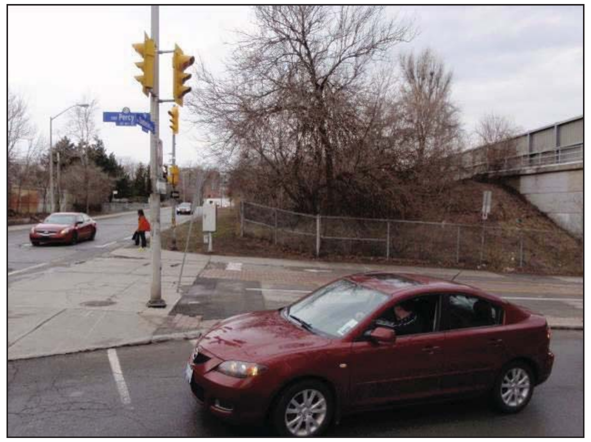

Plate 43: West view of SW quadrant of Highway 417/ Percy Street bridge.

Plate 44: East view of SE quadrant of Highway 417/ Percy Street bridge.

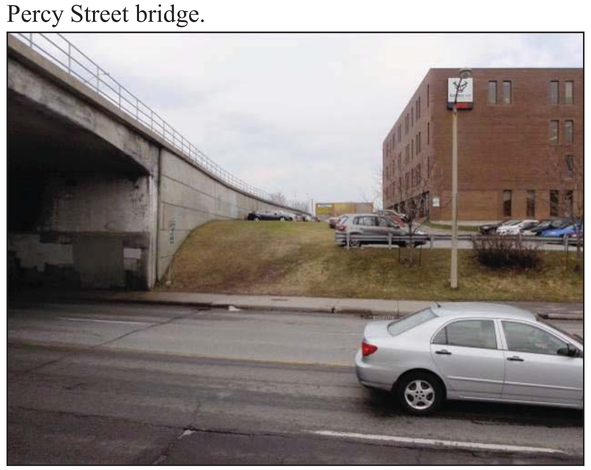

Plate 45: West view of NW quadrant of Highway 417/ Bank Street bridge.

Plate 46: South view of NW and NE quadrant of Highway 417/ Bank Street bridge.

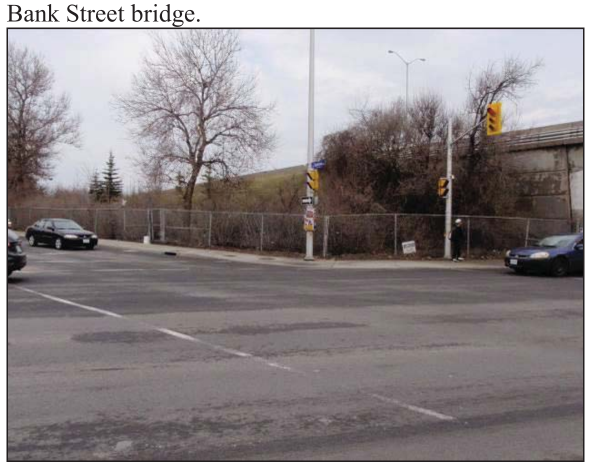

Plate 47: Northwest view of SW quadrant of Highway 417/ Bank Street.

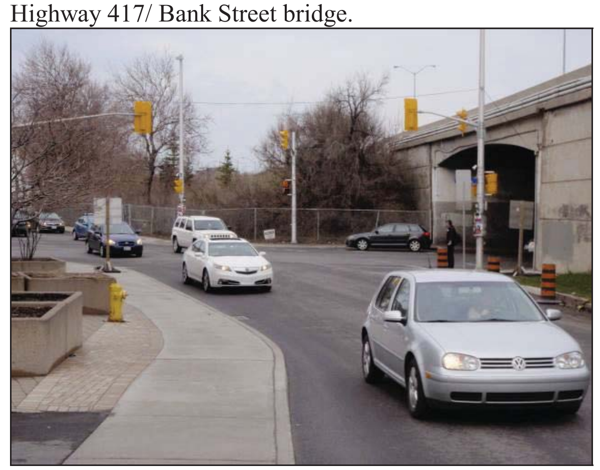

Plate 48: West view of SE quadrant of Highway 417/ Bank Street bridge.

Plate 49: South view of NW quadrant of Highway 417/ O'Connor Street bridge.

Plate 50: Southeast view of NE quadrant of Highway 417/ O'Connor Street bridge.

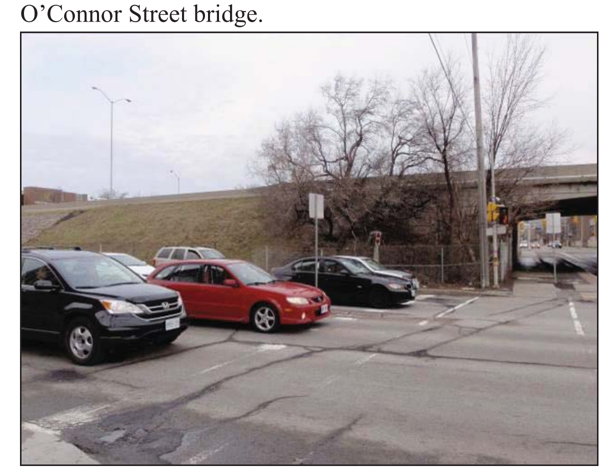

Plate 51: Northwest view of SW quadrant of Highway 417/ O'Connor Street bridge.

Plate 52: East view of SE quadrant of Highway 417/ O'Connor Street bridge.

8.0 MAPS

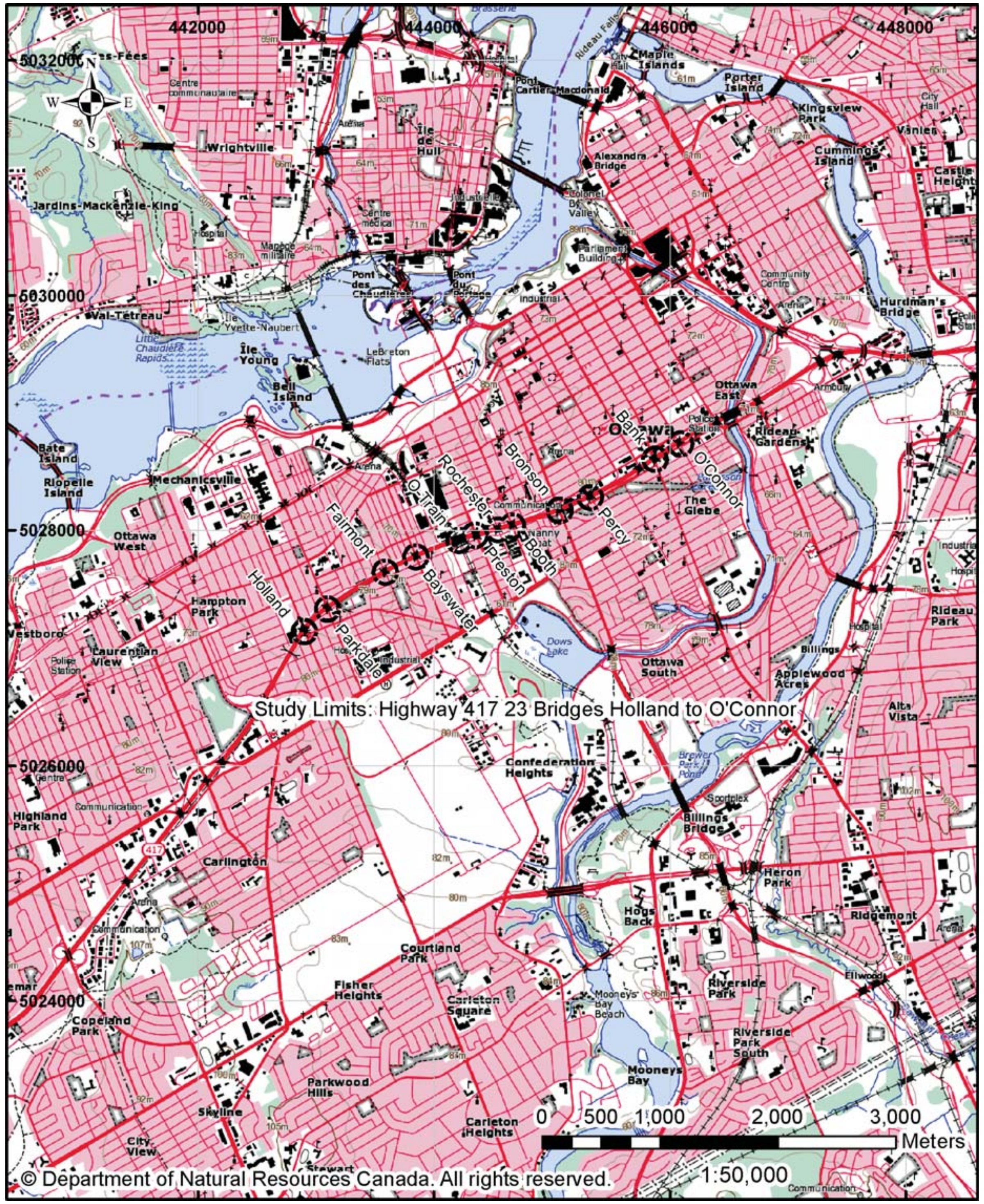

Figure 1: Location of the Highway 417 23 bridges from Holland Avenue to O'Connor Street (Natural Resources Canada 2010).

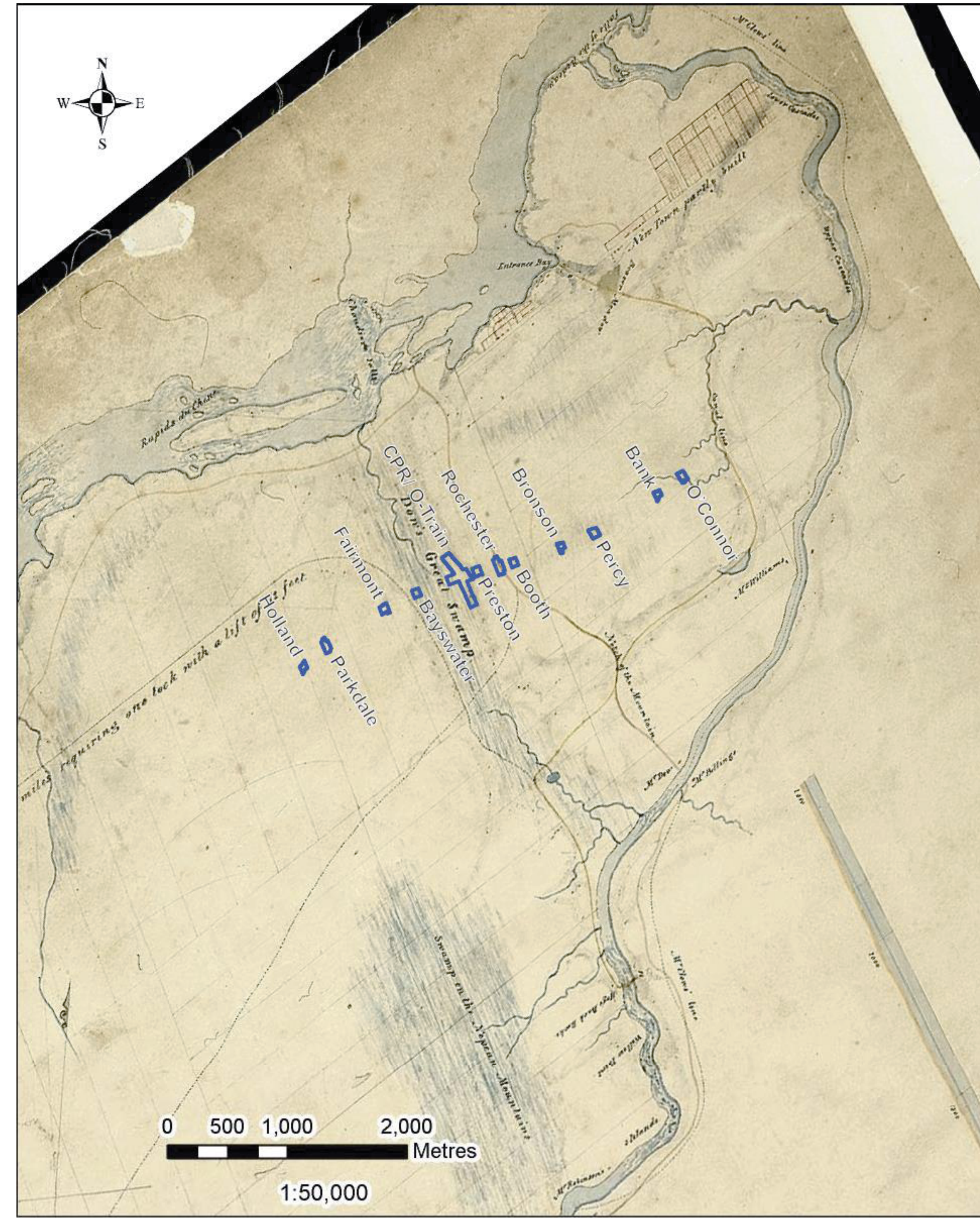

Figure 2: Location of study areas on early Ottawa area map adjusted to 1: 50,000 scale showing proximity to early water and roads (By 1827).

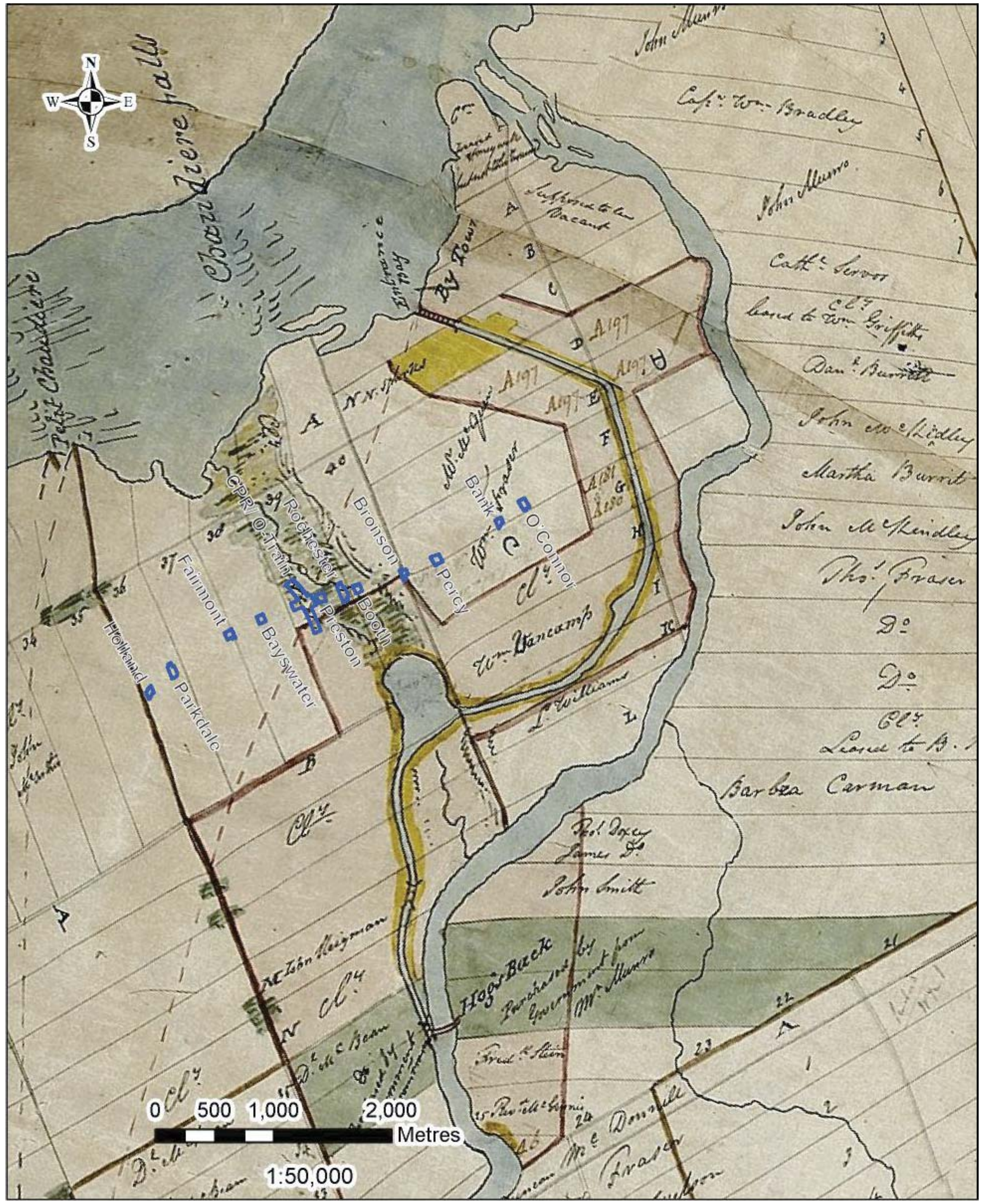

Figure 3: Location of study areas on early Ottawa area map adjusted to 1: 50,000 scale showing new Rideau Canal and land ownership (By 1830) (Reproduced from Library and Archives Canada NMC 17345).

Figure 4: Location of study areas on 1863 Walling map (Walling 1863).

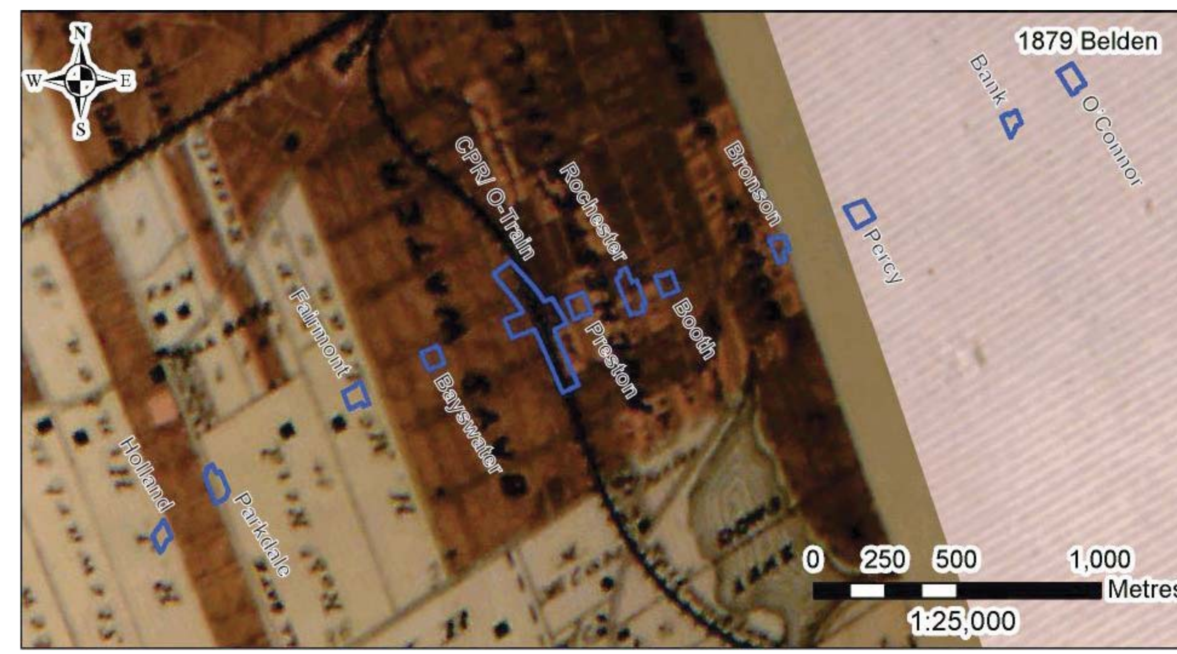

Figure 5: Location of study areas on 1879 Nepean Township map (Belden 1879).

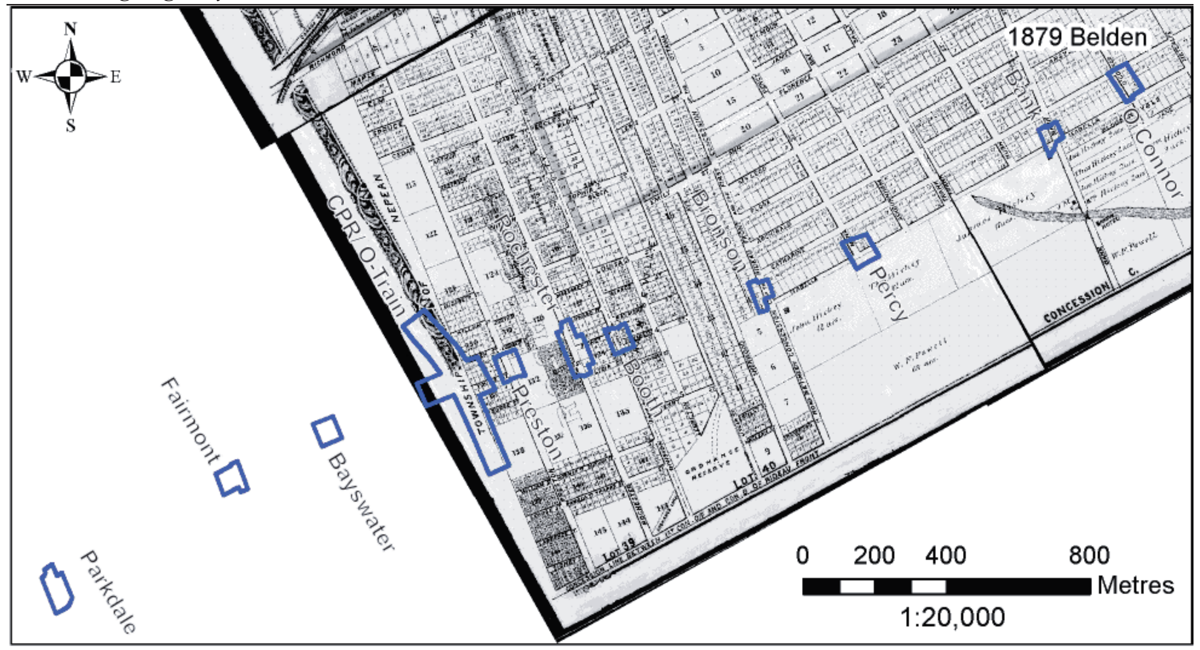

Figure 6: Location of study areas on 1879 detailed Ottawa map (Belden 1879).

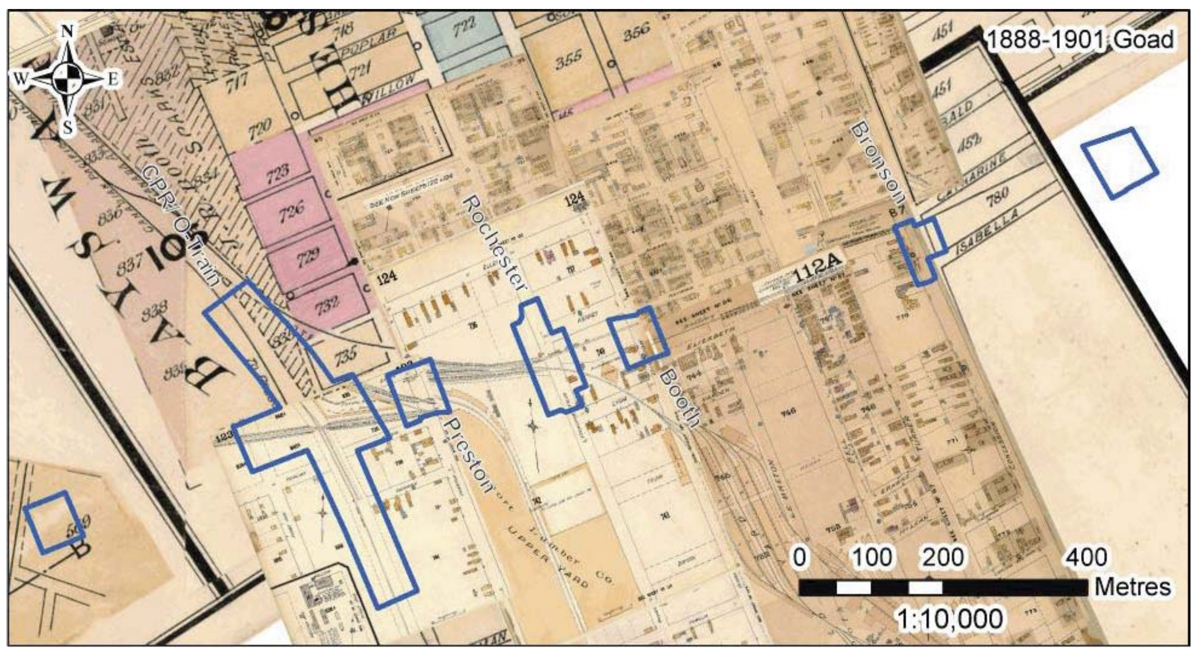

Figure 7: Location of O-Train, Preston, Rochester, Booth and Bronson study areas on amalgamated Goad Insurance maps from 1888 to 1901 (Goad 188, 1901).

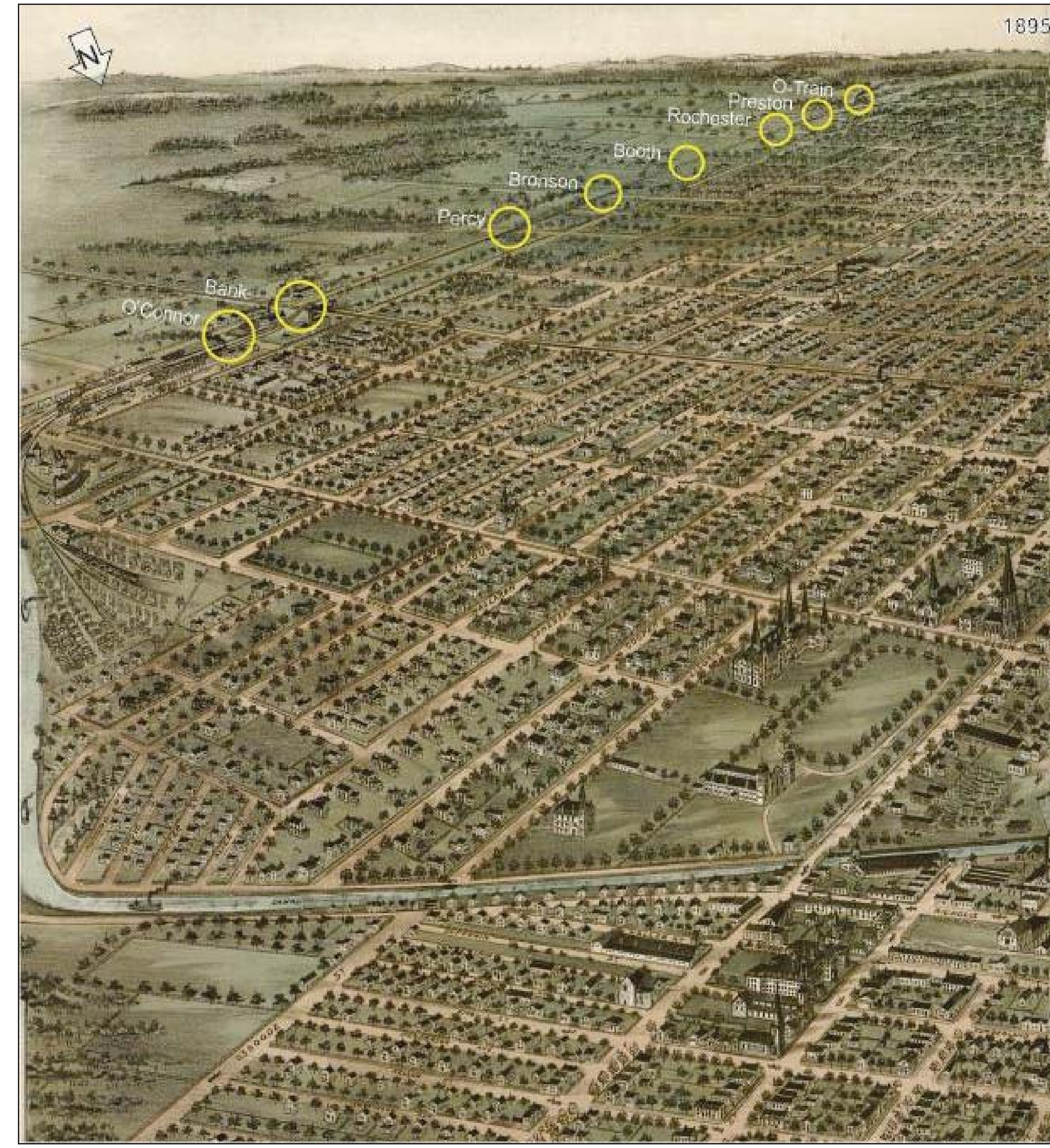

Figure 8: Approximate locations of eight of the study areas on detail of 1895 bird's eye view of Ottawa (Toronto Lithographing Co. 1895: Reproduced from Library of Congress, Geography and Map Division).

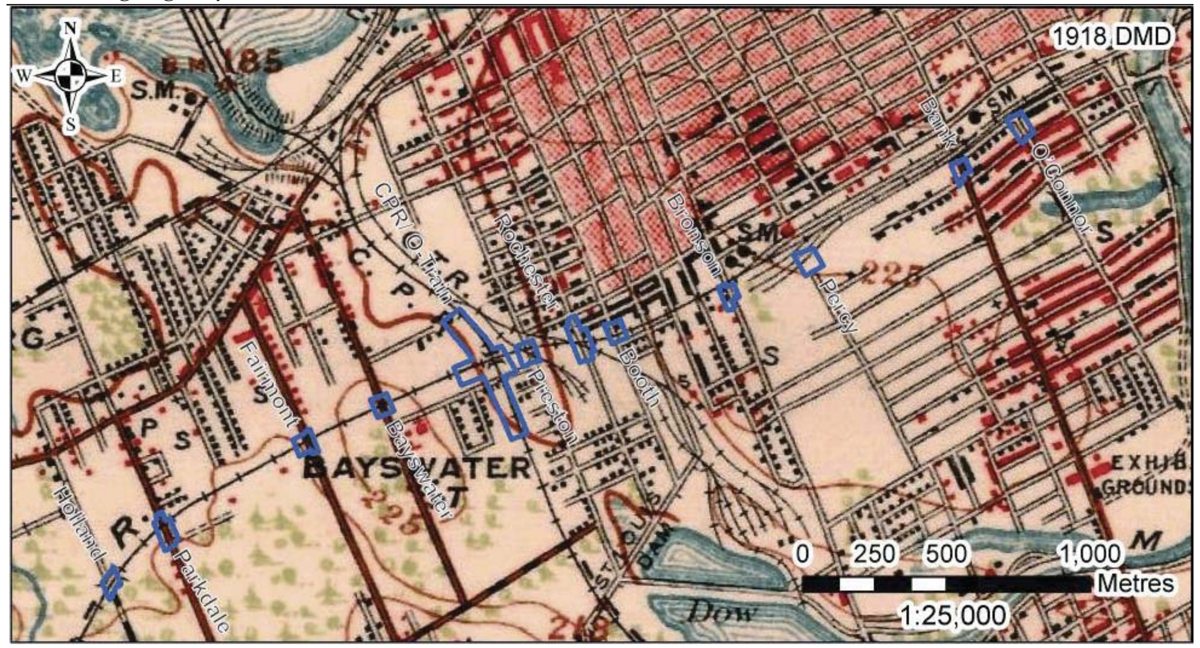

Figure 9: Location of study areas on 1918 topographic map of Ottawa (DMD 1918).

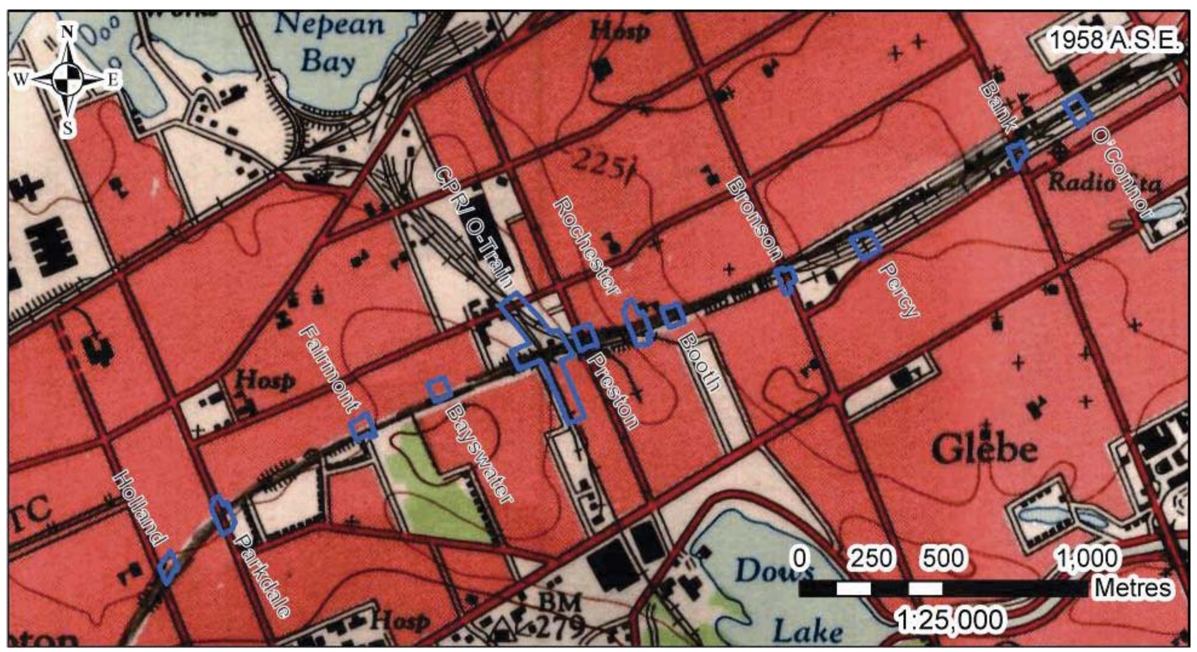

Figure 10: Location of study areas on 1958 topographic map of Ottawa (ASE 1958).

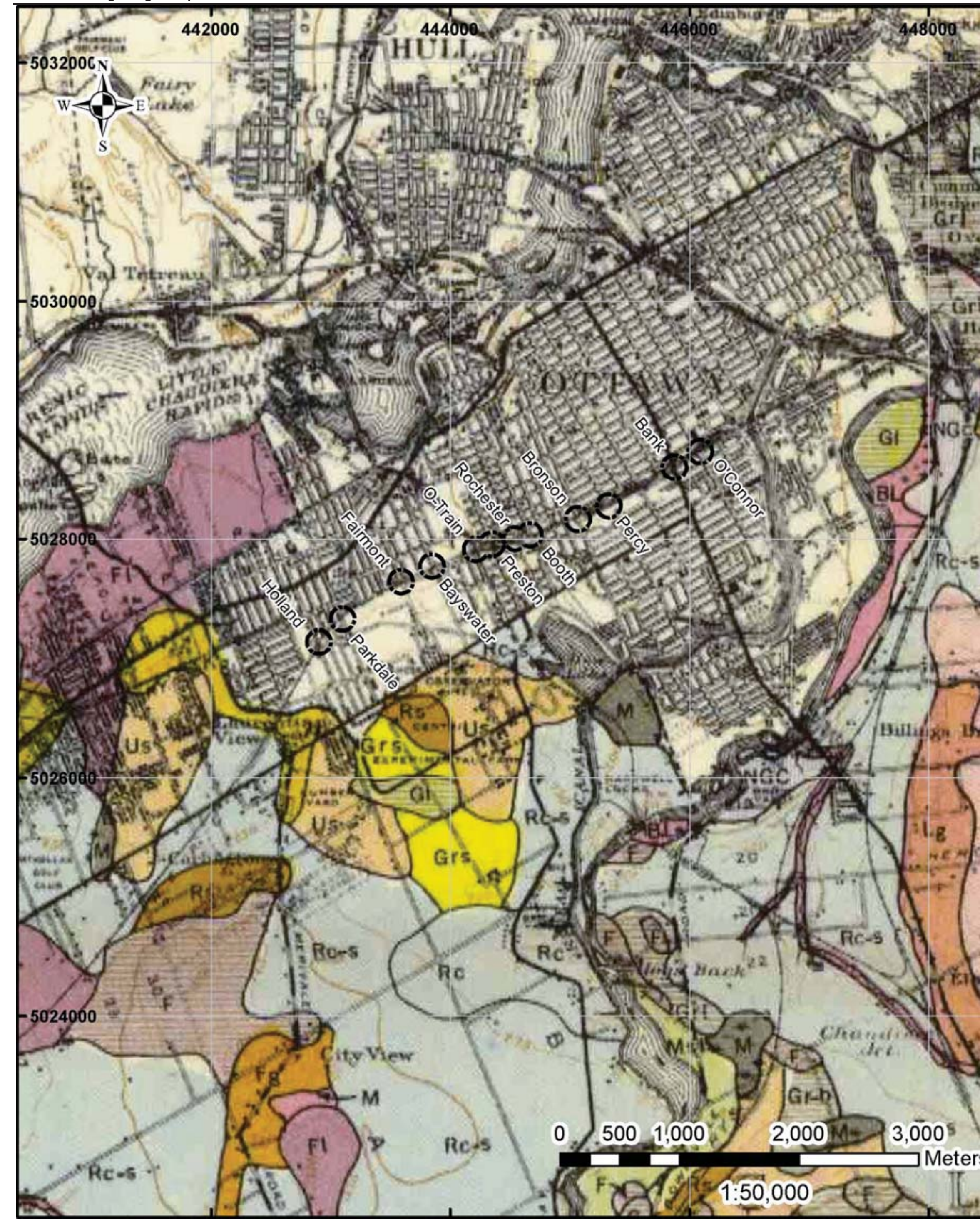

Figure 11: Location of study areas on soil map (Department of Agriculture 1944).

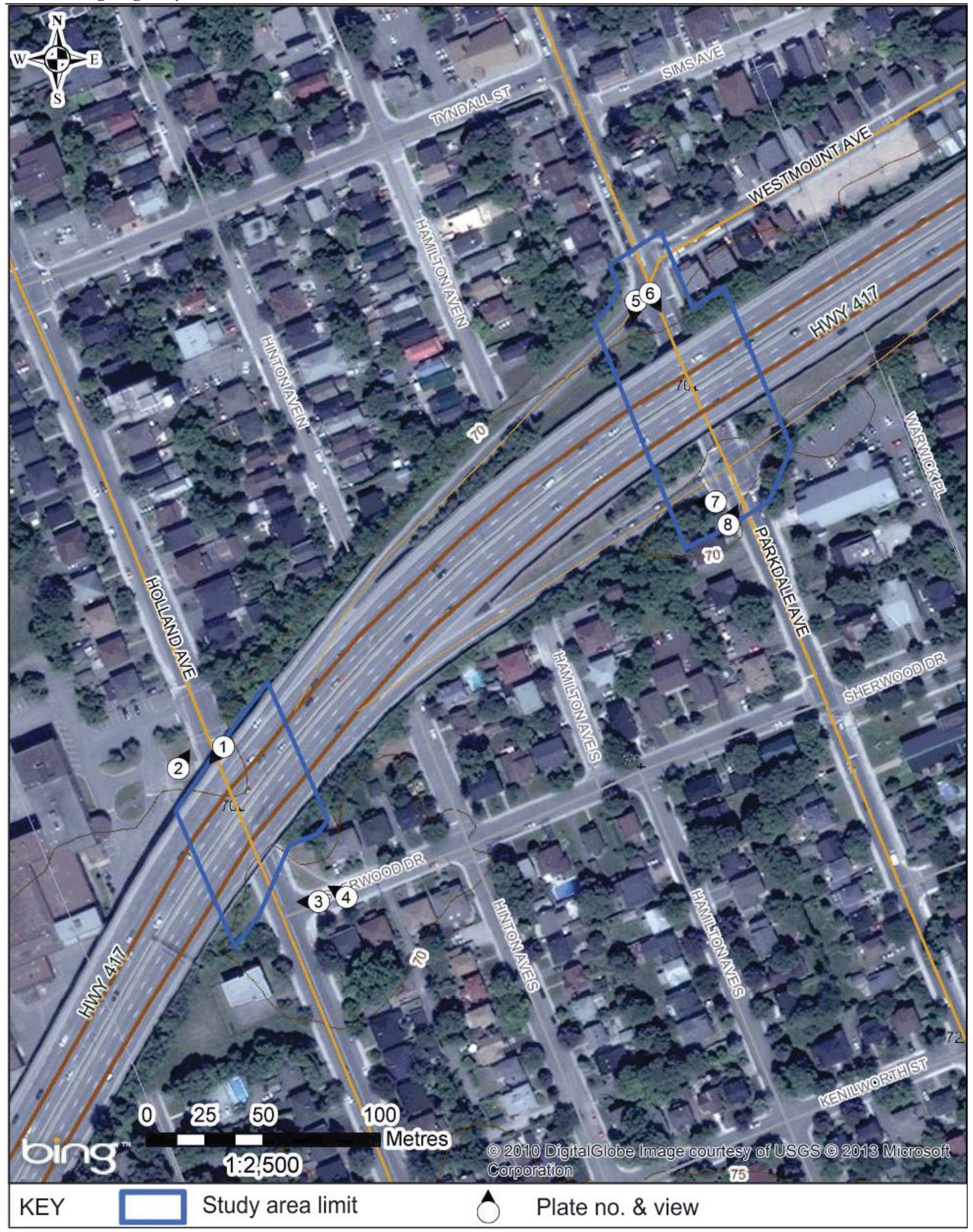

Figure 12: Archaeological potential at Holland Avenue and Parkdale Avenue with photo views and 5 metre contours from Ontario Basic Map, ESRI Canada and Microsoft Bing[TM] (MNR 2004).

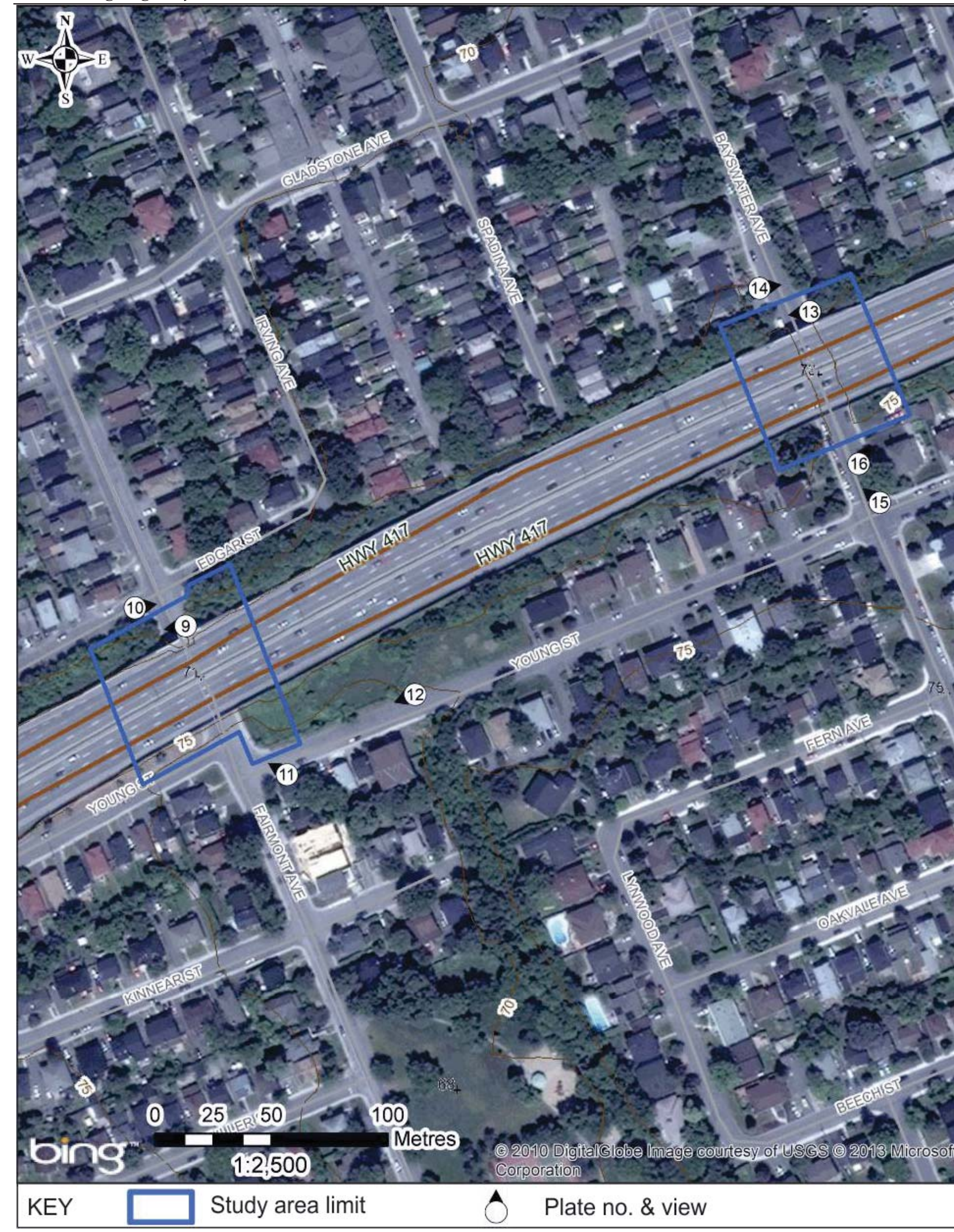

Figure 13: Archaeological potential at Fairmont Avenue and Bayswater Avenue with photo views and 5 metre contours from Ontario Basic Map, ESRI Canada and Microsoft Bing[TM] (MNR 2004).

Figure 14: Archaeological potential at O-Train and Preston Street with photo views and 5 metre contours from Ontario Basic Map, ESRI Canada and Microsoft Bing™ (MNR 2004).

Figure 15: Archaeological potential at Rochester Street and Booth Street with photo views and 5 metre contours from Ontario Basic Map, ESRI Canada and Microsoft Bing™ (MNR 2004).

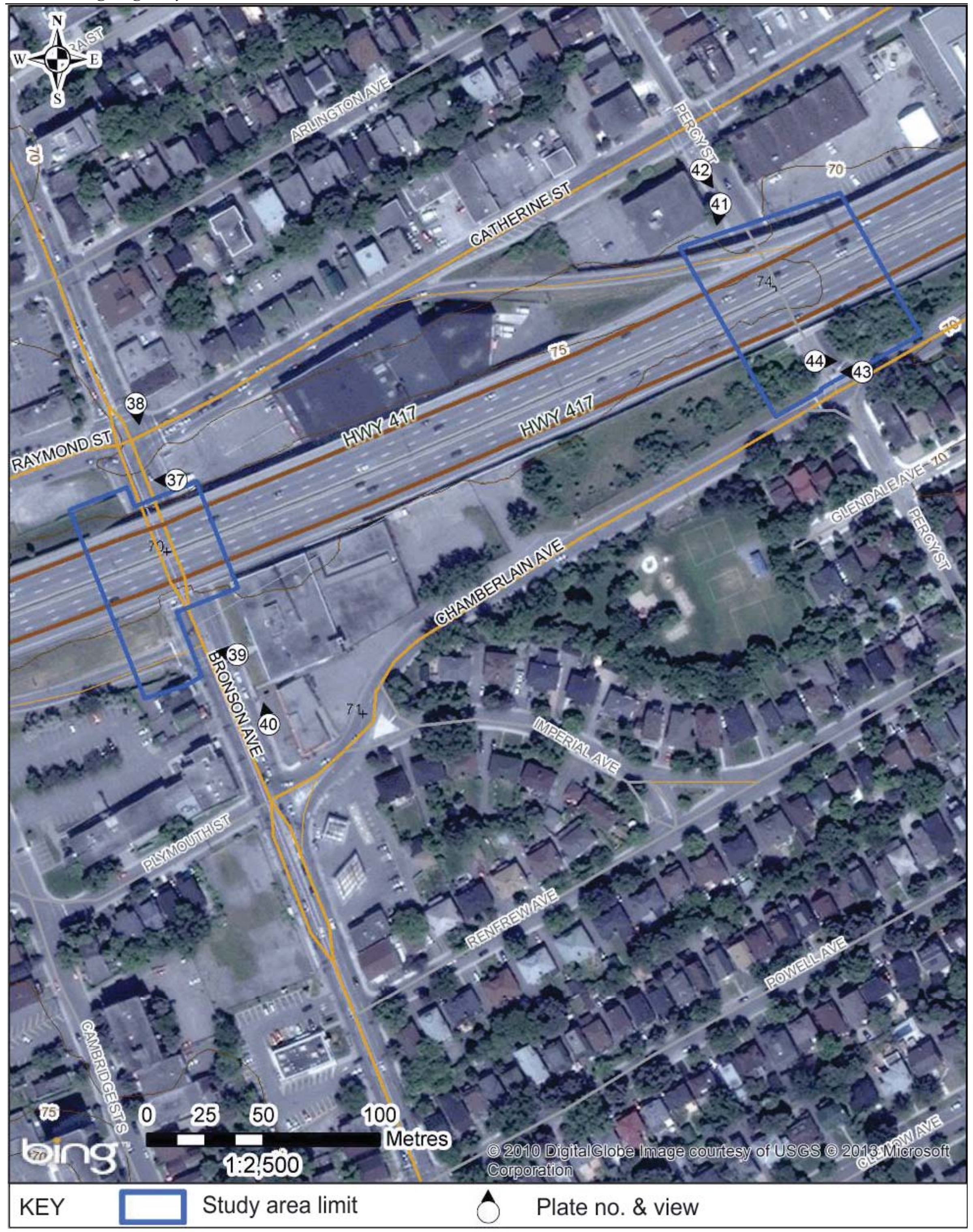

Figure 16: Archaeological potential at Bronson Avenue and Percy Street with photo views and 5 metre contours from Ontario Basic Map, ESRI Canada and Microsoft Bing[TM] (MNR 2004).

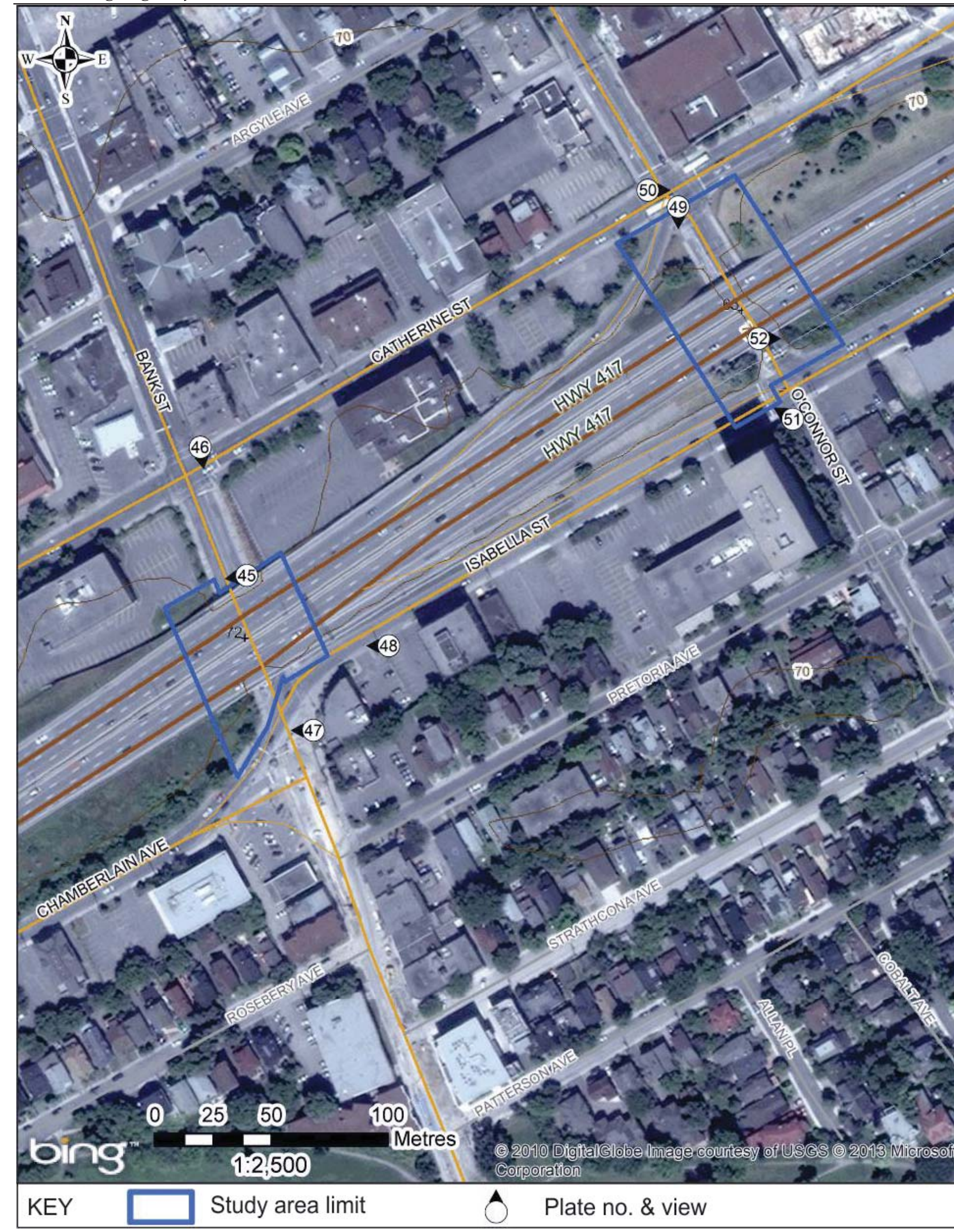

Figure 17: Archaeological potential at Bank Street and O'Connor Street with photo views and 5 metre contours from Ontario Basic Map, ESRI Canada and Microsoft Bing[TM] (MNR 2004).

APPENDIX D: Land Use Memorandum

MEMORANDUM

MORRISON HERSHFIELD

TO:	Project File	ACTION BY:	N/A
FROM:	Bettina Henkelman, Environmental Planner	FOR INFO OF:	Ministry of Transportation of Ontario
PLEASE RESPOND BY:		PROJECT No.:	1124127.00
RE:	Queensway Mid-town Bridges Land Use Factors Memo	DATE:	July 16, 2013

L:\PROJ\1124127\ENVIRONMENTAL\WORKING\LAND-USE\FINAL_LAND_USE_MEMO_QUEENSWAYMIDTOWNBRIDGES_GWP4075-11-00_JULY-16-2013.DOCX

Preliminary Design and Environmental Assessment Study for the Rehabilitation / Replacement of Ottawa Queensway Mid-town Bridges from Holland Avenue to O'Connor Street, G.W.P 4075-11-00

The following provides detailed information on the Land Use Factors found within the Broader Study Area (BSA) and Local Study Area (LSA) for the Ottawa Queensway Mid-town Bridges from Holland Avenue to O'Connor Street. The BSA is bordered by Somerset Avenue W. to the north, the Rideau Canal to the east, Carling Avenue to the south, and Clarendon Avenue to the west. The study entails the assessment of twenty-three bridges at twelve locations, with each location surrounded by a Local Study Area (LSA), for which the boundary is approximately 200 m from the actual bridges.

Land Use Factors

City of Ottawa Official Plan

The following is a brief description of the Land Use Designations within the BSA as per City of Ottawa's 2007 Official Plan. They are displayed in Figure 1 below.

- **General Urban Area** – this designation permits all types and densities of housing, as well as employment, retail uses, service, industrial, cultural, leisure, greenspace, entertainment and institutional uses.
- **Mixed Use Centres** – this designation applies to areas that have been identified as strategic locations on the rapid-transit network and lie adjacent to major roads. They act as focal points of activity, both within their respective communities and within the larger municipal structure.
- **Mainstreets** – are streets that are identified as offering some of the most significant opportunities in the city for intensification through more compact forms of development, a lively mix of uses and a pedestrian-friendly environment.
- **Major Open Space** – are large parks, open space corridors along the Ottawa and Rideau Rivers and the Rideau Canal, parkway corridors and corridors reserved for rapid-transit and major roads. Most Major Open Spaces are already in public ownership. The Rideau River and Canal are national historic sites. Major Open Spaces are a key component of the Greenspace Network, which contributes to the quality of life in neighbouring communities as well as to the overall integrity of the natural environment.

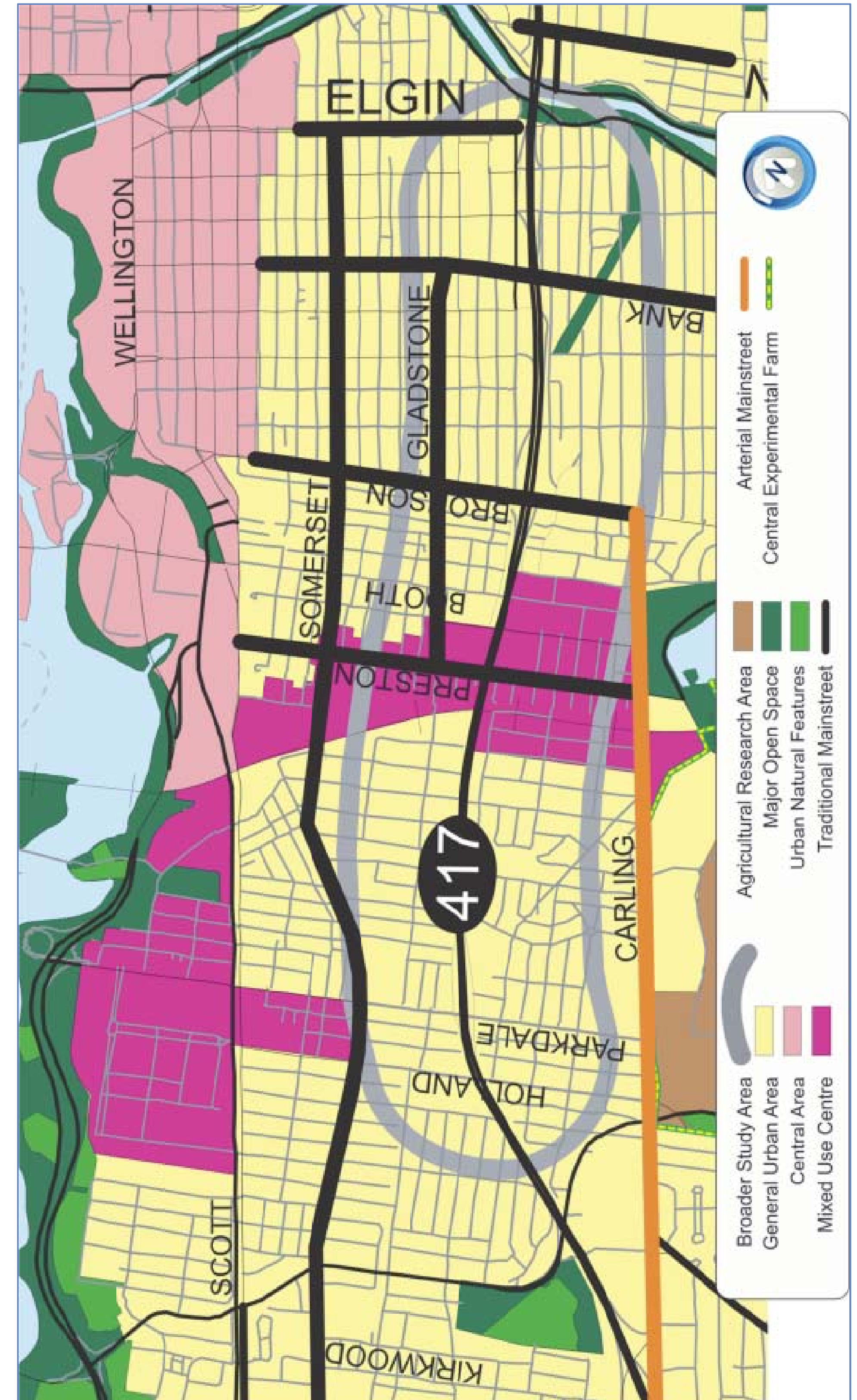

Figure 1. City of Ottawa Land Use Designations within the Broader Study Area (Official Plan, 2007)

Summary of Existing Land Use within the Broader Study Area

If a typical land use is not listed and described below, it has been found not to apply to this study.

Agricultural

The Central Experimental Farm comprises the Agricultural Land Use near the BSA, however, instead of being intended for the production of agricultural goods, it is meant for a range of uses to preserve the cultural, scientific and historical value of the Central Experimental Farm for present and future generations.

Residential

There are many neighbourhoods within the LSAs. The geographical boundaries of these areas are based on those identified by neighbourhood associations or are historically delineated. These boundaries are different than the Municipal Wards, which are defined by the City of Ottawa and are political boundaries, and may encompass or overlap neighbourhood boundaries. Neighbourhoods are displayed in Figure 2 while Ward Boundaries are shown in Figure 3.

There are some self-designated communities (and representative associations) with loose geographical boundaries that may be within other larger designated neighbourhoods. These include:

- Island Park – includes the parts of the Westboro, Civic Hospital and Hintonburg neighbourhoods adjacent to Island Park Drive
- Wellington West – within Hintonburg adjacent to Wellington Street West
- Fisher Park – within Hintonburg adjacent to Holland Avenue and north of the Queensway
- McNabb – within Centretown, east of Bronson Avenue, and north of the Queensway, near the McNabb Park Community Centre

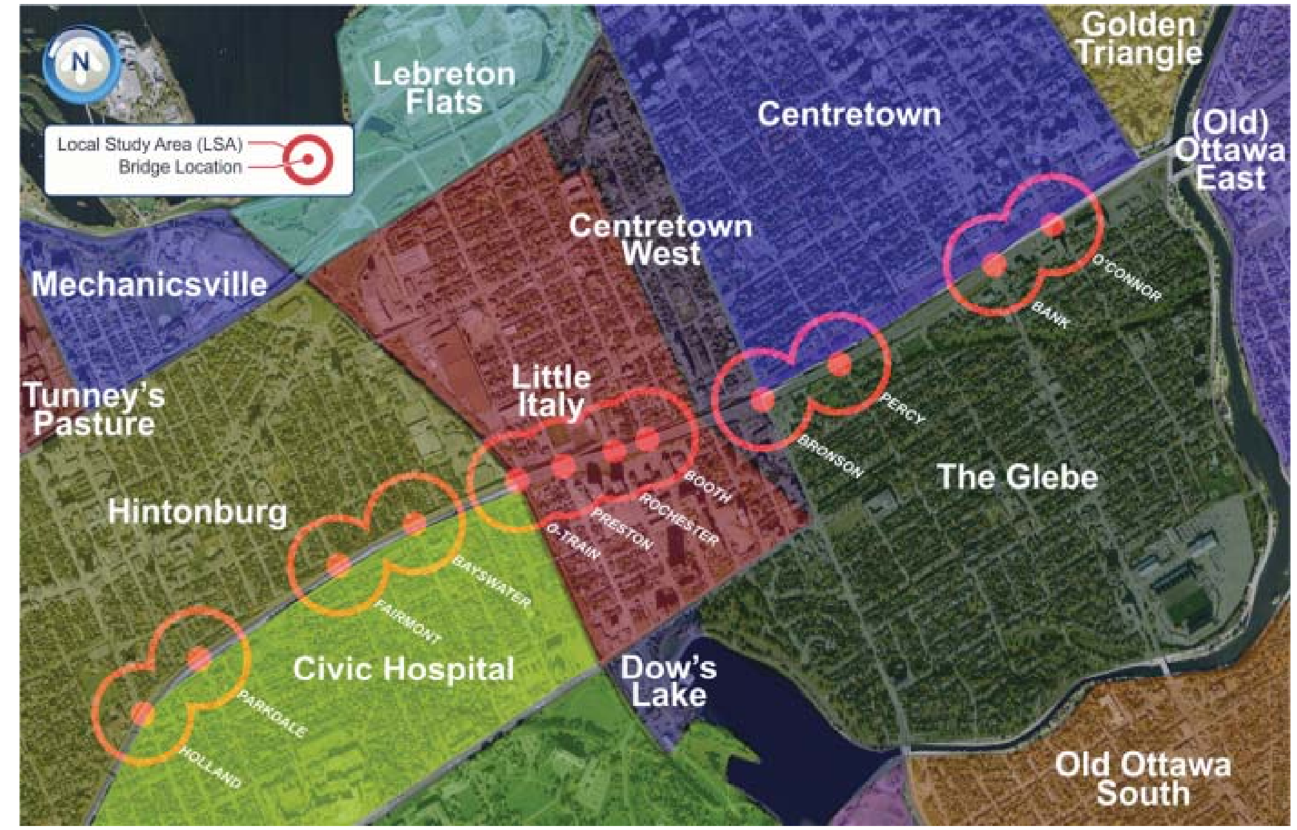

Figure 2. Neighbourhood Boundaries

Note that Centretown West is also known as Chinatown, and Tunney's Pasture Residential which is immediately east of Tunney's Pasture is also known as Champlain Park.

The ward boundaries in Figure 3 below are political boundaries and have elected Councillors representing each ward on the City of Ottawa's Council.

Figure 3. Ward Boundaries

The Wards are large and only three (3) are directly within the BSA. They are the Kitchissippi, Somerset, and Capital Wards.

Commercial, Industrial and Tourism

A majority of the areas immediately around the LSAs are residential (within several hundred metres), however, in some areas, minor commercial uses are allowed and can be found on the Mainstreets, such as Holland Avenue and Parkdale Avenue to the north, and on Bronson Avenue to the north and within areas immediately south of the Queensway. North of Parkdale Avenue and northwest of Fairmont Avenue is one of the Community Information Centres for Ottawa. As well, the Parkdale Market, a busy open summer market, is north on Parkdale Avenue.

Preston Street both north and south is within the area called Little Italy and is known for its restaurants and shopping, and is a tourism destination for visitors to Ottawa as it is also close to Dow's Lake and the Rideau Canal. Preston Street is also a thriving area for employment, with Preston Towers and many other businesses along this street. As well, Public Works and Government Services Canada on Somerset Street W. near Preston Street and the O-Train corridor provide employment for many public servants, however the area is intended to be re-developed into a Mixed-Use Centre Zone, continuing to house a government employment centre, and the new Somerset Wastewater Storage Facility (for the storage of combined sewage and stormwater to prevent an overflow), subject to site plan approval.

Also at the O-Train corridor, one small area to the southwest is zoned for General Industrial Zone use; however it is currently used for commercial purposes. Most of the area around this crossing is zoned commercial and is used for that purpose.

To the south of Rochester Street and Booth Street, there are major government and private employment centres. North and south of Bronson, there is a mix of smaller commercial businesses along Bronson Avenue. North of Percy Street, there are very limited commercial and industrial uses, and none to the south, despite the General Industrial zoning on the vacant land. However, north and south on Bank Street, the street is lined with many small commercial businesses. As well, the Lansdowne Park Development is located south on Bank Street near Holmwood Avenue. It will be a major commercial area and will host large events once completed.

The area immediately south of O'Connor Street supports some commercial uses such as small restaurant businesses, and to the north, the street-side use is predominately commercial. The Canadian Museum of Nature which is northeast of O'Connor Street and the Queensway area is a major tourist destination. As well, the Rideau Canal, which is found approximately 350 m east O'Connor Street is a major tourist destination. O'Connor Street may also be used to access the downtown core, where the Parliament buildings and Sparks Street are major tourist draws. As well, one manned Tourist Information Centre is near the Parliament Buildings – at the World Exchange Plaza on Albert Street.

Community Facilities

Community Facilities includes indoor recreation centres (both municipal and private), libraries, educational facilities, and places of worship that are generally within 1 km of the Queensway in the BSA.

Elmdale Public School is east of Holland Avenue at the Queensway. Fisher Park / Summit Alternative Public School is north on Holland Avenue at the Queensway. Located south on Holland Avenue are the Royal Ottawa Mental Health Centre and the Ottawa Civic Hospital. Also located north on Holland Avenue is the Great Canadian Theatre Company and the West Park Bowling Lanes.

Parkdale United Church is north on Parkdale Avenue, as is the Cornerstone House of Refuge Apostolic Church and the Saint Albertus Pfarrgemeinde. As well, Rosemount Public Library and the Ottawa West Centre for Senior Citizens are on Wellington Street W. northeast of Parkdale Avenue. South of Parkdale Avenue at the Queensway is the Saint Matthias Anglican Church and the adjacent Parkdale Montessori School. Connaught Public School is north of the Queensway between Parkdale Avenue and Fairmont Avenue.

At Fairmont Avenue, the Hintonburg Community Centre is to the north, which houses a library, full-sized gym, large dance studio, and banquet/ meeting rooms. The Saint Francis of Assisi church is located north on Fairmont Avenue at Wellington Street, and is also beside the Hintonburg Community Centre.

At Bayswater Avenue, the Companions of the Cross Roman Catholic Church is located immediately south of the Queensway, and the Ottawa Catholic School Board is south as well. Also south of Bayswater Avenue at the Queensway is Saint Mary Elementary School. Approximately 500 m north of Bayswater Avenue at the Queensway is the Devonshire Community Public School, located on Breezehill Avenue. The next bridge to the east is the O-Train corridor, where the Ev Tremblay Park is to the south; however the closest Queensway access would be from Bayswater Avenue.

At Preston Street, there is the office of the Ontario Disability Support Program directly south of the Queensway, and the Plant Recreation Centre is located north on Preston St. at Somerset Street W. The Plant Recreation Centre houses two (2) pools, has swimming lessons, a fitness centre and associated fitness programs, and a variety of indoor recreation programs. It also contains five (5) meeting/banquet rooms and kitchen facilities.

To the north of Rochester Street and Booth Street, the Adult High School is part of the Ottawa-Carleton District School Board and provides an educational facility catering to adults. Further north on Booth Street is the Dalhousie Community Centre and the Saint Anthony School. The Somerset West Community Health Centre is at Booth Street and Eccles Avenue. Also north on Booth Street is a Community Garden, located immediately north of the Queensway.

The Cambridge Street Community Public School is approximately 400 m north of Bronson Avenue at the Queensway on Cambridge Street. The McNabb Community Centre and Library are north on Bronson Avenue and Percy Street at Gladstone. Also north and between Percy Street and Bank Street is a Community Garden located on Lyon Street near Lisgar Street. The Glebe Collegiate Institute and the Ottawa District School Board are located to the south of the Queensway between Bronson Avenue and Percy Street. Southeast of Percy Street, the Saint James United Church is located on Lyon Street S. near Glebe Avenue. Also south of Percy Street is the Glebe Memorial Park (immediately south of Chamberlain Avenue.) which contains a Community Garden.

North of Bank Street are several churches, including the First United Church and the Church of Saint Barnabus on Kent Street near James Street, the Korean Holy Martyr's Parish Rectory on Gilmour Street west of Kent Street, the Salvation Army Gladstone Community Church on Gladstone Avenue west of Bank Street, and the Centretown United Church, directly on Bank Street. Also north of Bank Street at the Queensway is the Glashan Public School. To the south, the Chinese United Church is on Bank Street near the Queensway. South of Bank Street and Bronson Avenue, the Glebe Montessori School is located on Lyon Street S. near Glebe Avenue. Further south, the Saint Giles Presbyterian Church is on Bank Street, and Saint Matthew's Anglican Church is on First Avenue near Bank Street. Approximately 700 m south on Bank Street, the Glebe Community Centre, the Mutchmor Public School, and the Ottawa Carleton District School Board are on Lyon Street near Fifth Street. On Bank Street near Fourth Avenue are the Fourth Avenue Baptist Church and the Friends Religious Society. As well on Bank Street near Holmwood Street is Lansdowne Park. Lansdowne Park will house the Ottawa Civic Centre arena, exhibition buildings, and a stadium, which will be used for large events.

The Metcalfe Street Church is southeast of O'Connor Street and the Queensway. First Avenue Public School is found directly south on O'Connor Street, as well as the adjacent Glebe Parent's Daycare. Northeast of O'Connor Street and west of Elgin Street is the Jack Purcell Park. It contains a skating rink, pool, weight room, meeting rooms, and access to an adjacent Elgin Street Public School gym. Approximately 600 m north of O'Connor Street and located on Elgin Street is the Elgin Street Public School.

Emergency Services Facilities

There are several Emergency Services Facilities located within 1 km of the Queensway in the BSA. These include community police centres, police stations, ambulance stations, and fire stations.

There is one community police centre, and it is north of the Queensway. It is approximately 600 m north of Fairmont Avenue, and is on Wellington Street W. There are three (3) police stations, the first being near the only community police centre near Wellington Street W. at Fairmont Avenue. Another is

approximately 860 m north on Bank Street and the Queensway, and the third is immediately east of O'Connor Street at the Queensway on Catherine Street, facing Elgin Street.

Two (2) fire stations are within 1 km of the Queensway in the BSA. One is approximately 600 m north on Preston Street at Eccles Street (near Somerset Street), and the other is approximately 850 m south of O'Connor Street at Fifth Avenue, immediately adjacent the Rideau Canal.

There is one ambulance station, located approximately 300 m north on Bronson Avenue at Gladstone Avenue and Cambridge Street N. As well, there are a few hospitals in the area. The Ottawa Civic Hospital is approximately 700 m south on Parkdale Avenue at Carling Avenue. The Saint Vincent Hospital is almost 1 km north on Bronson Avenue, at Cambridge Street N. and Primrose Avenue. The Royal Ottawa Mental Health Centre is located on Carling Avenue southwest of Holland Avenue and the Queensway.

Recreation

Outdoor recreation facilities include parks, skating rinks, tennis courts, sports fields, and multi-use pathways.

The Elmdale Tennis Club and Byron Tramway Park, a linear boulevard park following Byron Avenue, are located north on Holland Avenue. Byron Tramway Park contains a multi-use pathway. Also north of Holland Avenue are the sports fields of Fisher Park Public School.

North of Parkdale Avenue is Parkdale Park, which contains a small wading pool, gazebo, and fieldhouse, and is adjacent the Parkdale Market. As well, northeast of Parkdale Avenue on Wellington Street W. is the urban McCormick Park. Reid Park is southeast of Parkdale and the Queensway. Reid Park has wading pools, basketball courts, and lawn bowling. Southeast of Bayswater, the Ev Tremblay Park is located off Beech Street near the O-Train corridor. It has a basketball court, play structures, wading pool, and small lawn area.

At Fairmont Avenue, Fairmont Park is to the south and Hintonburg Park to the north. Fairmont Park contains trails, an ice rink, and tennis courts. Hintonburg Park has a splash pad and sports fields.

At Preston Street, Plouffe Park is located adjacent to the Plant Recreation Centre and is north on Preston Street near Somerset Street W. The Plant Recreation Centre rents two (2) mini soccer fields in the Plouffe Park. North on Rochester Street is the Chaudiere Park and Primrose Park, two (2) urban parks.

The McNabb Park is north on Bronson Avenue and Percy Street at Gladstone Avenue. It contains facilities for skating and sports fields. There is another sports field beside Glebe Collegiate Institute south of the Queensway between Bronson Avenue and Percy Street. Also south of Percy Street is the Glebe Memorial Park (immediately south of Chamberlain Avenue) which contains a skating rink. To the north of Percy Street, DunDonald Park is located between Bay Street and Lyon Street N. south of Somerset Street W. It does not contain any sports fields but contains memorial plaques, benches, and a few paths.

To the southwest of Bank Street and southeast of Percy Street, Chamberlain Park is directly south of the Queensway and contains tennis courts, a soccer field, and a park with walking paths which extends east to Patterson Creek and the Rideau Canal. Approximately 700 m south on Bank Street, near the Glebe Community Centre on Lyon Street N., there are tennis courts south of Third Avenue. South of

O'Connor Street and Bank Street, Lansdowne Park is adjacent to the Rideau Canal, and in between, there is NCC land containing the heavily used multi-use pathways beside the Rideau Canal. In the immediately adjacent Sylvia Holden Park, there are two (2) sports fields, a small pool, play structures, sports fields, and a fenced dog park.

There are no parks immediately north on O'Connor Street, but northeast, the Jack Purcell Park is located west of Elgin Street, and contains a dog park.

Only one multi-use pathway bi-sects the BSA – this off-road pathway traverses under the Queensway immediately east of the O-Train corridor, and currently goes under the bridge at that location, extending north and south. It has a recently paved portion from Young Street to Gladstone Avenue. From the field investigations conducted for this study and through communication with City of Ottawa Staff, the paved multi-use pathway has been confirmed to have been constructed between Young Street and the Ottawa River, connecting to the NCC's Ottawa River Pathway as planned. South of Young Street, an existing gravel path continues to Carling Avenue. A functional design is currently being prepared for the multi-use pathway to extend from Young Street to Dow's Lake and could be constructed as early as 2014, funding dependent.

The Ottawa Cycling Network (present and planned) has cycling routes that line up with the majority of structures under this study including along: Holland Avenue, Fairmont Avenue, Bayswater Avenue, Preston Street, Rochester Street for a short segment immediately north of the Queensway, Booth Street, Percy Street, Bank Street, and O'Connor Street.

Natural Features / Natural Systems

Natural features and systems are discussed in detail in the Terrestrial Existing Conditions Report (MH, 2012). In general, the LSAs as well as the BSA are highly urbanized and do not contain significant natural features or systems.

Municipal Services

Municipal Services include City Hall, which is located at the east end of the BSA, and is 1 km north of the Queensway on Elgin Street. It also houses a Municipal Client Services Centre. There are two (2) public libraries within 1 km – the Rosemount Branch at Wellington Street W. and Rosemount Avenue, and the Main Branch at Metcalfe Street and Laurier Avenue W. Several municipal parking lots are located north of the BSA. One is under the City Hall on Elgin Street, another immediately across Elgin Street near Laurier Avenue W., another below the Main Branch Public Library, another at Bank Street and Gloucester Street, and one on Somerset Street W. at Bell Street N.

There are two active Municipal Public Works Yards within the BSA. One is located at 380 Catherine Street, and is north of the Queensway, east of Percy Street, and west of Lyon Street North. The second is a traffic operations facility at 175 Loretta Avenue North (which also makes use of a small property south of Gladstone Avenue and east of the O-Train corridor). Another former Municipal Public Works Yard exists within the BSA south of Somerset Street and north of Gladstone Avenue and east of the O-Train corridor, formerly called the Bayview Yard. It is now vacant and in the new Official Plan, the Bayview Yard and surrounding area are designated as a mixed-used centre.

Utility Corridors

There are no major utility corridors within the LSA or BSA. However, various public and privately owned utilities exist in close proximity to the various bridge sites including a large watermain along much of the south side of the corridor as well as storm and sanitary sewers, gas, hydro, bell and telecom infrastructure. A utilities composite plan will be prepared at a later stage of this study.

Specific Land Use in Vicinity of Local Study Areas

The current Land Use Zoning (enacted by Zoning Bylaws) for areas immediately adjacent to the bridge areas is related to the Official Plan Land Use Designation. The zoning or land use by-laws lay out the day-to-day administrative duties and put into effect the policies set out in the City's Official Plan. The zoning by-law states in detail:

- What uses are permitted on the lands;
- Where buildings and structures can be located;
- The types of buildings and specific uses of the building;
- The lot area and dimensions, setbacks and height restrictions; and
- The amount of landscaped open space and parking required for the use.

All sections of the zoning bylaw are legally enforceable and any construction or new development must comply with the zoning by-law unless an amendment is made.

Descriptions of Allowed Uses under Current Zoning

The zoning designations in Table 1 are referred to in the following section. Additional details on what specific uses are allowed and what provisions apply for those uses are found in the City of Ottawa's Zoning By-law documents and are not relevant to this study. The allowed uses for the various zoning are as follows:

Table 1. Zoning Designations within the Local Study Area

Zoning Designation	Allowed Land Use
Community Leisure Facility Zone	• Permits recreational uses that meet the needs of the surrounding community to be located on land designated as General Urban Area, Major Open Space, Mixed Use Centre and Central Area in the Official Plan; and • Imposes regulations which ensure that the scale and intensity of these uses is compatible with any adjacent residential uses.
General Industrial Zone	• Permits a wide range of low to moderate impact, light industrial uses in accordance with the Employment Area designation of the Official Plan or, the General Urban Area designation where applicable; • Allows in certain Employment Areas or General Urban Areas, a variety of complementary uses such as recreational, health and fitness uses and service commercial (e.g. convenience store, personal service business, restaurant, automobile service station and gas bar), occupying small sites as individual occupancies or in groupings as part of a small plaza, to serve the employees of the Employment or General Urban Area, the general public in the immediate vicinity, and passing traffic;

Zoning Designation	Allowed Land Use
	• Prohibits retail uses in areas designated as Employment Area but allow limited sample and showroom space that is secondary and subordinate to the primary use of buildings for the manufacturing or warehousing of the product; and • Provides development standards that would ensure that the industrial uses would not impact on the adjacent non-industrial areas.
General Mixed Use	• This zoning specifically allows residential, commercial and institutional uses, or mixed use development.
Local Commercial	• Allows a variety of small, locally-oriented convenience and service uses as well as residential uses in the General Urban Areas and in the Residential Character Areas of the Central Area designations of the Official Plan; • Restricts the non-residential uses to individual occupancies or in groupings as part of a small plaza that would meet the needs of the surrounding residential areas; • Provides an opportunity to accommodate residential or mixed uses development; and • imposes development standards that will ensure that the size and scale of development are consistent with that of the surrounding residential area.
Major Leisure Facility	• Permits a broad range and intensity of leisure, recreational, cultural and related uses; and allows a moderate density and scale of development.
Minor Institutional Zone	• Permits a range of community uses, institutional accommodation and emergency service uses to locate in areas designated as General Urban Area or Central Area in the Official Plan; and • Minimizes the impact of these minor institutional uses located in close proximity to residential uses by ensuring that such uses are of a scale and intensity that is compatible with neighbourhood character.
Mixed Use Centre	• Ensures that the areas designated Mixed-Use Centres in the Official Plan accommodate a combination of transit-supportive uses such as offices, secondary and post-secondary schools, hotels, hospitals, large institutional buildings, community recreation and leisure centres, day care centres, retail uses, entertainment uses, service uses such as restaurants and personal service businesses, and high- and medium-density residential uses; • Allows the permitted uses in a compact and pedestrian-oriented built form in mixed-use buildings or side by side in separate buildings; and • Imposes development standards that ensure medium to high profile development while minimizing its impact on surrounding residential areas.
Open Space	• Permits parks, open space and related and compatible uses to locate in areas designated as General Urban Area, General Rural Area, Major Open Space, Mixed Use Centre, Village, Greenbelt Rural and Central Area as well as in Major Recreational Pathway areas and along River Corridors as identified in the Official Plan, and • Ensures that the range of permitted uses and applicable regulations is in keeping with the low scale, low intensity open space nature of these lands.
Residential	The urban residential zones include: • R1- Residential First Density, which allows for detached dwellings • R2- Residential Second Density, which permits two (2) unit dwellings • R3- Residential Third Density, which permits townhouse dwellings

Zoning Designation	Allowed Land Use
	• R4- Residential Fourth Density, which permits low rise apartments • R5- Residential Fifth Density, which permits mid/high-rise apartments For the purposes of this study, the zoning is generally referred to as Residential.
Traditional Mainstreet Use	• Accommodates a broad range of uses including retail, service commercial, office, residential and institutional uses, including mixed-use buildings but excluding auto-related uses.

The actual land uses comply with the zoning and are described below. Figures are provided for reference.

Holland Avenue LSA

Private residences surround most areas around Holland Avenue (Figure 4), and the area is zoned for Residential uses. The Hydro Substation also resides on land zoned as residential. Where Fisher Park School and sports fields are located, the area is zoned as Minor Institutional. Further north on Holland Avenue, small commercial business uses line the street. However, Holland Avenue to the south is used for residential purposes except where it meets Carling Avenue.

Figure 4. Holland Avenue Bridge LSA Land Uses

Parkdale Avenue LSA

There are several places of worship along Parkdale Avenue (Figure 5): Parkdale Baptist Church to the north, and Saint Matthias's Anglican Church and Saint Stephen's Presbyterian Church to the south. These three (3) properties are zoned Minor Institutional. All other areas are zoned Residential and are used for this purpose, except for Reid Park, which is zoned for Community Leisure Facility uses. Further north on Parkdale Avenue, there are commercial businesses, and the Ottawa Civic Hospital is to the south on Parkdale Avenue at Carling Avenue.

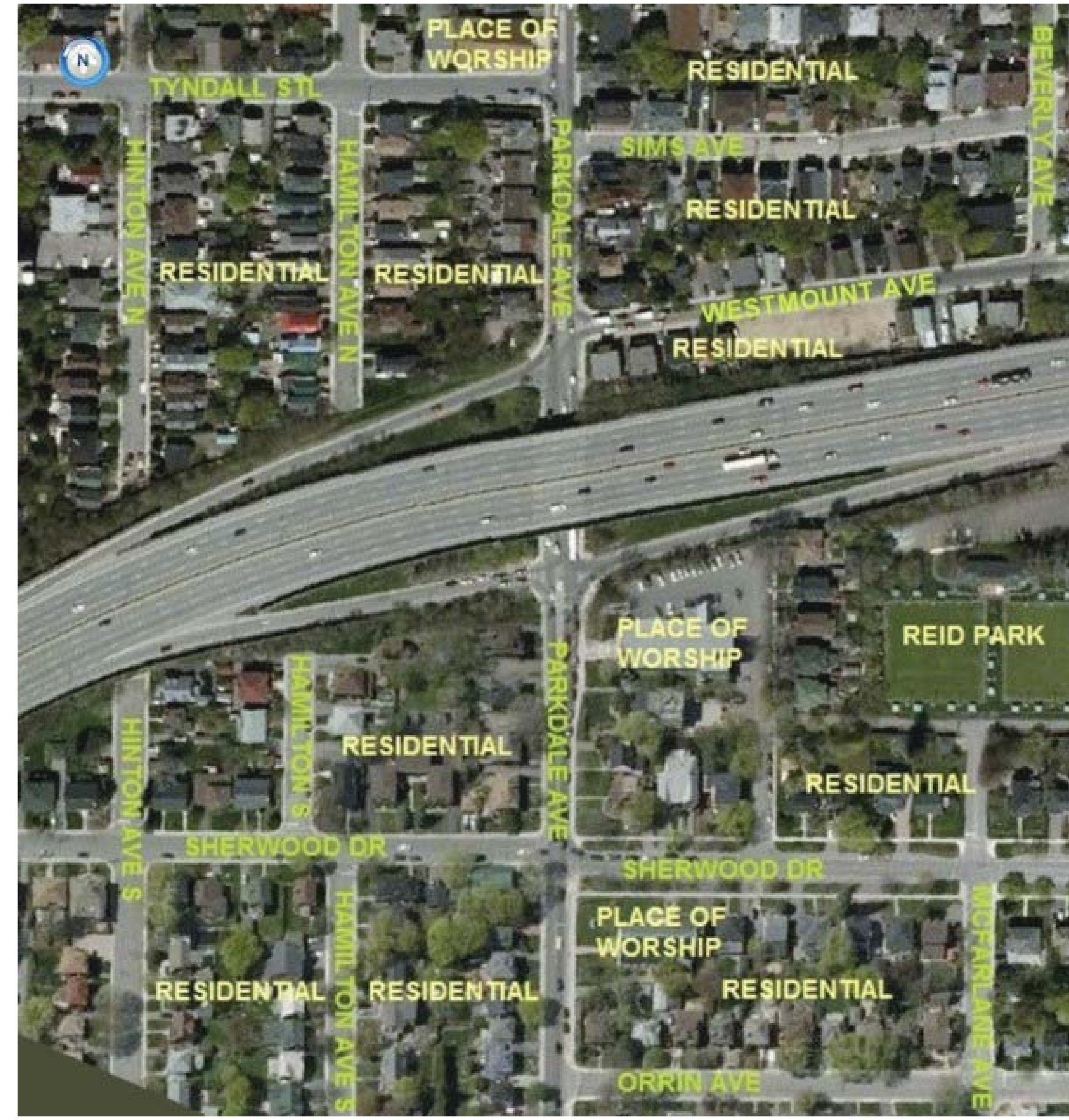

Figure 5. Parkdale Avenue Bridge LSA Land Uses

Fairmont Avenue LSA

All areas north and south of the Queensway along Fairmont Avenue (Figure 6) are residential and are also zoned for Residential uses, with two (2) exceptions. The area north of Edgar Street and west of Saint Francis Street has a mix of residential, commercial, and is also the location of an elementary school. It is also zoned Residential. As well, a convenience store is located at the corner of Gladstone Avenue and Fairmont Avenue. This property is zoned for Local Commercial use.

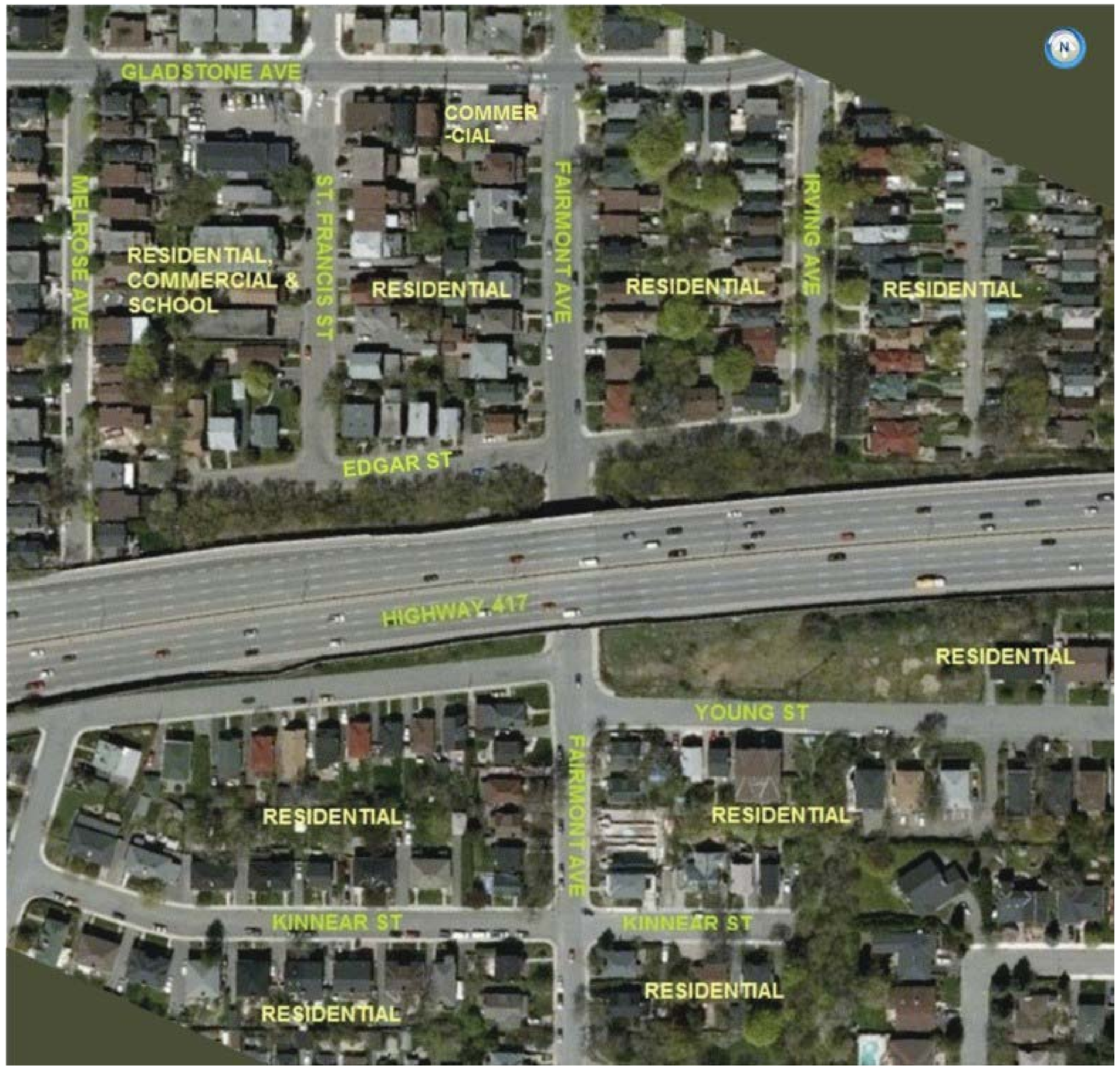

Figure 6. Fairmont Avenue Bridge LSA Land Uses

Bayswater Avenue LSA

Areas north and south of the Queensway along Bayswater Avenue (Figure 7) are zoned Residential and are currently used for this purpose. The exception is a Roman Catholic Church (Companions of the Cross), and school and school board buildings (not depicted) south of Young Street and east of Bayswater Avenue, which is zoned as a Minor Institutional Zone.

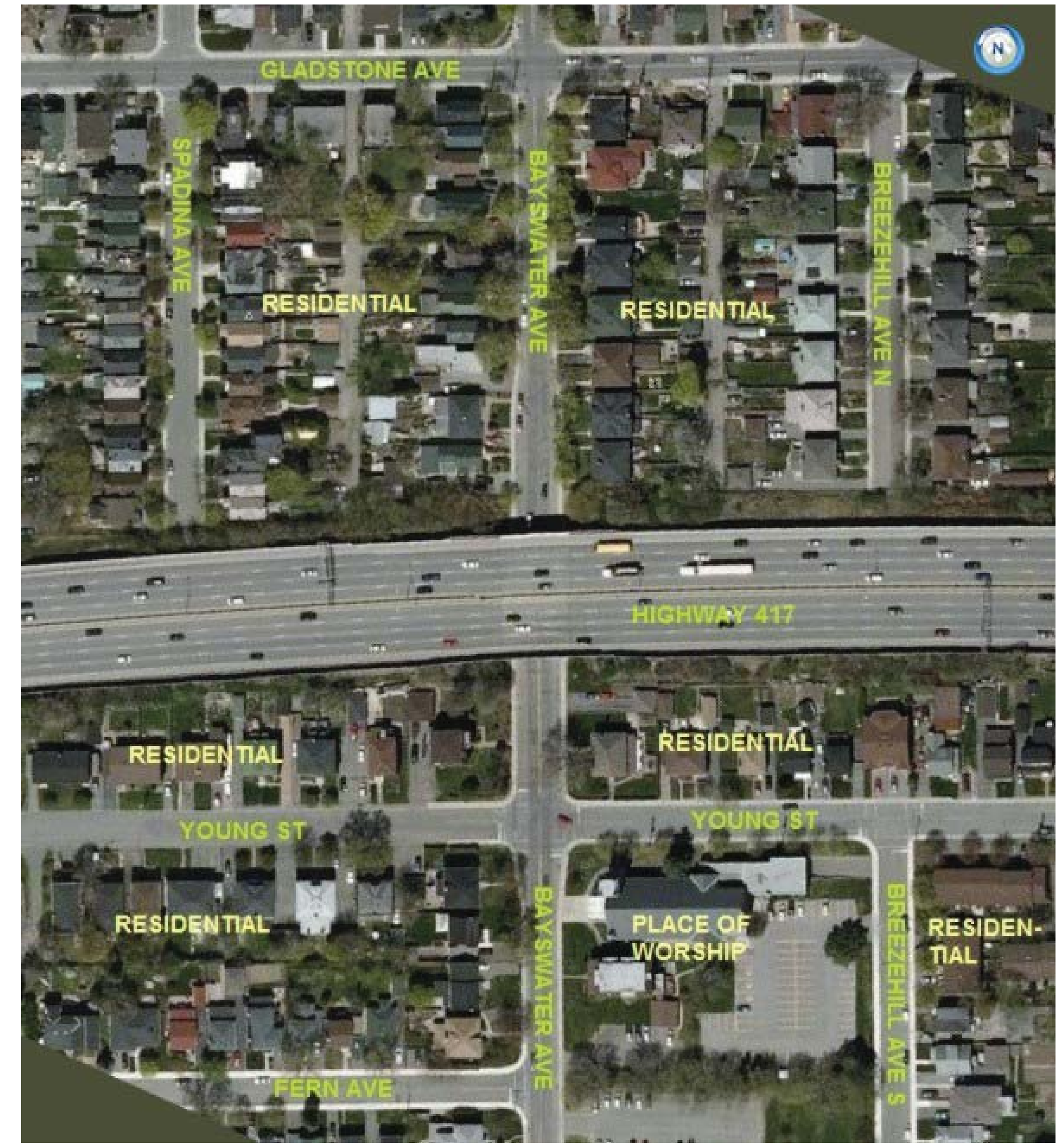

Figure 7. Bayswater Bridge LSA Land Uses

O-Train LSA

The areas to the northeast of the O-Train corridor at the Queensway (Figure 8) which are currently used for the soccer club (Ottawa St-Anthony Italia Soccer Club), commercial, and residential uses, are zoned for Mixed Use Centre Zone. The areas northwest of the O-Train corridor at the Queensway are zoned General Industrial Zone and host a variety of light industrial and other business activities and associated buildings. To the immediate northwest is the City of Ottawa's Municipal traffic operations facility at 175 Loretta Avenue N. Almost all areas southwest of the O-Train / Queensway intersection and west of the Traditional Mainstreet zoning along Preston Street are zoned as Residential. One small area currently used for commercial activities (Lixar I.T. Inc.) which is north of Young Street and east of Champagne Street S. is zoned as General Industrial. A footpath and pedestrian bridge crosses the O-Train on Young Street. A paved multi-purpose pathway connecting Young Street to Gladstone Avenue (and continues northward) has been constructed along the east side of the O-Train, extending under the Queensway. The pathway continues south from Young Street to Carling Avenue, however currently has a gravel surface in this area. Within the mixed residential and commercial areas southeast of the O-Train / Queensway intersection, an example of the commercial use is the Young Street Garage on Young Street.

Figure 8. O-Train Bridge LSA Land Uses

Preston Street LSA

The Adult High School area north of the Queensway along Preston Street is zoned for Community Leisure Facility uses (Figure 9). To the northeast and southeast, the areas beside Preston Street are zoned for Traditional Mainstreet uses. Further west and north of the Queensway, it is zoned for Mixed Use Centre uses. Likewise, the Preston Street Towers are zoned for Mixed Use Centre uses. Areas southwest and not directly along Preston Street are zoned for Residential, but also contain limited commercial uses, as is allowed by this zoning.

Figure 9. Preston Street Bridge LSA Land Uses

Rochester Street and Booth Street LSAs

The Adult High School property to the northeast of Rochester Street and the Queensway is zoned as a Community Leisure Facility Zone (Figure 10). The areas currently used for Residential are zoned for higher density such as low rise apartments, but also allow some commercial uses.

The areas south of the Queensway are major employment centres, mainly government. They are zoned as a Mixed-Use Centre Zone, and currently contain government offices, private business, and residential apartments.

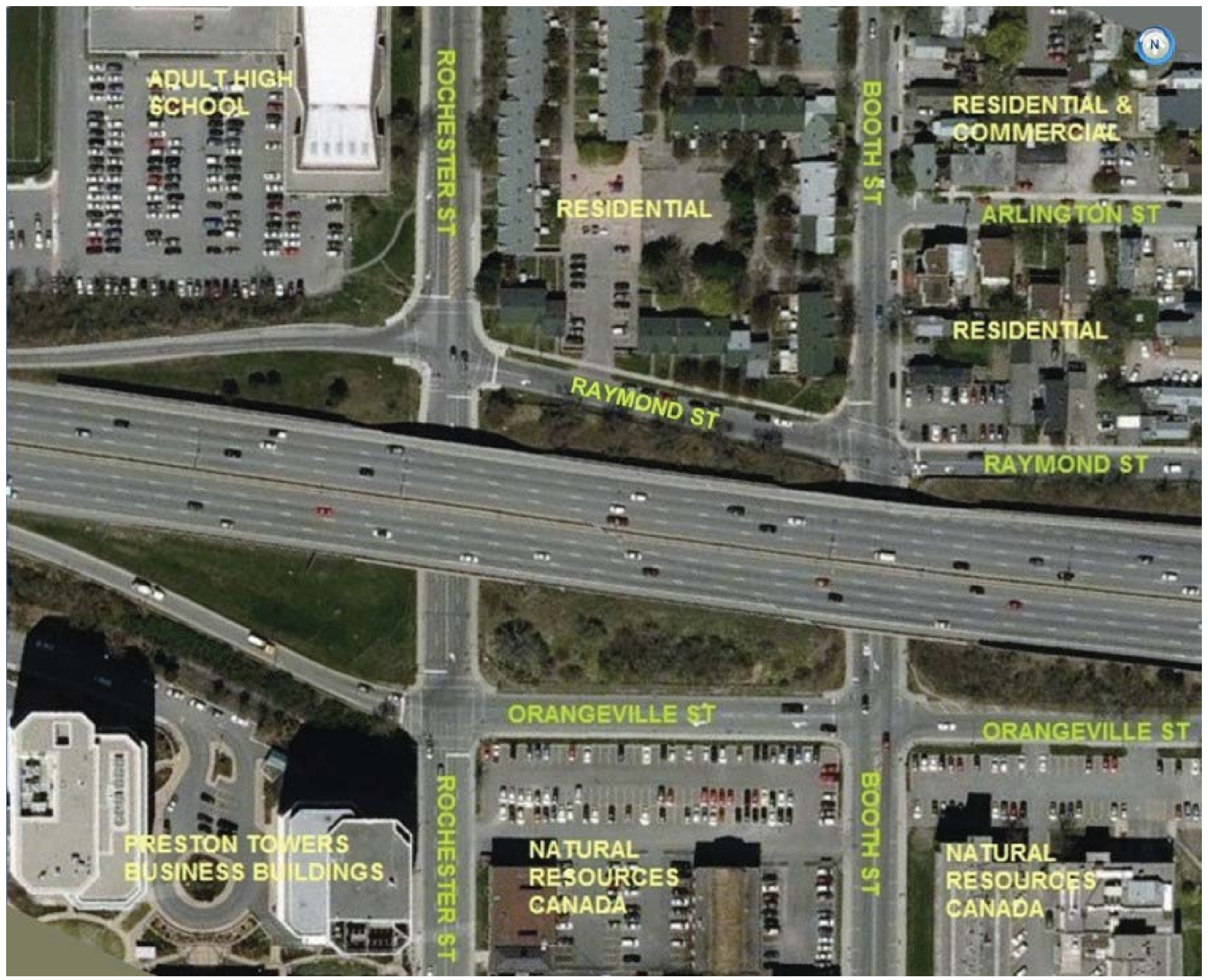

Figure 10. Rochester Street and Booth Street Bridge LSA Land Uses

Bronson Avenue LSA

Northwest of the Queensway, the zoning allows for Traditional Mainstreet use along Bronson Avenue (currently used for restaurants, other commercial uses, and residential), and Residential immediately north of the Queensway in an area currently used for parking (Figure 11). To the northeast, the area is zoned for General Mixed Use and has a mix of commercial and residential uses. Areas southeast of the Queensway and north of Chamberlain Avenue and Imperial Avenue are zoned General Industrial and contain the former Media Centre (a space simulation centre) and an automobile service centre. To the southwest are Traditional Mainstreet uses and a mix of small business and residential uses. The vacant grassed area to the north of the Queensway eastbound off-ramp is zoned Community Leisure Facility. The vacant grassed area to the south of the Queensway westbound on-ramp is zoned Residential and Traditional Mainstreet.

Figure 11. Bronson Avenue Bridge LSA Land Uses

Percy Street LSA

Immediately north of the Queensway at Percy Street, the zoning allows for General Mixed Use and contains a mix of commercial buildings, and a City of Ottawa Municipal Yard and building (Figure 12). Immediately south of the Queensway in an undeveloped area, the zoning is General Industrial Zone, and south of Chamberlain Avenue, the zoning allows for Residential and Open Space. The Glebe Memorial Park and tennis courts are located in area zoned as Open Space.

Figure 12. Percy Street Bridge LSA Land Uses

Bank Street LSA

North and south of Bank Street, the zoning allows for General Mixed Use and contains a mix of gas stations, schools, and business buildings (Figure 13). The exception is the commercial area to the southeast of the Bank Street and Queensway crossing; in this area, the zoning allows for Traditional Mainstreet use, and has a Randall's store and an apartment building.

Figure 13. Bank Street Bridge LSA Land Uses

O'Connor Street LSA

To the north of the Queensway, the land along O'Connor Street is mainly zoned General Mixed Use and contains vacant land and private parking immediately adjacent to the Queensway (Figure 14). The exception is the location of the YMCA which is zoned Major Leisure Facility Zone.

The current zoning immediately south allows for General Mixed Use. Currently the buildings to the south are a maximum height of 23.5 m where they abut Isabella Street on the south side. Immediately south and adjacent to the Queensway, the land is vacant. Within 50 m, there are apartment buildings, restaurants, automotive services and other businesses to the south.

Figure 14. O'Connor Street Bridge LSA Land Uses

Future Land Uses

Information on future land use development within the BSA is restricted to what is permitted with current zoning; OP amendments, and zoning amendment and minor variance applications that are currently under review are not included in this report.

The entire BSA and LSAs are subject to a Special Infill Provision. Although infill is generally considered desirable as it has less need for additional City services and infrastructure, it must also be compatible with existing adjacent communities and land uses. Recommendations from the City regarding infill include the need to:

- Improve the relationship between the front of house and the street, and promote more neighbourly frontages and uses at street level
- Improve the landscape and streetscape treatment so that new homes 'fit' better in established neighbourhoods
- Increase the permeability of yards and front yard green potential
- Improve the implementation of the City's Urban Tree Conservation By-law

Portions of the BSA are designated as Design Priority Areas. Design Priority Areas are mixed-use nodes and corridors that are significant to the City's overall design. They include the downtown precinct, traditional mainstreets, arterial mainstreets, mixed-use centres, town centres, village cores, CDPs and capital projects. They are subject to design review by the Urban Design Review Panel.

Design Priority Areas are found south of the Queensway from Loretta Avenue S. to Lebreton Street S. Both sides of Bronson Avenue and Bank Street are also considered to be Design Priority Areas. To the north of the Queensway, from the O-Train to Rochester Street is considered to be a Design Priority Area, as is from halfway between Lyon Street N. and Kent Street to the Queen Elizabeth Drive.

Ottawa's Business Improvement Areas (BIAs) include some of the City's most vibrant commercial districts (Figure 15). BIAs come into existence when local business and property owners join together to improve, promote and undertake projects that will result in a stronger and more competitive commercial Mainstreet or business district. With the City's support, they organize, finance and complete local improvements and promotional events from their common location within a defined commercial area. Within the BSA there are three (3) BIAs which abut the LSAs: the Glebe BIA, Preston Street BIA, and Wellington West BIA; additionally three (3) BIAs are located partly within the BSA: Somerset-Chinatown BIA, Bank Street Promenade BIA, and Somerset Village BIA.

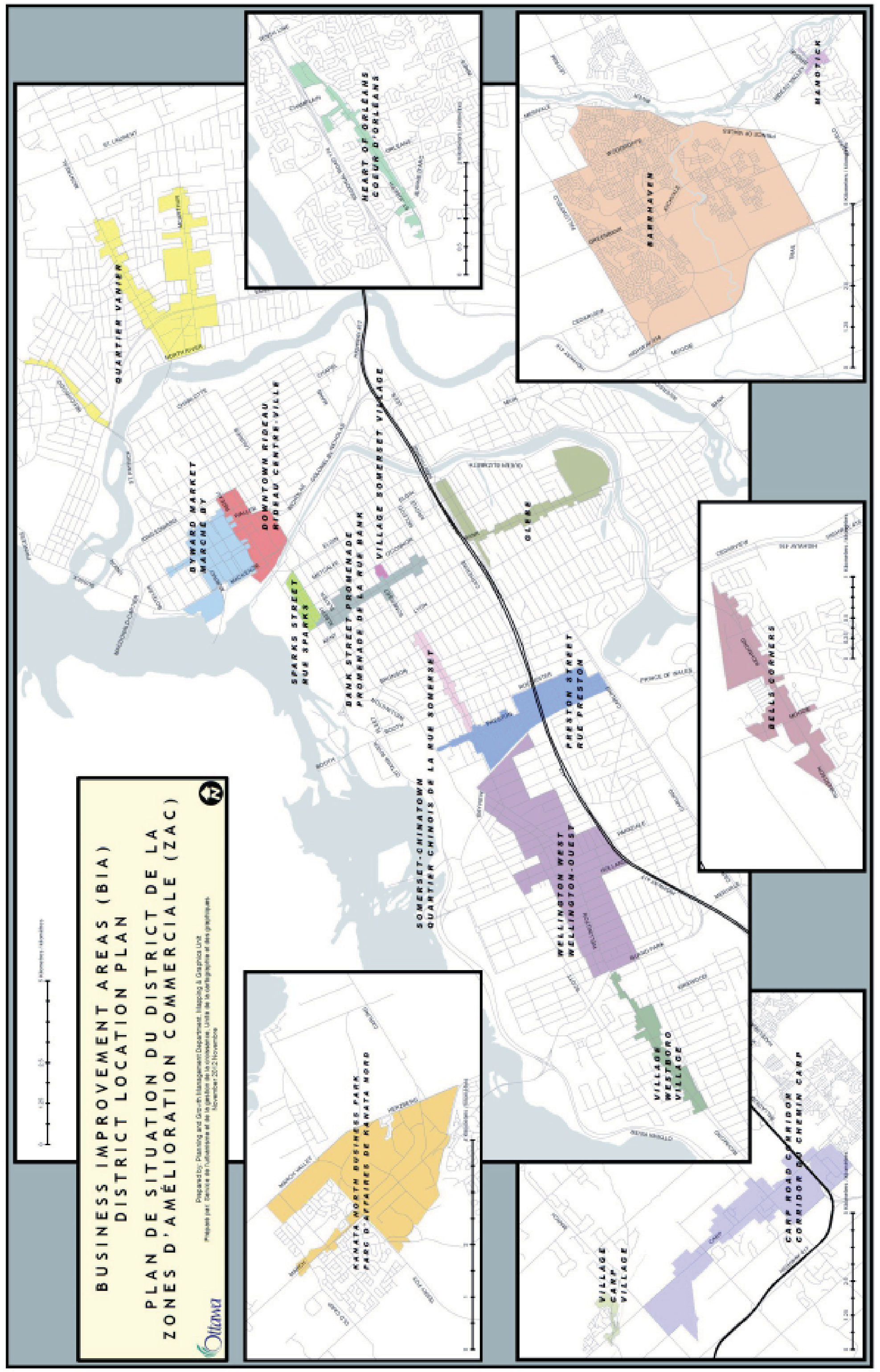

Figure 15. Business Improvement Areas (image from City of Ottawa)

Designated Areas

Designated Areas are defined by resource agencies, municipalities, the government and / or the public, through legislation, policies, or approved management plans, to have special or unique value. Such areas may have a variety of ecological, recreational, and / or aesthetic features and functions that are highly valued. Within the BSA, there are a few areas zoned as Open Space areas, which are the location of public parks, greenspaces, and sports fields. One is located north on Holland Avenue at Byron Avenue. It is the connected Elmdale Tennis Club and Byron Tramway Park, a linear boulevard park following Byron Avenue. Byron Tramway Park contains a multi-use pathway.

One area zoned as Open Space is north of the Queensway between Parkdale Avenue and Fairmont Avenue in the Hintonburg neighbourhood. It is the McCormick Park, an urban park with ties to the historic McCormick Mill. There are two (2) areas zoned as Open Space on Fairmont Avenue. To the north at the Duhamel Street and Fairmont Avenue intersection is the Hintonburg Park, and to the south and opposite the Hereford Place and Fairmont Avenue intersection is the Fairmont Park.

A large area zoned as Open Space is the Dow's Lake area, south of Carling Avenue near the O-Train Corridor, Preston Street, Rochester Street, and Booth Street. It is connected to the far more extensive NCC lands beside the Rideau Canal and contiguous Brown's Inlet off Percy Street and Bank Street.

To the north on Booth Street at Gladstone Avenue is the Piazza Dante Park within Little Italy, which was recently revitalized (completed in 2012) and now has many features such as carved granite entrance columns, games tables, and benches to commemorate veterans and internees of the Second World War. This park is zoned Open Space.

Immediately south of the Queensway between Bronson Avenue and Percy Street is the Glebe Memorial Park, which is zoned as Open Space. Also south of the Queensway and further east is Chamberlain Park, which is contiguous to Central Park (also zoned as Open Space), and which creates a linear park which initiates east of Lyon Street S. and terminates at the Rideau Canal near Linden Terrace.

North on Lyon Street N. at McLaren Street and between Percy Street and Bank Street is the DunDonald Park, a treed urban park for passive recreation activities, which is zoned as Open Space.

South on O'Connor Street is the urban Lionel Britton Park at Fifth Avenue which is zoned as Open Space. Further south on O'Connor Street is the Lansdowne Park Complex, of which the portion near the Rideau Canal is zoned as Open Space.

All areas zoned as Open Space are meant to be used for parks and open space, and according to the zoning bylaw, the permitted uses are community gardens, environmental preserve and education area, and park. Some other permitted uses, depending on the applicable subzone category, are golf course, community arena, sports arena, community centre, museum, library, parking garage, parking lot, recreational and athletic facility, cemetery, fairground, municipal service centre, marine facility, restaurant, theatre, agricultural use, utility installation (limited to a high pressure natural gas pipeline and compressor station), and forestry operation.

None of these areas are considered particularly environmentally sensitive (except those along watercourses) but they are very important in a social context, providing open areas for all residents of the City of Ottawa to enjoy and use.

APPENDIX E: Landscape Composition Photographic Record

MEMORANDUM

MORRISON HERSHFIELD

TO:	Project File	ACTION BY:	N/A
FROM:	Julia Dewing, Environmental Planner	FOR INFO OF:	Ministry of Transportation of Ontario
PLEASE RESPOND BY:	N/A	PROJECT No.:	1124127.00
RE:	Queensway Mid-Town Bridges Landscape Composition Photographic Record	DATE:	May 7, 2013

L:\PROJ\1124127\ENVIRONMENTAL\WORKING\REPORTING\SECR\APPENDICES\E-LANDSCAPE COMPOSITION PHOTOGRAPHIC RECORD\DRAFT_LANDSCAPE_COMPOSITION_QUEENSWAYMIDTOWNBRIDGES_GWP4075-11-00_APRIL, 24, 2013.DOCX

The following images have been captured as part of the Landscape Composition Photographic Record for the Ottawa Queensway Mid-town Bridges Preliminary Design and Environmental Assessment Study (GWP 4075-11-00).

Holland Avenue

Figure 1. Holland Avenue Bridge (looking north)

Figure 2. Holland Avenue Bridge (looking south)

Parkdale Avenue

Figure 3. Parkdale Avenue Bridge (looking north)

Figure 4. Parkdale Avenue Bridge (looking south)

Fairmont Avenue

Figure 5. Fairmont Avenue Bridge (looking north)

Figure 6. Fairmont Avenue Bridge (looking south)

Bayswater Avenue

Figure 7. Bayswater Avenue Bridge (looking north)

Figure 8. Bayswater Avenue Bridge (looking south)

O-Train

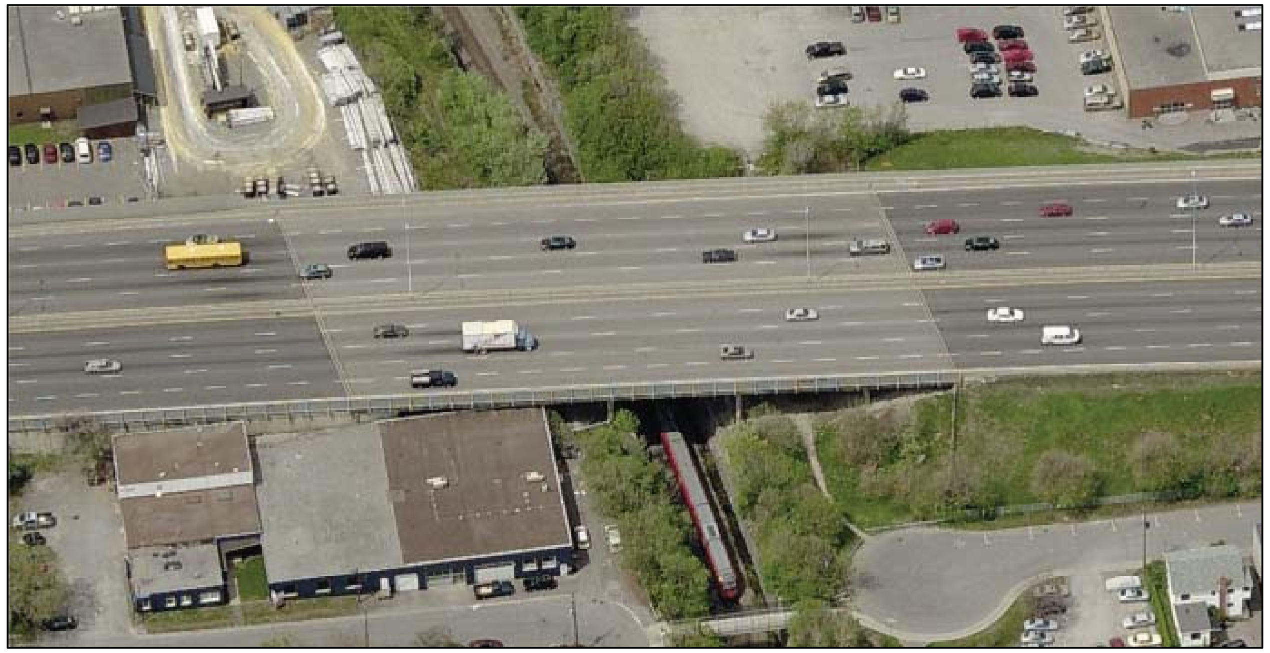

Figure 9. O-Train Bridge

Figure 10. O-Train Bridge (looking north)

Figure 11. O-Train Bridge (looking north from pedestrian bridge)

Preston Street

Figure 12. Preston Street Bridge (looking north)

Figure 13. Preston Street Bridge (looking south)

Rochester Street

Figure 14. Rochester Street Bridge (looking north)

Figure 15. Rochester Street Bridge (looking south)

Booth Street

Figure 16. Booth Street Bridge (looking north)

Figure 17. Booth Street Bridge (looking south)

Bronson Avenue

Figure 18. Bronson Avenue Bridge (looking north)

Figure 19. Bronson Avenue Bridge (looking south)

Percy Avenue

Figure 20. Percy Avenue Bridge (looking north)

Figure 21. Percy Avenue Bridge (looking south)

Bank Street

Figure 22. Bank Street Bridge (looking north)

Figure 23. Bank Street Bridge (looking south)

O'Connor Street

Figure 24. O'Connor Street Bridge (looking north)

Figure 25. O'Connor Street Bridge (looking south)

APPENDIX F: Contamination Overview Study

MORRISON HERSHFIELD

FINAL
CONTAMINATION OVERVIEW STUDY

Preliminary Design and Environmental Assessment Study for the Rehabilitation / Replacement of Ottawa Queensway Mid-town Bridges from Holland Avenue to O'Connor Street

G.W.P. 4075-11-00

Agreement # 4011-E-0025

MH Project # 1124127.00

Presented to:

Kevin Ogilvie
Senior Environmental Planner

Ministry of Transportation
1355 John Counter Blvd. P.O. 4000
Kingston, ON
K7L 5A3

Project No. 1124127.00 July 12, 2013

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CONTAMINATION OVERVIEW STUDY

Preliminary Design and Environmental Assessment Study for the Rehabilitation / Replacement of Ottawa Queensway Mid-town Bridges from Holland Avenue to O'Connor Street

MTO Project Number: GWP 4075-11-00

1124127.00

July 2013

Ontario

Prepared By:

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Geo-Environmental EIT

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Geo-Environmental Practice Leader
Contaminant/Waste Management Key Contact

Ce document hautement spécialisé n'est disponible qu'en anglais en vertu du règlement 671 / 92, qui en exempte l'application de la Loi sur les services en français. Pour de l'aide en français, veuillez communiquer avec Heather Edwardson, ministère des Transports, au 905 704-2210.

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APPENDIX D: Locations of Sites Observed During Site Reconnaissance

1. INTRODUCTION

The Ontario Ministry of Transportation (MTO) Eastern Region initiated this Preliminary Design and Environmental Assessment Study to determine the preferred alternative for the rehabilitation and / or replacement of twenty-three (23) bridges (at twelve locations) on Highway 417 (Ottawa Queensway) from Holland Avenue to O'Connor Street. Through this assignment, MTO will obtain environmental clearances associated with a cleared Transportation Environmental Study Report for the structure rehabilitation or replacement work, including any necessary closures. As part of this process it is necessary to determine the presence and significance of any actual or potential site contamination within the study area, which could have an impact on construction activities.

1.1 Study Area

The study area includes twenty-three (23) bridges (twelve locations) along the Queensway from Holland Avenue to O'Connor Street which are highlighted on Figure 1.1. The study area includes the bridge sites and staging areas, and also includes adjacent property that has the potential for contaminant migration onto MTO lands. Based on industry standards, the study area for the Contamination Overview Study (COS) is defined as everything within 250 m of the centroid of each bridge.

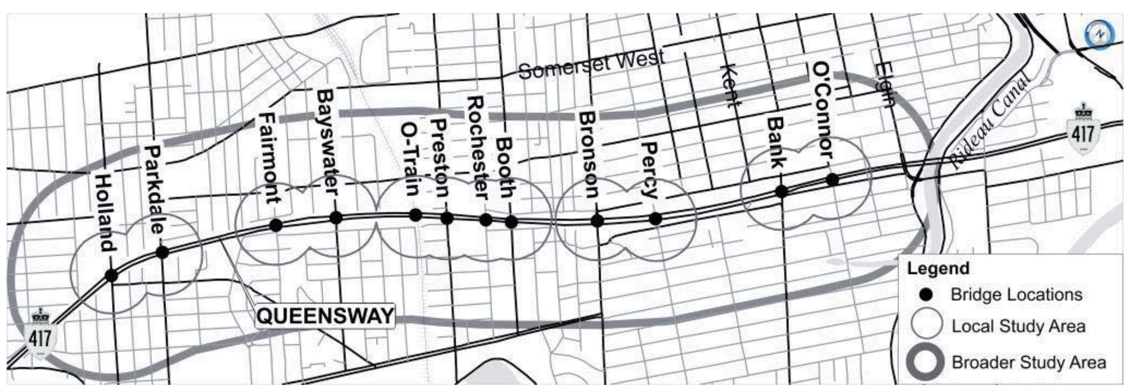

Figure 1.1. Study Area

A key part of the study area is the Queensway crossing of the O-Train corridor. This bridge is to be replaced, and subsurface work will take place there.

1.2 Scope of Work

A COS is a general overview of a study area (more than one property) to identify properties/areas with the potential for site contamination. The results of a COS are generally used during transportation planning studies to assist in the selection of the preferred alternative, or the rejection of alternatives where potential environmental concerns may prove to be significant. As such, a COS is not a full environmental liability assessment of each property potentially impacted by the undertaking, and it does not constitute a Phase I Environmental Site Assessment (ESA) as defined by the Canadian Standards Association

(CSA Z768-01), and/or Ontario Regulation 153/04 (O.Reg. 153/04). In conducting a COS it is necessary to rank potential contaminant sources according to their likelihood of impacting construction activities. In the current study, rankings of “low”, “medium” or “high” are assigned on the basis of a number of factors including information about the potential source, the physical setting, and the contemplated construction activities. This is, by definition, a subjective exercise which is undertaken based on the available information and the professional judgement of the assessor.

The Scope of Work is to undertake a COS for the purpose described in the previous paragraph. The COS includes:

Records Review

The records review consisted of desk-top review of the following data sources:

a) Physiographic, Geological and Hydrogeological Maps and Reports

b) Historical and Current Aerial Photographs and Satellite Imagery

c) Government and Private Databases

d) Municipal Data

Site reconnaissance

This assessment included a “windshield” level site reconnaissance of the study area to broadly identify operations (e.g., gasoline sales), land use (e.g., industrial), or conditions (e.g., evidence of actual contamination) with the potential to cause contamination which could have an impact on construction activities. The site reconnaissance does not constitute a complete assessment of the study area, and it is noted that all observations were made from publicly accessible lands.

1.3 Contents of Report

This section of the report provides information on the context for the study, the scope of work and the layout of the report. Section 2 provides information on the physical setting of the study area necessary to assess the potential for contamination to impact the construction activities. Sections 3 and 4 summarize the results of the records review and site reconnaissance, respectively. Section 5 presents an analysis of the key findings collected during the study to determine the relative potential (high, moderate and low potential) for soil and groundwater contamination. Identified Areas of Potential Environmental Concern (APECs) are described in Section 6, while recommendations for further investigation, if any, are included in Section 7. The qualifications of the assessors are presented in Section 8, while limitations of the report are stated in Section 9. References are provided in Section 10. Figures, tables, and supporting documents are provided in the appendices.

2. PHYSICAL SETTING

2.1 Current Land Use

At the O-Train bridge, the land use beneath the bridge is rail transportation, while at all other sites, the land use beneath the bridge is road. Land use surrounding the bridge sites varies and includes residential, institutional (e.g., school), commercial (e.g., retail), and light industrial (e.g., warehousing).

2.2 Topography and Drainage

The study area is flat to gently rolling, but with a pronounced dip between approximately Bronson Avenue in the east and Bayswater Avenue in the west. The latter streets are high points for the study area, at 74 metres above sea level (masl), while the area between them, which is north of Dow's Lake, dips down to approximately 63 masl. The study area low point is the O-Train trench at approximately 53 masl. Drainage on streets and surrounding the bridge sites is collected by storm sewers, and there are no natural drainage features in the area. Drainage of the O-Train trench is by overland flow towards the north.

2.3 Physiography

According to Chapman and Putnam's "The Physiography of Southern Ontario" (1984), the study area falls within the Ottawa Valley Clay Plain, which is a broad valley with clay deposited at the bottom of the Champlain Sea approximately 13,000 to 10,000 years ago. The study area is mapped as drumlinized till plain, limestone plain and clay plain.

2.4 Geology

According to Ontario Geological Survey (2010) the surficial soils east of approximately Bank Street are fine-textured glaciomarine deposits of silt and clay, minor sand and gravel (massive to well laminated). West of approximately Bank Street, the surficial soils are mapped as either not present (bedrock at surface) or stone-poor, sandy silt to silty sand-textured till on Paleozoic terrain.

According to Armstrong and Dodge (2007), the Paleozoic bedrock geology of the study area consists of Upper and Middle Ordovician limestone, dolostone (as minor part of the Gull River Formation only) and shale. The area between O'Connor Street in the east and Holland Avenue in the west is transected by 5 faults and the following rock formations: Gull River, Bobcaygeon, Verulam, Lindsay and Billings.

2.5 Hydrogeology

The Middle Ordovician limestone, dolostone and shales are all of relatively low permeability, and are not known to be productive aquifers. The study area is highly urbanized, and serviced by City of Ottawa municipal water supply. There is no domestic use of groundwater, and no groundwater discharge to mapped surface water features. Groundwater does discharge to the O-Train trench year round, which flows northerly towards the Ottawa River.

3. RECORDS REVIEW

3.1 Reports and Other Background Information

Drawings for original construction of all twelve (12) bridge sites dating to approximately 1960 were reviewed. Also reviewed were drawings for rehabilitation of the bridges, dating to approximately 1983. No areas of environmental concern were noted during this drawing review.

The following reports were reviewed for the O-Train site:

Phase II Environmental Site Assessment, Champagne Corridor, South of Gladstone Avenue, Ottawa, Ontario, Draft Report, Intera Engineering Ltd., July, 2003.

The report documented a field investigation of a 0.4 hectare parcel east of the O-Train tracks, south of Gladstone, north of the Queensway, and west of the terminus of Louisa and St. Anthony Street, owned by the City of Ottawa and NCC. This study was a due diligence Phase II ESA to determine environmental concerns, for potential purchase by City of Ottawa of the NCC-owned parcel, and for planning purposes related to possible development of the property as a train station. The investigation consisted of excavating nine test pits, drilling six boreholes, installation of three (3) monitoring wells in bedrock, and collecting soil and groundwater samples for laboratory analysis. Fill with various amounts of asphalt, concrete, brick, metal, and glass was present across the site and in stockpiles containing higher proportions of asphalt and concrete. Only barium in one sample out of eight exceeded the Ministry of the Environment (MOE) Table B criteria for industrial / commercial land use (MOE, 1998), while the groundwater was found to entirely meet the same standards. Other than a recommendation to segregate the deleterious materials for landfill disposal, on-site management of the fill was recommended.

Phase II Environmental Site Assessment, City Works Yard, 175 Loretta Avenue, Ottawa, Ontario, Report, Golder Associates Ltd., October, 2003.

This report documented an intrusive investigation of the 175 Loretta Avenue parcel, including drilling three (3) boreholes near the underground storage tanks (USTs) and pump island in the northeast part of property, installation of three (3) monitoring wells, sampling of soil and groundwater, and comparison of results to MOE Table B criteria for industrial / commercial land use (MOE, 1998). Soil and groundwater were found to meet the standards and no further work was recommended.

Phase II Environmental Site Assessment, Existing Light Rail Right of Way, Ottawa, Ontario, Report for Marshall Macklin Monaghan by Golder Associates Ltd., October, 2005.

This report documented an intrusive investigation of the existing light rail right-of-way from Bayview at the northern limit to Huntclub Road at the southern limit. The investigation included drilling seventeen (17) boreholes, digging sixteen (16) test pits, installation of fifteen (15) monitoring wells, sampling of soil and groundwater, and comparison of results to MOE standards. The soil was found to be impacted with PHCs and metals above acceptable standards. Strong hydrocarbon odour and creosote odour were observed at some borehole locations. Additional investigation was recommended.

Phase I Environmental Site Assessment and Designated Substance Survey, 175 Loretta Avenue, Ottawa, Ontario, Final Report, Intera Engineering Ltd., October, 2005.

The report documented a Phase I ESA of the 1.0 hectare parcel west of the O-Train tracks, south of Gladstone, north of the Queensway and east of Loretta Avenue North, owned by the City of Ottawa. The Phase I ESA was conducted in accordance with CSA Standard Z768-01. The investigation found that the subject property had historically been used for industrial and commercial purposes and was currently being used as a paint shop and works yard complete with one (1) diesel above-ground storage tank (AST), one (1) diesel UST, one gasoline AST, and several traffic paint ASTs. The historical and present day land-use was considered to have the potential to have contaminated soil and groundwater, and a Phase II ESA was recommended. The historical records review also indicated that the property to the east of the O-Train tracks was previously a lumber yard (Sparks Estate), and that the area between Young Street and what is now the Queensway was developed from vacant to commercial between 1938 and 1965. (Note air photos: 1938, 1944, 1950, 1965, 1975, 1983, and 1999; and Fire Insurance Plans (FIPs) 1901, 1912, 1922, and 1956).

Phase II Environmental Site Assessment, 175 Loretta Avenue, Ottawa, Ontario, Final Report, Intera Engineering Ltd., August, 2006.

The report documented an intrusive investigation of the 175 Loretta Avenue parcel, including drilling of thirteen (13) boreholes, installation of six (6) monitoring wells, a geophysical survey (EM31), and collection of soil and groundwater samples for laboratory analysis. The results indicated the soil in two (2) boreholes near the east property boundary and within 25 m of the south property boundary contained petroleum hydrocarbons at concentrations greater than MOE Table 3 full depth generic standards for non-potable groundwater conditions and industrial/commercial land use and coarse-textured soils (MOE, 2004). Lead in groundwater was found to exceed the same standards in one (1) borehole near the north end of the property. Additional investigation of the identified petroleum hydrocarbon contamination was recommended.

Semi-Annual Groundwater Monitoring Program, 175 Loretta Avenue, Ottawa, Ontario, Report, AMEC Earth and Environmental, January, 2007.

This report documented the results of a semi-annual groundwater sampling program conducted at the 175 Loretta Avenue parcel. The report also documented the installation of one borehole with associated soil sampling. Petroleum hydrocarbons were not detected in either soil or groundwater.

2007 Semi-Annual Groundwater Monitoring Program, 175 Loretta Avenue, Ottawa, Ontario, Report, AMEC Earth and Environmental, January, 2008.

This report documented two rounds of groundwater sampling at the Loretta Avenue parcel conducted during 2007. Petroleum hydrocarbons were not detected in groundwater.

2009 Semi-Annual Groundwater Monitoring Program, 175 Loretta Avenue, Ottawa, Ontario, Report, AMEC Earth and Environmental, February, 2010.

This report documented two rounds of groundwater sampling at the Loretta Avenue parcel conducted during 2009. No free phase petroleum hydrocarbon was detected in any monitoring well, BTEX was not detected, but concentrations of petroleum hydrocarbons

(PHC) F3 and F4 were found to exceed MOE Table 3 full depth generic standards for non-potable groundwater conditions and industrial/commercial land use and coarse-textured soils (MOE, 2004).

2010 Semi-Annual Groundwater Monitoring Program, 175 Loretta Avenue, Ottawa, Ontario, Report, AMEC Earth and Environmental, October, 2010.

This report documented two rounds of groundwater sampling at the Loretta Avenue parcel conducted during 2010. No free phase petroleum hydrocarbon was detected in any monitoring well, BTEX was not detected, but concentrations of petroleum hydrocarbons (PHC) F3 and F4 were found to exceed MOE Table 3 full depth generic standards for non-potable groundwater conditions and industrial/commercial land use and coarse-textured soils (MOE, 2011).

Remediation of Petroleum Hydrocarbon Impacted Soil, City of Ottawa Private Fuel Outlet, 175 Loretta Avenue, Ottawa, Ontario, Report, AMEC Earth and Environmental, October, 2011.

This report documented the excavation of petroleum hydrocarbon impacted soil in July and August, 2011 from the area of the USTs and pump island in the northeast part of property. The excavation was 630 square metres in area and 3.5 m depth. Approximately 3,300 tonnes of contaminated soil was removed from the site. Over three hundred (303) verification samples were collected, and 27 were submitted for analysis of BTEX and PHCs. Exceedances of MOE (2011) Table 3 standards were found to remain along the northwest, north, and northeast walls of the excavation. Additional investigation was recommended.

Phase I Environmental Site Assessment, Champagne Corridor South of Gladstone Avenue, Ottawa, Ontario, Report, Intera Engineering Ltd. For the City of Ottawa, April 17, 2003.

This report documented a Phase I ESA of the Champagne Corridor south of Gladstone Avenue. The investigation split the study area into 4 Parcels of Land; Parcel N, Parcel E, Parcel S, and Parcel W. Parcel N was found to historically hold drums of waste toluene before taken off site by licensed contractor for disposal. Parcel S was found to historically contain fill piles, though quality of the piles is unknown. Parcel S was also identified to be part of British American Oil Company in the past and may be impacted by TPH in soil and groundwater. Parcel E historically was part of the railway with rail-line running directly through the property. Potential risk of creosote along with possible impacts from railway operations and cargo handling practices were identified. Parcel E currently covered with fill materials including asphalt, grave, concrete, and metal debris. The land use of area surrounding the study area include current and historical industrial and commercial land use. Parcel W was identified to be downgradient from a variety of commercial industries. Additional investigation was recommended including shallow soil sampling and groundwater monitoring.

Phase I Environmental Site Assessment, Canadian Pacific Railway, Ellwood Subdivision – Mile 0.0 to 4.99, Prescott Subdivision – mile 4.89 to 8.17, AMEC Earth & Environmental, March 2005.

This report documented a Phase I ESA of 13.3 km CPR from Ottawa River (northern limit) to Leitrim Road (southern limit). The investigation included review of 15 previous reports along with aerial photograph and government and private database review. The review identified significant areas of surface & subsurface heavy metal, PHC, and PAH soil impacts. However, due to the current site use at the time of the report, it was concluded the impacts would not pose potential risk to human health. It was also concluded that future development on the subject lands may pose a risk to human health. Additional investigation was recommended including assessment of previous un-investigated areas of potential environmental concerns, confirming site contamination conditions defined in previous reports, and further defining extent & magnitude of impact.

Phase I Environmental Site Assessment, Preliminary and Detail Design of the Champagne Pathway from Ottawa River Pathway to Young Street, Ottawa, Ontario, Paterson Group, April 17, 2012.

This report documented a Phase I ESA of proposed Champagne Pathway from Ottawa River Pathway to Young Street. The investigation included a historical review, site visit, and a geotechnical investigation. The historical review revealed the site was originally occupied by CNR line (Wellington to south of Gladstone) and CPR line (south of Gladstone to Young) and the surrounding properties had predominantly always been light industrial/commercial land use. Two former landfills north of Wellington and south of Ottawa River were also identified. Rail ties and ballasts potentially covered in creosote or other hazardous chemical were observed during the site visit. A monitoring well, considered part of the monitoring program for a former landfill, was also observed between Ottawa River Parkway and Scott Street. A geotechnical investigation was also carried out in 2011 on Scott-Somerset segment of the property. PHC and metals were detected but within MOE Table 3 standards. No groundwater was assessed as part of this investigation. Further investigation was recommended including testing of materials identified during geotechnical investigation, groundwater quality assessment, and disposal of railway ties.

Soil Characterization Program, Preliminary and Detailed Design of the Champagne Pathway from Ottawa River Pathway to Young Street, Ottawa, Ontario, Paterson Group, May 14, 2012.

This report documented a soil characterization program of the Champagne Pathway which included drilling of twelve (12) boreholes, installation of two (2) piezometers, and sampling and lab testing of soil. The soil was found to be mostly brown silty sand fill with gravel to depths of 1.8 to 2.4 m, with vapour readings between 0 and 10 ppm. The soil was found to be impacted by metals (lead), PHCs, and PAHs. Significant portions of the land were found to contain coal mixed with silty sand fill. Further testing of soil was recommended if the soil is to be taken off-site for disposal or moved on-site for fill.

Risk information determined from the report review is summarized in Table 3.1

Table 3.1. Summary of Information from Report Review

Location	Concern	Ranking
175 Loretta Ave. (Adjacent NW of O-Train Bridge)	Soil in excess of MOE Table 3 Standards for PHC in boreholes approximately 25 m north of O-Train Bridge – additional work recommended. It is noted that groundwater in installed monitoring wells did not exceed criteria.	Medium
O-Train Right-of-Way	Soils in the right-of-way are documented to be impacted by PHCs, metals, and creosote (PAHs)	Medium

3.2 Aerial Photographs and Satellite Imagery

Aerial photographs dated 1944, 1950, 1963, and 1978 for the O-Train Bridge were obtained from the National Air Photo Library (NAPL) in Ottawa, Ontario. Annotated versions of these photographs are included in Appendix A. More recent satellite imagery (2004 - 2009) was reviewed using Google Earth™, and 2012 Google Street View™ images were reviewed to augment findings from the site reconnaissance. The aerial photographs and satellite imagery were reviewed for information about land use in the study area, as it pertains to the potential contamination at the bridge sites. The findings of the review of historical aerial photographs are summarized in

Table 3.2. Important findings from the review of aerial photographs are as follows:

- Queensway alignment was occupied by a rail line prior to construction of the highway. The Canadian National Rail (CNR) tracks (now O-Train tracks) appear to have been an important part of the rail infrastructure, and there was a greater density of industrial land use and rail activity east of the CNR tracks than west. In particular the area at and south of the Queensway between Preston Street and Booth Street was heavily used as rail sidings and lumber storage prior to construction of the highway.
- The light industrial building at 47 Young Street, which is a few metres southwest of the O-Train bridge has existed for at least 63 years, essentially in its present-day form.

Table 3.2. Historical Aerial Photograph Findings (O-Train Bridge)

Date and Roll No.	Observations for O-Train Bridge and Surrounding Area
1944, A7194-5	***O-Train Bridge Site:*** Bridge for train over CNR Tracks ***North:*** CNR Tracks adjacent north and commercial/light industrial building with large parking lot to adjacent north west. Large structure located further north similar to current condition. Vacant land along rail tracks further north west. ***South:*** CNR Tracks adjacent south with vacant land to adjacent south east and south west. Residential property further south west and mixed residential and commercial properties further south east, similar to current conditions. ***East:*** Rail tracks to adjacent east. Tracks merge in from north west direction to the current Queensway to the adjacent east. Mixed residential and commercial buildings to the north and south east. Large vacant land further south east. ***West:*** Rail tracks to adjacent west. Mixed residential and commercial buildings to the north west and south west similar to current conditions. Large vacant land further south west.
1950, A12714-24	***O-Train Bridge Site:*** No change ***North:*** Large commercial/light industrial structure constructed on southern part of previously vacant land further north west. ***South:*** Commercial/light industrial structure constructed adjacent south west. ***East:*** No change ***West:*** New residential properties developed on part of previously vacant land further south east.
1963, VRR2430-31	***O-Train Bridge Site:*** Bridge widened and under construction for Queensway. ***North:*** Property lost due to Queensway construction and widening to the adjacent north west. Parking lot constructed adjacent to large commercial/light industrial structure further north west. ***South:*** Adjacent south east property cleared of trees. ***East:*** Queensway under construction. Property lost due to Queensway widening to the south and north east. ***West:*** Queensway under construction. Residential/commercial properties developed further south east, adjacent to the Queensway.
1978, A24852-46	***O-Train Bridge Site:*** Construction completed. ***North:*** New commercial/light industrial structure constructed to adjacent north west. Large commercial/light industrial structure expanded with new parking lot further north west. ***South:*** Road crossing CNR tracks replaced by pedestrian crossing over the tracks to the south. ***East:*** Queensway construction complete. Residential properties replaced by large commercial/institutional structure further north east. ***West:*** Queensway construction complete. Residential/commercial properties demolished and left vacant further south west, adjacent to the Queensway.

The inspection of historical satellite images and Google Street View™ identified the following information of note:

- Reflective paint is generally present on the ground surface at the City of Ottawa works yard at 175 Loretta Avenue from 2004 to 2009.
- The parking lot on Gladstone north of the O-Train bridge may have been used for debris or waste storage.
- Preston Square, which is an office and retail building on the east side of Preston Street approximately 60 m south of the bridge site was occupied by a gravel parking lot and small buildings in 2004.
- The former landfill at the corner of Young Street and Fairmont Avenue as identified in the Historical Land Use Information (HLUI) results does appear to have less lush vegetative cover than surrounding areas.

3.1 Government and Private Databases

EcoLog ERIS is a provider of current and historical environmental risk information for real estate. Search terms are provided by the user (in this case MH) and EcoLog ERIS returns a report on their electronic access of federal, provincial, and private sector databases. In this case, MH requested information on the following databases, using a 250 m search radius from the O-Train site:

- **Record of Site Condition, 1997-Sept 2001, Oct 2004-2012** This database documents Record of Site Condition (RSC) made to MOE's Brownfields Environmental Site Registry. The citations document the soil, groundwater and sediment standards which the site has been demonstrated to meet.
- **Fuel Storage Tanks, 1905-Feb 2003** The Petroleum Storage Tank database, which is maintained by Manitoba's Petroleum Storage Program, contains information in regard to company name, location, status, outlet type (retail, used oil, bulk/used…), number of tanks, tank capacity and tank status.
- **Contaminated Sites on Federal Land, June 2000-May 2012** The Treasury Board of Canada Secretariat maintains an inventory of all known contaminated sites held by various Federal departments and agencies.
- **Ontario Spills, 1988-2011** This database identifies information such as location (approximate), type and quantity of contaminant, and date of spill.
- **Orders, 1994-2012** This database is a subset taken from Ontario's Environmental Registry (EBR) database. It includes Orders on the registry potentially pertaining to site contamination, generally made under Ontario's Environmental Protection Act.
- **TSSA Fuel Storage Tanks, Current to June 2011** The Technical Standards & Safety Authority (TSSA), under the Technical Standards & Safety Act of 2000 maintains a database of registered private and retail fuel storage tanks in Ontario with fields such as location, tank status, license date, tank type, tank capacity, fuel type, installation year and facility type.

- **TSSA Historic Incidents, 2006-June 2009** This database includes spills and leaks from pipelines, diesel, fuel oil, gasoline, natural gas, propane and hydrogen recorded by the TSSA using an older system.
- **TSSA Incidents June 2009-Mar 2012** This database includes spills and leaks from pipelines, diesel, fuel oil, gasoline, natural gas, propane and hydrogen recorded by the TSSA.

The results of the EcoLog ERIS search are included in Appendix B. Of the databases searched, and based on professional judgment considering the nature of the citation, the setting, and the distance from the site and all related information, citations of highest concern are summarized in the Table 3.3.

Table 3.3. Summary of Information from EcoLog ERIS (O-Train Bridge)

Location	Concern	Ranking
175 Loretta Ave. North (Adjacent NW of O-Train Bridge)	**Fuel Storage Tanks** 1 22,700 L Single Wall UST – Gasoline 1 22,700 L Single Wall UST – Diesel	Medium
47A Young St. (Adjacent SW of O-Train Bridge)	**Scott's Manufacturing Listing** Lixar IT Inc. – Software (2009)	Medium
203 Louisa St. (100m N of O-Train Bridge)	**Scott's Manufacturing Listing** L'Ora di Ottawa – Newspaper Publisher (1968-69)	Low

Risk rankings in Table 3.3 are based mainly on other information. For example, it is known from the site inspection and report review that the USTs at the City of Ottawa Works Yard at 175 Loretta Avenue have been removed and replaced with an AST facility. Similarly the Intera (2003) report assessed soil quality in the land immediately east of the O-Train tracks and north of the bridge, without finding significant concern.

3.2 Municipal Data

Historical Land Use Inventory

City of Ottawa Real Estate Partnership and Development Office was contacted to obtain Historical Land Use Inventory (HLUI) data. The City of Ottawa's HLUI includes records documenting historical and present-day activities and facilities that pose contamination risk to property. A complete list of the HLUI data is located in Appendix A. Based on the review of the Historical Land Use Inventory, considering proximity to bridge site, geological conditions, topography, date of citation, nature of citation, and other factors all properties within 250 m of a bridge site were given a risk rating of high, medium, or low, which are shown in Figure 1 in Appendix C. Properties with a medium or high risk rating (risk of soil and/or groundwater contamination with the potential to impact construction) are listed in Table 3.4.

Table 3.4. Summary of Information from City of Ottawa HLUI

HLUI 2005 Activity ID	Name	Concern	Risk	Nearest Bridge(s)
3030	Capital Brass Works Limited	Industry	Medium	Parkdale Ave.
14757	Former Landfill	Landfill	High	Fairmont Ave.
6674	Hodgins Bros. Limited	Industry	Medium	O-Train
3630	City of Ottawa Works Yard	Industry	Medium	O-Train
2043	British American Oil Co. Limited[1]	Fuel and Oil	Medium	O-Train
14515	Generic Former Landfill ID	Landfill	Medium	Preston St., Bank St., Percy St.
2634	Central Iron Works	Industry	Medium	Rochester St., Booth St.
6487	J.R. Booth's Lumber Yard[1]	Industry	Medium	Rochester St., Booth St.
6509	Jason Plunkett[1]	Industry	Medium	Preston St., Rochester St., Booth St., Bronson Ave.
9888	Ottawa Hydro	Industry	Medium	Bronson Ave.
10218	Ottawa-Carleton District School Board	Fuel tanks	High[2]	Bronson Ave.
1965	McAuliffe Davis Lumber Co. Limited	Industry	Medium	Bronson Ave., Percy St.
6519	Grand Trunk Railway[1]	Industry	Medium	Bank St., O'Connor St.
3787	Elie Auto Body	Fuel and Oil	Medium	O'Connor St.

Notes

[1] British American Oil Co. J.R. Booth Lumber Yard, Jason Plunkett, and Grand Trunk Railway are all examples of industrial land which existed over the study area generally prior to construction of the Queensway, especially at the O-Train Bridge and easterly.

[2] According to MTO, the former Ottawa-Carleton District School Board building at 605 Bronson Avenue is slated to be demolished and the site decommissioned in 2013. This work is to be carried out by MTO.

4. SITE RECONNAISSANCE

Site reconnaissance was performed on April 17 and 18, 2013. Land uses of note with medium or high risk rating are summarized in Table 4.1. Locations of these sites are noted in Figure 2 of Appendix D.

Table 4.1. Summary of Land Uses Noted During Site Reconnaissance

Recon ID	Name	Concern	Risk	Nearest Bridge(s)
1	Fisher Summit Middle School	Fuel Tanks	Low	Holland Ave.
2	Ottawa Hydro Facility	PCBs	Low	Holland Ave.
3	Light Industry	Metals, Fuels	Medium	O-Train
4	City of Ottawa Works Yard	Metals, Fuels	Medium	O-Train
5	Young Street Garage	Fuel, Oil	Medium	O-Train
6	Commercial Building	Misc.	Low	O-Train, Preston St.
7	Modern Dry Cleaners	Solvents	Medium	Bronson Ave.
8	Gravel Parking Lot	Misc.	Low	Bronson Ave.
9	A1 Self Storage	Misc.	Low	Bronson Ave.
10	Vacant Institutional	Fuel Tanks	High[1]	Bronson Ave.
11	Hodge's Service Centre and Power Automotive Machine Shop	Metals, Fuels	Low	Bronson Ave.
12	Drummond's Gas Station	Gasoline Sales	Low	Bronson Ave.
13	Brownfield (old gas station)	Fuels	Low	Bronson Ave.
14	City of Ottawa Works Yard	Fuels	Medium	Percy St.
15	Commercial Building	Misc.	Low	Percy St.
16	MacEwan Gas Station	Gasoline Sales	Low	Bank St.
17	Griffin Automotive	Fuel, Oil	Medium	O'Connor St.

Notes

[1] According to MTO, the former Ottawa-Carleton District School Board building at 605 Bronson Avenue is slated to be demolished and the site decommissioned in 2013. This work is to be carried out by MTO.

5. KEY FINDINGS

The key finding is that current and historical land use on, adjacent to and in proximity to the bridge sites has varying potential to impact soil and/or groundwater quality during construction. Activities or land uses with a medium or high risk rating determined from the records review and/or site reconnaissance are summarized by bridge site in Table 5.1.

Table 5.1. Summary of Activity of Land Use with Medium to High Risk Rating

Bridge Site	Factor with Medium or High Risk
Holland Ave.	• None
Parkdale Ave.	• Medium: Capital Brass Works Limited from HLUI – location not certain
Fairmont Ave.	• High: Former Landfill immediately adjacent to bridge site on south east quadrant
Bayswater Ave.	• None
O-Train	• Medium: City of Ottawa Works Yard with potential soil and groundwater impact • Medium: Young Street Garage, risk of hydrocarbon contamination • Medium: 47A Young Street, Light industry immediately adjacent to bridge site • Medium: O-Train right-of-way, risk of metals, PHC and PAH soil contamination
Preston St.	• Medium: Jason Plunkett in HLUI, prior industrial land use • Medium: Generic Former Landfill ID in HLUI
Rochester St.	• Medium: Jason Plunkett in HLUI, prior industrial land use • Medium: Central Iron Works from HLUI, prior industrial land use • Medium J.R. Booth Lumber Yard, prior industrial land use
Booth St.	• Medium: Jason Plunkett in HLUI, prior industrial land use • Medium: Central Iron Works from HLUI, prior industrial land use • Medium J.R. Booth Lumber Yard, prior industrial land use
Bronson Ave.	• Medium: Modern Dry Cleaners, TCE use over decades • High: Vacant Institutional (former OCDSB), adjacent to bridge site, risk of fuel tanks • Medium: Jason Plunkett in HLUI, prior industrial land use • Medium: McAuliffe Davis Lumber Co. Limited, prior industrial land use • Medium: Ottawa Hydro from HLUI, location uncertain
Percy St.	• Medium: Generic Former Landfill ID in HLUI • Medium: McAuliffe Davis Lumber Co. Limited, prior industrial land use • Medium: City of Ottawa Works Yard, immediately adjacent to bridge site
Bank St.	• Medium: Generic Former Landfill ID in HLUI • Medium: Grand Trunk Railway, prior industrial land use
O'Connor St.	• Medium: Elie Auto Body/Griffin Automotive, across Isabella St., risk of hydrocarbons • Medium: Grand Trunk Railway, prior industrial land use

6. AREAS OF POTENTIAL ENVIRONMENTAL CONCERN

Based on the findings of this report, there is potential site contamination within the study area, which could have an impact on construction activities. To guide in management of these potential impacts, the following areas of potential environmental concern (APECs) are identified:

- **Area 1 – Queensway Alignment Generally, O-Train Bridge and East**. Prior to construction of the Queensway these lands were heavily industrialized with rail sidings and lumber yards. Based on this land use, there is some potential for metals and/or heavy oils contamination in soil.

- **Area 2 – Former Landfill at Young Street and Fairmont Avenue.** The City of Ottawa HLUI identifies this former landfill as having operated from 1928 to 1932 in the area between the Queensway, Fairmont Avenue, Kinnear Street, and wooded area extending north of Fairmont Park. Based on this land use, there is some potential for poor quality fill, and/or contamination.

- **Area 3 – City of Ottawa Works Yard at 175 Loretta Avenue North.** This current works yard is the site of historic USTs for gasoline and diesel fuel, present day ASTs, and on-going sign painting and other industrial activity. One recommendation for follow-on environmental site assessment work was noted at a site within 25 m of the O-Train bridge. Based on these factors, there is some potential for petroleum hydrocarbon and/or metals contamination in soil and groundwater.

- **Area 4 – O-Train Bridge Right-of-Way.** Various ESAs on the O-Train right-of-way have identified metals, PHC and PAH soil contamination.

- **Area 5 – O-Train Bridge, South Side**. A light industrial building has existed within a few metres of the O-Train Bridge site on the southwest side for at least 63 years, essentially in its current form. Also, a multi-bay automobile service centre exists on Young Street east of the O-Train tracks, approximately 40 m southeast of the O-Train Bridge. Given these land uses, there is some potential for soil and/or groundwater contamination

- **Area 6 – Modern Dry Cleaners, Corner of Catherine and Bronson.** A dry cleaning operation has existed approximately 50 m north of the Bronson bridge site since 1948 (Modern Dry Cleaners, 2013), and perchloroethylene (PCE) is used on site for dry cleaning. Given the long history, the recalcitrance of the compound (PCE, a known Dense Non-Aqueous Phase Liquid) and the proximity to the bridge, there is some potential for soil and/or groundwater contamination.

- **Area 7 – Former OCDSB Building, the Queensway and Bronson.** This is a large and apparently vacant building situated a few metres southeast of the Bronson Avenue bridge. Given the size of the building, there is some potential for it to be heated with fuel from USTs. There is some potential for soil and/or groundwater contamination. According to MTO staff, the building will be demolished and the site decommissioned in 2013 by MTO.

- **Area 8 – City of Ottawa Works Yard at 380 Catherine Street.** The proximity of this site to the Percy Street bridge and the potential for fuel storage mean there is some potential for soil and/or groundwater contamination.
- **Area 9 – Automotive Repair Shop, Corner of Isabella Street and O'Connor Street.** This automobile repair shop with a large parking lot is approximately 30 m south of the O'Connor Street bridge site. There is some potential that the parking lot was formerly a gasoline service station, and the current land use has some potential for petroleum hydrocarbon contamination.

Final Contamination Overview Study Report (July 2013)
Preliminary Design and Environmental Assessment Study for the Rehabilitation / Replacement of Ottawa Queensway Mid-town Bridges from Holland Avenue to O'Connor Street - G.W.P. 4075-11-00

7. RECOMMENDATIONS

Based on the results of this study, nine (9) APECs were identified, all of which have potential for site contamination which could impact construction activities. Recommendations to manage these potential impacts are as follows:

1. An Excess Materials Management Plan (EMMP) should be developed prior to construction to manage excess materials and groundwater generated during replacement or rehabilitation of the Queensway Mid-town Bridges.
2. The requirement for additional soil and groundwater investigation (Phase II ESA) at all bridge sites except Holland Avenue and Parkdale Avenue to address the APECs identified in this study should be determined once the scope of work to be conducted at each bridge site is known. The number and location of boreholes and the selection of chemical parameters (Contaminants of Concern) should be determined on a case-by-case basis considering the proposed construction activities, the specifics of the APEC, and the geological and hydrogeological setting. The Phase II ESA can be coordinated with the geotechnical investigation, where feasible.

8. QUALIFICATIONS OF THE ASSESSORS

Morrison Hershfield is an employee-owned firm providing integrated multidisciplinary engineering and related expertise. We deliver innovative, cost effective and technically sophisticated solutions to clients in the Industrial, Telecommunications, Transportation, Building Engineering, Land Development, and Life Sciences sectors. Our staff of approximately 850 serve North America and beyond from 10 Canadian offices (from St. John's NL in the east to Whitehorse YK in the north, to Victoria in the west) and 6 U.S. offices. Now in its 66th year in business, Morrison Hershfield is firmly entrenched as part of the Canadian engineering landscape.

Anthony West, Ph.D., P.Eng is a senior geo-environmental engineer with Morrison Hershfield Limited, and leader of this practice within the firm. He has approximately 20 years of experience in assessment and remediation of contaminated sites, groundwater flow and contaminant transport modelling, and hydrogeology. He is a registered professional engineer, first licensed in 1995. He has a B.A.Sc., M.Eng., and Ph.D., all in civil engineering, with water resources, contaminant transport, and fractured bedrock hydrogeology specializations, respectively. Dr. West was responsible for project management and technical oversight.

Douglas Ndambuki, M.Sc. is a Sustainability Planner with Morrison Hershfield, with a Masters in environmental protection and management systems. He has approximately 8 years of diverse experience in environmental and sustainability consulting. Mr. Ndambuki was responsible for elements of the records review and site reconnaissance.

Adel Chowdhury, B.Eng. is a geo-environmental engineer-in-training. He has approximately one year of diverse experience related to assessment of actual and potential soil and groundwater contamination, and to properties of the sub-surface. Mr. Chowdhury was responsible for elements of the records review, site reconnaissance, and reporting.

9. LIMITATIONS AND USE OF THE REPORT

This report has been prepared for the exclusive use of the Ministry of Transportation of Ontario (MTO), by Morrison Hershfield Limited (Morrison Hershfield). Morrison Hershfield hereby disclaims any liability or responsibility to any person or party, other than MTO, for any loss, damage, expense, fines, or penalties which may arise from the use of any information or recommendations contained in this report by a third party.

In preparing this report Morrison Hershfield has relied in good faith on information provided by individuals and companies noted in this report. Morrison Hershfield assumes that the information provided is factual and accurate, and accepts no responsibility for any deficiency, misstatements or inaccuracies contained in this report as a result of omissions, misinterpretations or fraudulent acts of the persons interviewed or contacted.

The report, which specifically includes all tables, figures and appendices is based on data and information collected during investigations conducted by Morrison Hershfield and is based solely on the conditions of the site at the time of the investigation, supplemented by historical information and data obtained by Morrison Hershfield as described in this report. No intrusive sampling or analysis was conducted as part of the Phase I ESA. Furthermore, no assurance is made regarding changes in conditions and/or the regulatory regime (standards, guidelines, etc.), subsequent to the time of investigation.

Morrison Hershfield has exercised professional judgment in collecting and analyzing the information and formulating recommendations based on the results of the study. The services performed as described in this report were conducted in a manner consistent with that level of care and skill normally exercised by other members of the engineering and science professions currently practicing under similar conditions, subject to the time limits and financial and physical constraints applicable to this study. No other warranty or representation is either expressed or implied, as to the accuracy of the information or recommendations included or intended in this report.

10. REFERENCES

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APPENDIX A: Aerial Photographs

Contamination Overview Study
Ottawa Queensway Mid-town
Bridges, GWP 4075-11-00

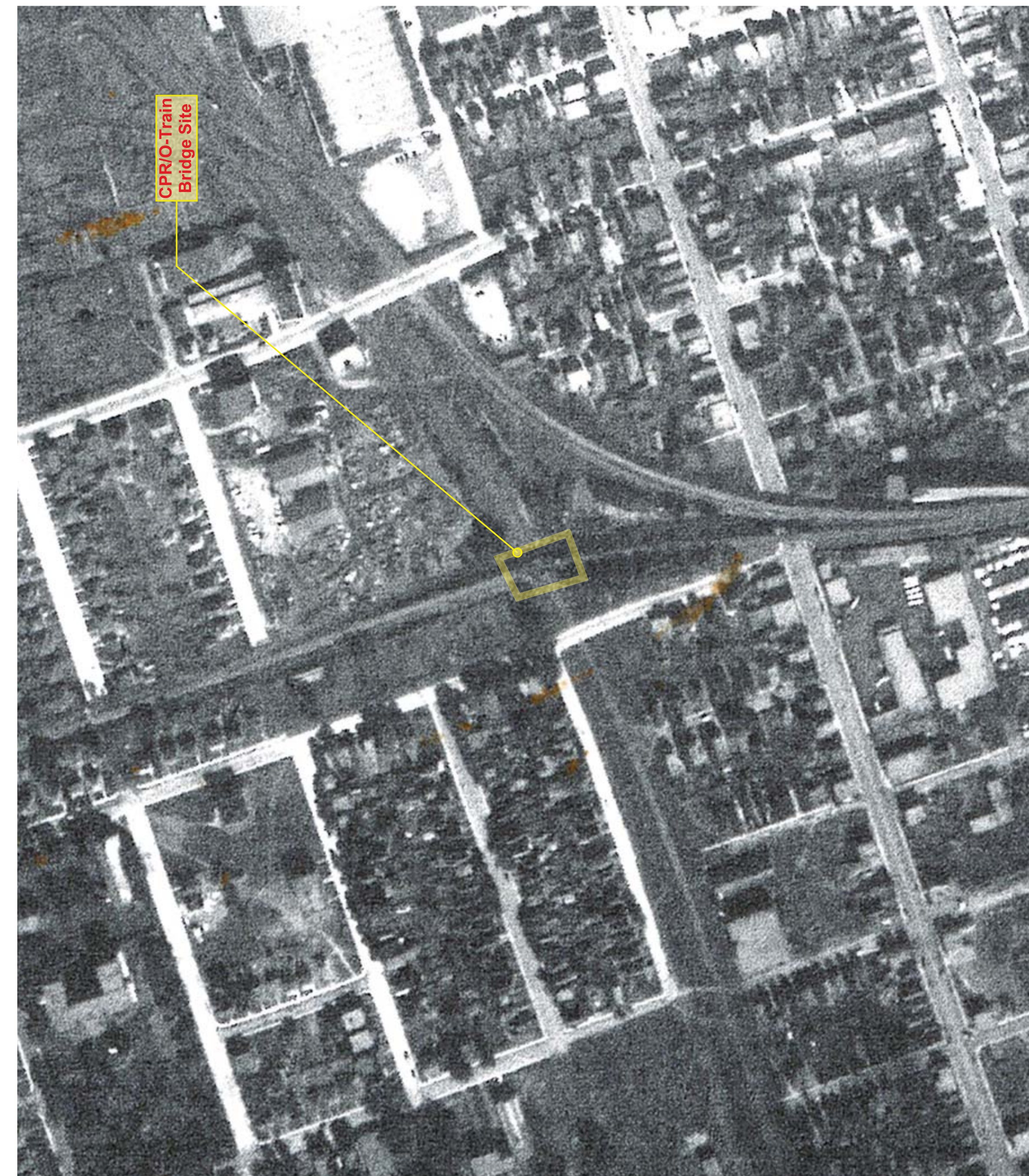
MORRISON HERSHFIELD

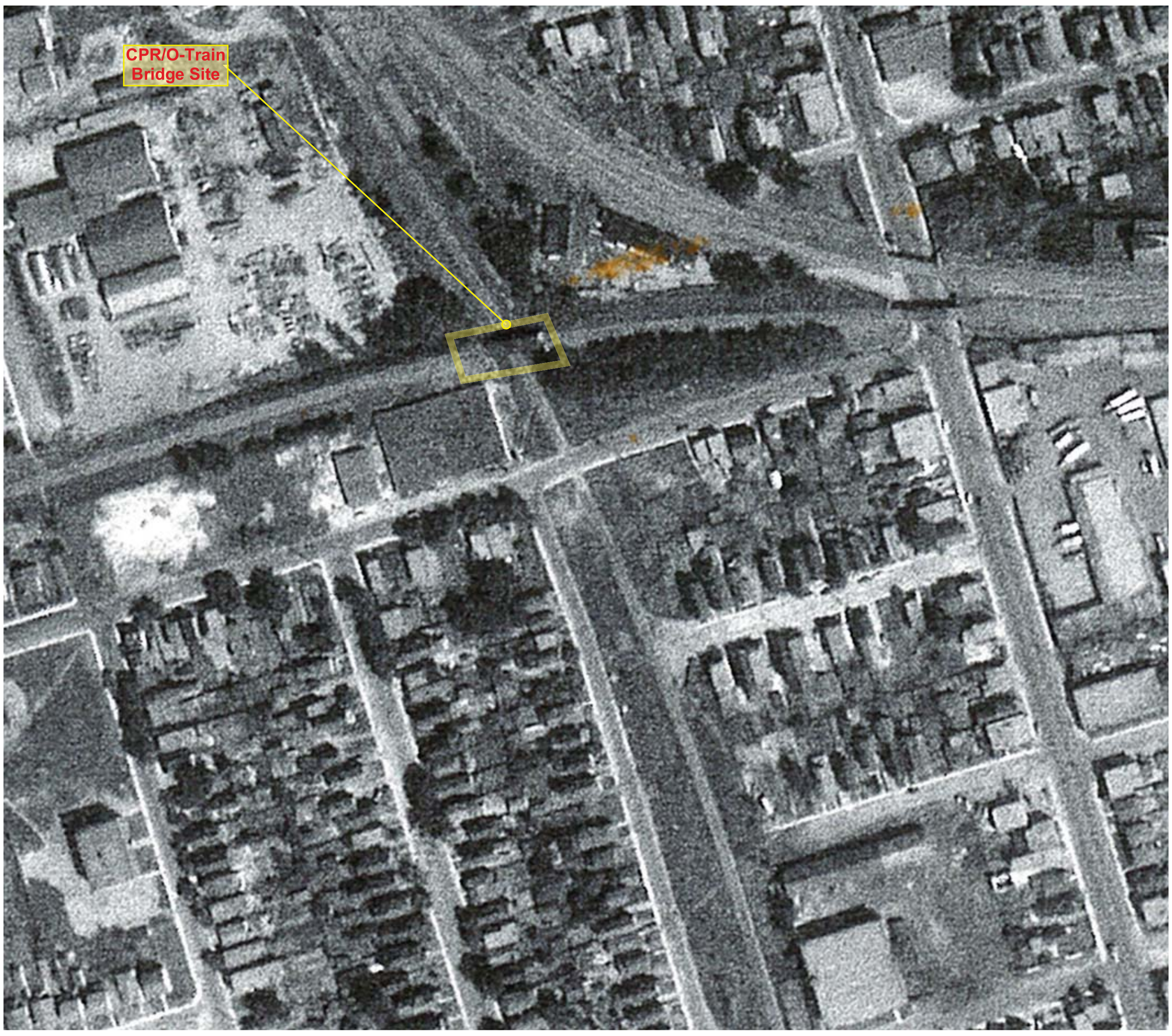
Aerial Photo 01

1944

A7194-5

N





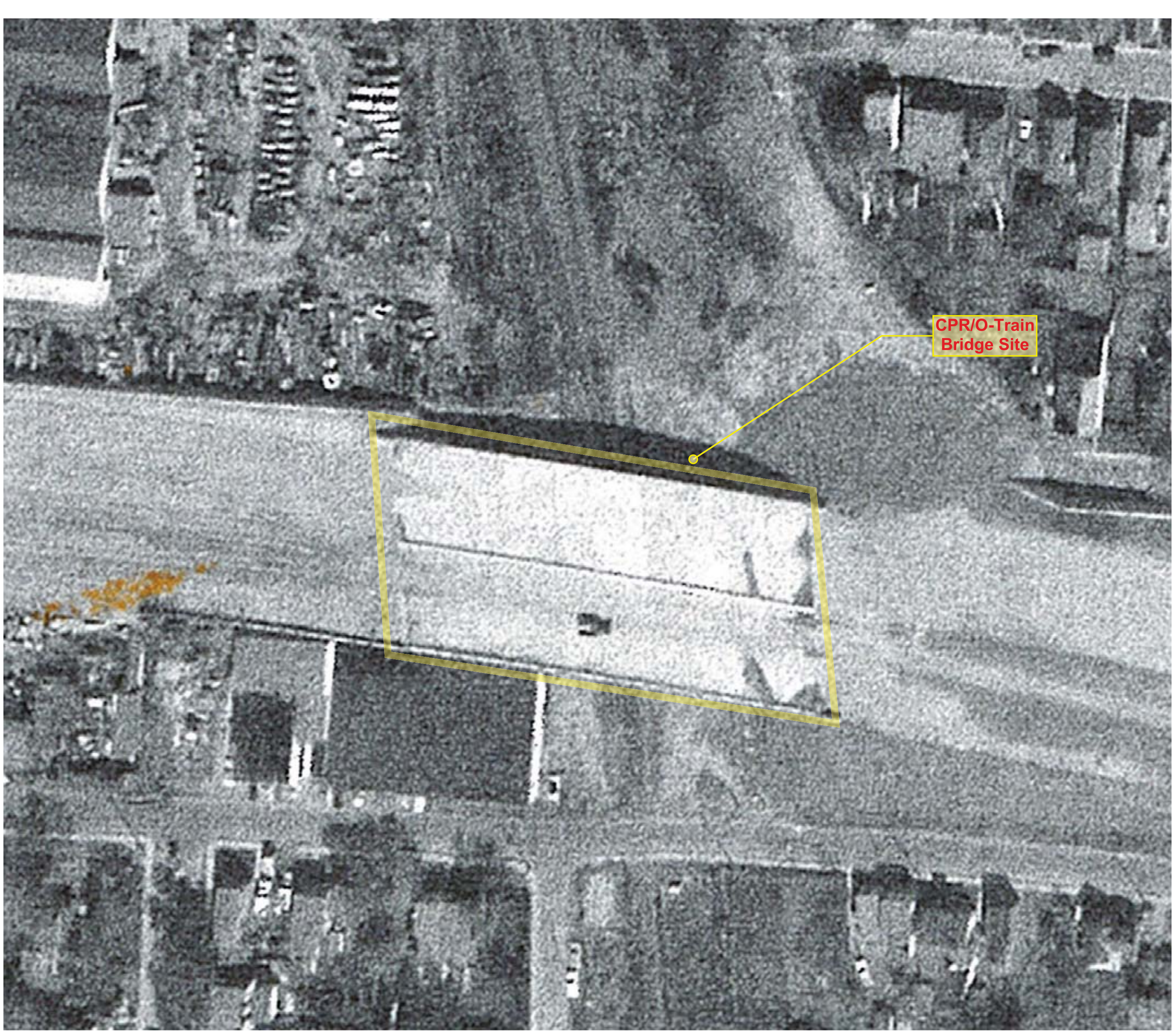
Aerial Photo 02

1950

A12714-24

MORRISON HERSHFIELD

Contamination Overview Study
Ottawa Queensway Mid-town
Bridges, GWP 4075-11-00

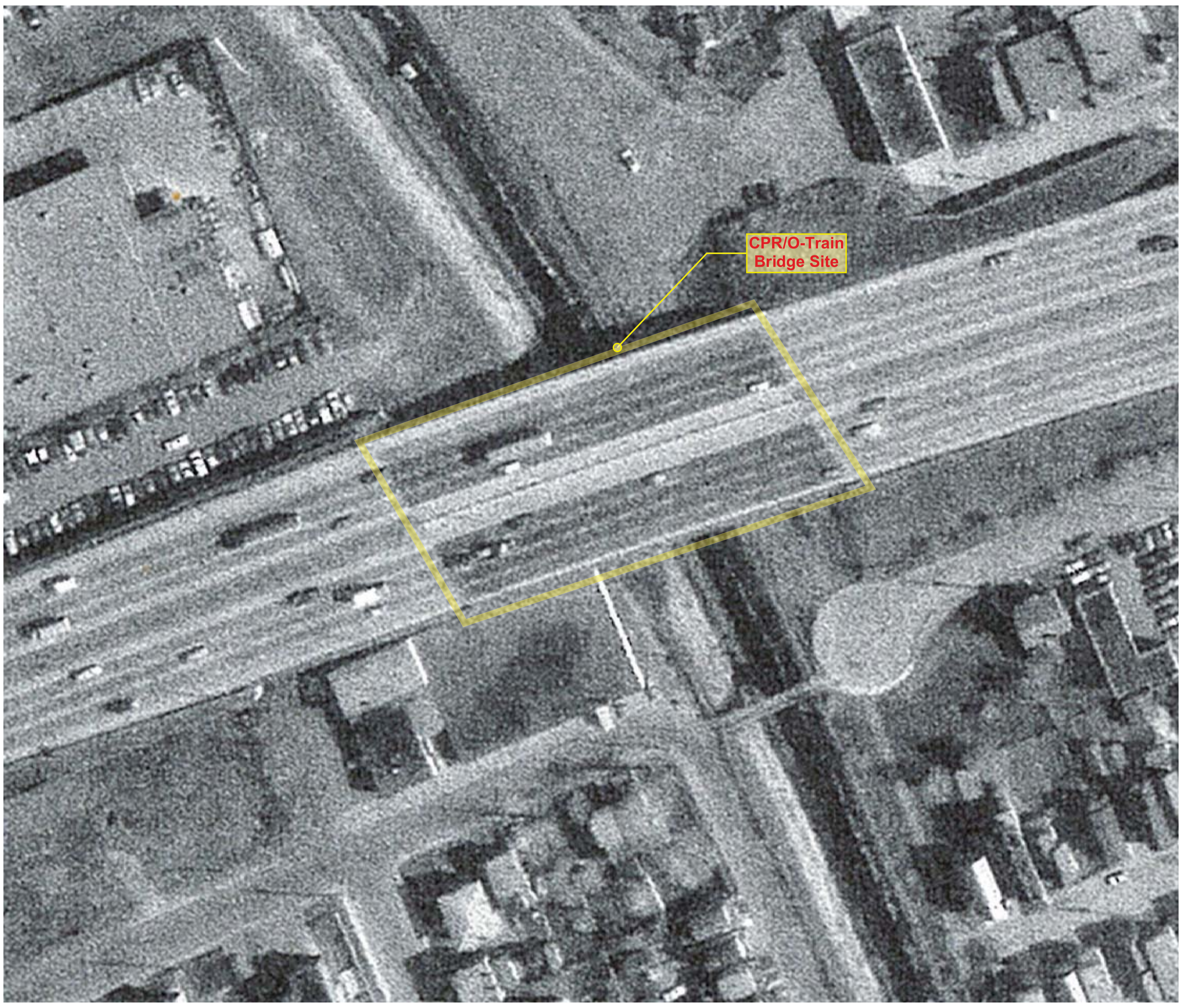


Aerial Photo 03

1963

VRR2430-31

MORRISON HERSHFIELD



Contamination Overview Study
Ottawa Queensway Mid-town
Bridges, GWP 4075-11-00

N

Aerial Photo 04

1978

A24852-46

MORRISON HERSHFIELD

Contamination Overview Study
Ottawa Queensway Mid-town
Bridges, GWP 4075-11-00

N

Aerial Photo 05

1987

A27211-171

MORRISON HERSHFIELD

Aerial Photo 06

1995

A28184-161

MORRISON HERSHFIELD

Contamination Overview Study
Ottawa Queensway Mid-town
Bridges, GWP 4075-11-00

Aerial Photo 07

2004

Google Earth

MORRISON HERSHFIELD

Contamination Overview Study
Ottawa Queensway Mid-town
Bridges, GWP 4075-11-00

Aerial Photo 08

2007

Bing Maps

MORRISON HERSHFIELD

N

APPENDIX B: Ecolog ERIS Report

Canada's Primary Environmental Risk Information Service

DATABASE REPORTS

Project Site:	Contamination Overview Study, Highway 417 Young Street & Loretta Avenue Ottawa, ON
Client:	Adel Chowdhury Morrison Hershfield 2240 Don Reid Drive Ottawa, ON K1H1E1
ERIS Project No:	20130110032
Report Type:	Standard Select Report - .25km Search Radius
Prepared By:	Rafal Wojtasik rwojtasik@eris.ca
Date:	January 21, 2013

ECOLOG ERIS Environmental Risk Information Services Ltd.

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Site Address: Young Street & Loretta Avenue Ottawa, ON
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Section

Report Summary — i
This outlines the number of records from each database that fall on the site, and within various distances from the site.

Site Diagram — ii
The records that were found within a specified distance from the project property (the primary search radius) have been plotted on a diagram to provide you with a visual representation of the information available. Sites will be plotted on the diagram if there is sufficient information from the database source to determine accurate geographic coordinates. Each plotted site is marked with an acronym identifying the database in which the record was found (i.e., WDS for Waste Disposal Sites). These are referred to as "Map Keys". A variety of problems are inherent when attempting to associate various government or private source records with locations. EcoLog ERIS has attempted to make the best fit possible between the available data and their positions on the site diagram.

Site Profile — iii
This table describes the records that relate directly to the property that is being researched.

Detail Report — iv
This section represents information, by database, for the records found within the primary search radius. Listed at the end of each database are the sites that could not be plotted on the locator diagram because of insufficient address information. These records will not have map keys. They have been included because they may be found to be relevant during a more detailed investigation.

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Appendix: Database Descriptions

Report Summary

Order Number: 20130110032
Site Name: Contamination Overview Study, Highway 417
Site Address: Young Street & Loretta Avenue Ottawa, ON
Report Type: Standard Select Report, 0.25 km Search Radius

Number of Mappable Records Surrounding the Site

Database		Selected	On-site	Within 0.25	0.25km to 2.00km	Total
AAGR	Abandoned Aggregate Inventory	N	0	0	0	0
AGR	Aggregate Inventory	N	0	0	0	0
AMIS	Abandoned Mine Information System	N	0	0	0	0
ANDR	Anderson's Waste Disposal Sites	N	0	0	13	13
AUWR	Automobile Wrecking & Supplies	N	0	0	4	4
BORE	Borehole	N	0	21	929	950
CA	Certificates of Approval	N	0	17	288	305
CFOT	Commercial Fuel Oil Tanks	N	0	0	0	0
CHEM	Chemical Register	N	0	0	0	0
COAL	Coal Gasification Plants	N	0	0	1	1
CONV	Compliance and Convictions	N	0	0	0	0
CPU	Certificates of Property Use	N	0	0	0	0
DRL	Drill Hole Database	N	0	0	0	0
EASR	Environmental Activity and Sector Registry	N	0	0	3	3
EBR	Environmental Registry	N	0	3	28	31
ECA	Environmental Compliance Approval	N	0	1	3	4
EEM	Environmental Effects Monitoring	N	0	0	0	0
EHS	ERIS Historical Searches	N	0	7	289	296
EIIS	Environmental Issues Information System	N	0	0	0	0
EXP	List of TSSA Expired Facilities	N	0	14	152	166
FCON	Federal Convictions	N	0	0	1	1
FCS	Contaminated Sites on Federal Land	Y	0	0	41	41
FOFT	Fisheries & Oceans Fuel Storage Tanks	N	0	0	0	0
FST	Fuel Storage Tank	Y	0	5	78	83
GEN	Ontario Regulation 347 Waste Generators Summary	N	0	36	1143	1179
HINC	TSSA Historic Incidents	Y	0	1	70	71
IAFT	Indian & Northern Affairs Fuel Tanks	N	0	0	0	0
INC	TSSA Incidents	Y	0	1	27	28
LIMO	Landfill Inventory Management Ontario	N	0	0	0	0
MINE	Canadian Mine Locations	N	0	0	0	0
MNR	Mineral Occurrences	N	0	0	6	6
NATE	National Analysis of Trends in Emergencies System (NATES)	N	0	0	0	0
NCPL	Non-Compliance Reports	N	0	0	0	0
NDFT	National Defence & Canadian Forces Fuel Storage Tanks	N	0	0	0	0
NDSP	National Defence & Canadian Forces Spills	N	0	0	0	0
NDWD	National Defence & Canadian Forces Waste Disposal Sites	N	0	0	0	0
NEES	National Environmental Emergencies System (NEES)	N	0	0	0	0
NPCB	National PCB Inventory	N	0	0	46	46
NPRI	National Pollutant Release Inventory	N	0	15	60	75
OGW	Oil and Gas Wells	N	0	0	0	0
OOGW	Ontario Oil and Gas Wells	N	0	0	2	2
OPCB	Inventory of PCB Storage Sites	N	0	0	32	32

Report Summary

Order Number: 20130110032
Site Name: Contamination Overview Study, Highway 417
Site Address: Young Street & Loretta Avenue Ottawa, ON
Report Type: Standard Select Report, 0.25 km Search Radius

Database		Selected	On-site	Within 0.25	0.25km to 2.00km	Total
ORD	Orders	Y	0	0	1	1
PAP	Canadian Pulp and Paper	N	0	0	6	6
PCFT	Parks Canada Fuel Storage Tanks	N	0	0	0	0
PES	Pesticide Register	N	0	0	44	44
PINC	TSSA Pipeline Incidents	N	0	0	24	24
PRT	Private and Retail Fuel Storage Tanks	N	0	3	59	62
PTTW	Permit to Take Water	N	0	0	6	6
REC	Ontario Regulation 347 Waste Receivers Summary	N	0	0	4	4
RSC	Record of Site Condition	Y	0	2	25	27
RST	Retail Fuel Storage Tanks	N	0	1	23	24
SCT	Scott's Manufacturing Directory	Y	0	14	271	285
SPL	Ontario Spills	Y	0	3	329	332
SRDS	Wastewater Discharger Registration Database	N	0	0	4	4
TANK	Anderson's Storage Tanks	N	0	0	0	0
TCFT	Transport Canada Fuel Storage Tanks	N	0	0	0	0
VAR	Variances for Abandonment of Underground Storage Tanks	N	0	0	1	1
WDS	Waste Disposal Sites - MOE CA Inventory	N	0	0	0	0
WDSH	Waste Disposal Sites - MOE 1991 Historical Approval Inventory	N	0	0	10	10
WWIS	Water Well Information System	N	0	6	151	157
		TOTAL	0	150	4,174	4,324

The databases chosen by the client as per the submitted order form are denoted in the 'Selected' column in the above table. Counts have been provided outside the primary buffer area for cursory examination only. These records have not been examined or verified, therefore, they are subject to change.

ECOLOG ERIS
Pinpointing Your Environmental Risks
80 Valleybrook Dr, Toronto, ON M3B 2S9
416-510-5204

Project Property: Contamination Overview Study, Highway 417
Young Street & Loretta Avenue
Ottawa, ON

ERIS Project #: 20130110032
Date: JAN-21-2013

LEGEND

Project Property
Database Location

Points of Interest
Chimney
Silo

Pipe & Transmission Lines
Pipeline
Transmission Line
Transmission Tower
Transformer Station

Rail
Railway - Main
Railway - Sidetrack
Railway - Abandoned
Bridge
Tunnel

Transportation - Other
Embankment
Trail
Runway

Hydrographic Features
Permanent Waterway
Intermittent Waterway
Open Reservoir
Dyke/Levee
Dam
Breakwall
Wetland

Landuse Classifications
Open Area
Residential
Commercial
Resource and Industrial
Government and Institutional
Parks and Recreational
Waterbody

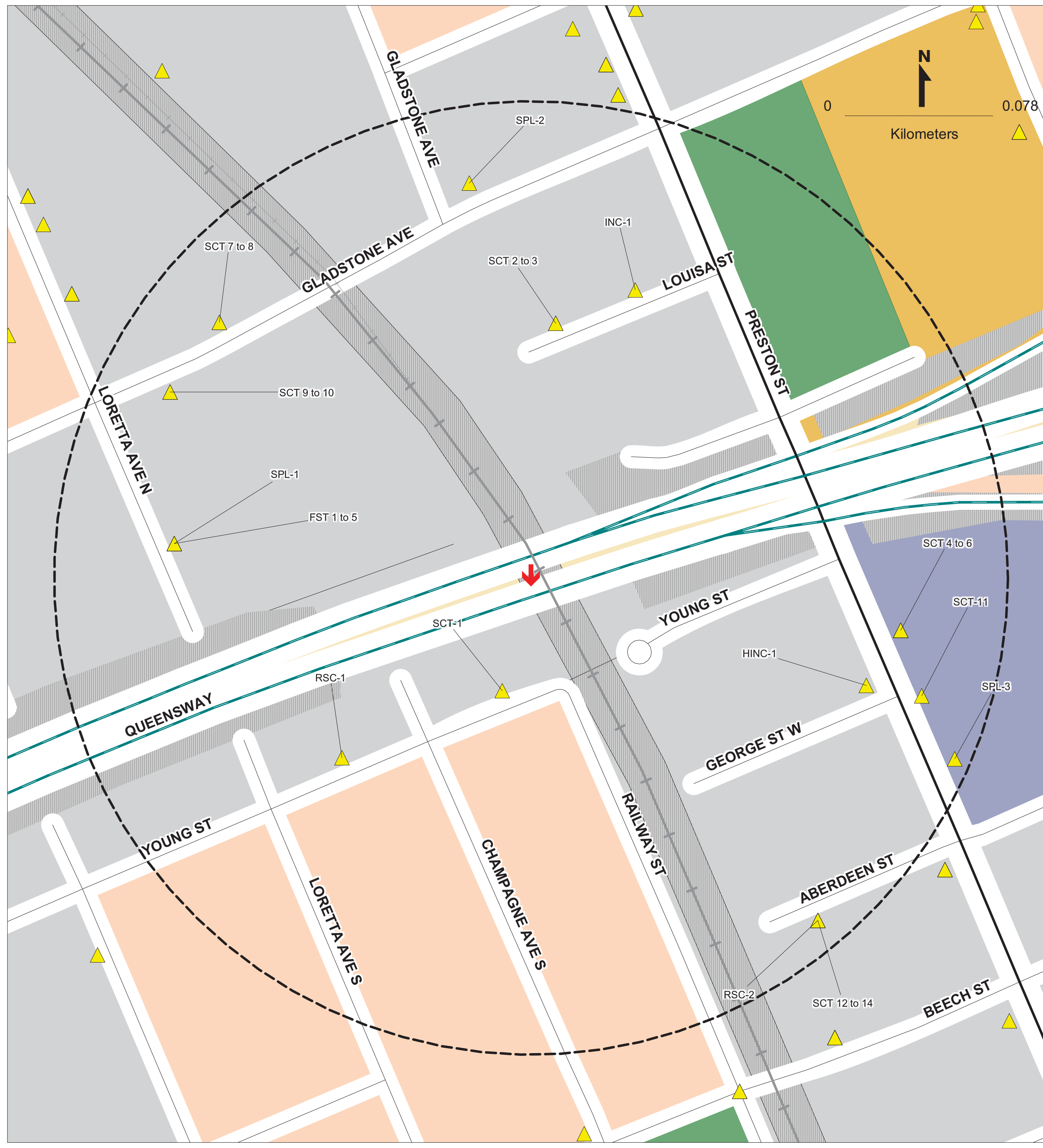
Recreation
Golf Course/Driving Range
Park/Sports Field
Other Recreation Area
Sports/Race Track
Cemetery
Campground

Vegetation
Wooded Area
Orchard
Vineyard

Industrial Resources
Conveyor
Crane: Moveable
Crane: Stationary
Tank
Rock Cut
Auto Wrecker
Lumber Yard
Pit

This diagram is to be used solely for relative street location purposes. It may not accurately portray street or site positions.

SITE DIAGRAM



Site Report

Order Number: 20130110032
Site Name: Contamination Overview Study, Highway 417
Site Address: Young Street & Loretta Avenue Ottawa, ON
Report Type: Standard Select Report, 0.25 km Search Radius

FOR COMPLETE INFORMATION, REFER TO DETAIL REPORT

A search has been conducted for this site (address) and company name. No records were found, within the database(s) selected, that meet either of these criteria.

Detail Report

Order Number: 20130110032
Site Name: Contamination Overview Study, Highway 417
Site Address: Young Street & Loretta Avenue Ottawa ON
Report Type: Standard Select Report, 0.25 km Search Radius

If information is required for sites located beyond the selected address, please contact your ERIS representative.

Fuel Storage Tank

TSSA Historic Incidents

TSSA Incidents

Record of Site Condition

Scott's Manufacturing Directory

Ontario Spills

Provincial Source Database

Fuel Storage Tank

Map Key	Company	Address	License Issue Date	Tank Status	Tank Status As Of	Operation Type	Facility Type
FST-1	REGIONAL MUNICIPALITY OF OTTAWA CARLETON ATTN : MARC LEVESQUE	175 LORETTA AV N OTTAWA K1Y 4L8	1/22/1991	Licensed	August 2007	Private Fuel Outlet	Gasoline Station - Self Serve

Status	Capacity (L)	Year of Installation	Corrosion Protection	Tank Fuel Type
Active	22700	1991		Liquid Fuel Single Wall UST - Gasoline
Active	22700	1991		Liquid Fuel Single Wall UST - Diesel

Map Key	Company	Address	License Issue Date	Tank Status	Tank Status As Of	Operation Type	Facility Type
FST-2	REGIONAL MUNICIPALITY OF OTTAWA CARLETON ATTN : MARC LEVESQUE	175 LORETTA AV N OTTAWA K1Y 4L8	1/22/1991	Licensed	December 2008	Private Fuel Outlet	Gasoline Station - Self Serve

Status	Capacity (L)	Year of Installation	Corrosion Protection	Tank Fuel Type
Active	22700	1991		Liquid Fuel Single Wall UST - Gasoline
Active	22700	1991		Liquid Fuel Single Wall UST - Diesel

Map Key	Company	Address	License Issue Date	Tank Status	Tank Status As Of	Operation Type	Facility Type
FST-3	REGIONAL MUNICIPALITY OF OTTAWA CARLETON ATTN : MARC LEVESQUE	175 LORETTA AV N OTTAWA K1Y 4L8			June 2011	Private Fuel Outlet	FS PRIVATE FUEL OUTLET - SELF SERVE

Status	Capacity (L)	Year of Installation	Corrosion Protection	Tank Fuel Type
Active	22700	1991	Sacrificial anode	Liquid Fuel Single Wall UST - Diesel
Active	22700	1991	Sacrificial anode	Liquid Fuel Single Wall UST - Gasoline

Map Key	Company	Address	License Issue Date	Tank Status	Tank Status As Of	Operation Type	Facility Type
FST-4	REGIONAL MUNICIPALITY OF OTTAWA CARLETON ATTN : MARC LEVESQUE	175 LORETTA AV N OTTAWA K1Y 4L8			June 2010	Private Fuel Outlet	FS PRIVATE FUEL OUTLET - SELF SERVE

Status	Capacity (L)	Year of Installation	Corrosion Protection	Tank Fuel Type
Active	22700	1991	Sacrificial anode	Liquid Fuel Single Wall UST - Diesel
Active	22700	1991	Sacrificial anode	Liquid Fuel Single Wall UST - Gasoline

Fuel Storage Tank

Map Key	Company	Address	License Issue Date	Tank Status	Tank Status As Of	Operation Type	Facility Type
FST-5	REGIONAL MUNICIPALITY OF OTTAWA CARLETON ATTN : MARC LEVESQUE	175 LORETTA AV N OTTAWA K1Y 4L8			January 2010	Private Fuel Outlet	FS PRIVATE FUEL OUTLET - SELF SERVE

Status	Capacity (L)	Year of Installation	Corrosion Protection	Tank Fuel Type
Active	22700	1991	Sacrificial anode	Liquid Fuel Single Wall UST - Diesel
Active	22700	1991	Sacrificial anode	Liquid Fuel Single Wall UST - Gasoline

TSSA Historic Incidents

Map Key	Company	Address	External File Num	Date of Occurrence	Fuel Occurrence Type	Fuel Type Involved
HINC-1		352 PRESTON STREET OTTAWA	FS INC 0809-05292	9/15/2008	Pipeline Strike	Natural Gas

Status Desc: Completed - Causal Analysis(End)
Job Type Desc: Incident/Near-Miss Occurrence (FS)
Oper. Type Involved: Construction Site (pipeline strike)
Service Interruptions: Yes
Property Damage: No
Fuel Life Cycle Stage: Transmission, Distribution and Transportation
Root Cause: Root Cause: Equipment/Material/Component:No Procedures:Yes Maintenance:No Design:Yes Training:No Management:No Human Factors:No
Reported Details:
Fuel Category: Gaseous Fuel
Occurrence Type: Incident
Affiliation: Industry Stakeholder (Licensee/Registration/Certificate Holder, Facility Owner, etc.)
County Name: Ottawa
Approx. Quant. Rel:
Nearby body of water:
Enter Drainage Syst.:
Approx. Quant. Unit:
Environmental Impact:

TSSA Incidents

Map Key	Company	Address	Incident ID	Incident Number	SR Type	Status Code
INC-1		179 LOUISA STREET, OTTAWA K1R 6Y9	2284250	133414	FS-Incident	Causal Analysis Complete

Summary:	179 LOUISA STREET, OTTAWA - 2" PIPELINE HIT
Drainage System:	
Sub Surface Contam.:	
Aff. Prop. Use Water:	
Contam. Migrated:	
Contact Natural Env.:	
Near Body of Water:	
Approx. Quant. Rel.:	
Equipment Model:	
Serial No:	
Residential App. Type:	
Commercial App. Type	
Industrial App. Type:	
Institutional App. Type:	
Venting Type:	
Vent Connector Mater.:	
Vent Chimney Mater.:	
Notes:	
Pipeline Type:	Main Distribution Pipeline
Pipeline Involved:	
Pipe Material:	Steel
Depth Ground Cover:	0.7
Regulator Location:	Outside
Regulator Type:	Service Regulator (up to 60 psi intake)
Operation Pressure:	60
Pipeline Notes:	
Liquid Prop Make:	
Liquid Prop Model:	
Liquid Prop Serial No:	
Equipment Type:	
Cylinder Capacity:	
Cylinder Capac. Units:	
Cylinder Material Type:	
Tank Capacity:	
Tank Material Type:	
Tank Storage Type:	
Tank Location Type:	
Pump Flow Rate Capac	
Liquid Prop Notes:	

Record of Site Condition

Map Key	Company	Address	Date Submitted	Date Acknowledg.	Date Returned	Certification Date	Soil Type	Restoration Type
RSC-1	4461916 Canada Corp	53 YOUNG ST, OTTAWA, ON, K1Y 3P5 K1S 5T5	26-Jan-11			29-Nov-10		

Registration #:	96114
Stratified (Y/N):	
Criteria:	
Consultant:	
District Office:	OTTAWA
Intended Prop Use:	Residential
Current Property Use:	Industrial
Certificate Prop Use #:	No CPU
Applicable Standards:	Full Depth Site Conditions Standard, with Nonpotable Ground Water, Coarse Textured Soil, for Residential/Parkland/Institutional property use
Legal Description:	PT BLK D, PL 73, PART 1, 5R8356; OTTAWA/NEPEAN
Prop. Identification #:	04106-0150 LT
Entire legal prop. (y/n):	Yes
UTM Coordinates:	NAD83 18-444107-5027820 (converted from Latitude & Longitude)
Latitude & Longitude:	45.40166670N 75.71416670W
Accuracy Estimate:	11 to 20 meters
Measurement Method:	Digitized from a satellite image
CPU Issued Sect 1686:	No

Map Key	Company	Address	Date Submitted	Date Acknowledg.	Date Returned	Certification Date	Soil Type	Restoration Type
RSC-2		80 Aberdeen St. Ottawa K1S 5R5	02/09/01	02/14/01			Medium/fine	Generic

Registration #:	
Stratified (Y/N):	N
Criteria:	Ind/Comm + Nonpotable
Consultant:	EAMIC Ltd.
District Office:	Ottawa
Intended Prop Use:	
Current Property Use:	
Certificate Prop Use #:	
Applicable Standards:	
Legal Description:	
Prop. Identification #:	
Entire legal prop. (y/n):	
UTM Coordinates:	
Latitude & Longitude:	
Accuracy Estimate:	
Measurement Method:	
CPU Issued Sect 1686:	

Scott's Manufacturing Directory

Map Key	Company	Address	Established	Plant Size (ft²)	Employment	SIC/NAICS Code	Description
SCT-1	Lixar IT Inc.	47A Young St Ottawa K1S 3H6	01-AUG-99			511210	Software Publishers
						518210	Data Processing, Hosting, and Related Services
						511210	Software Publishers
						541510	Computer Systems Design and Related Services
SCT-2	L'Ora di Ottawa (1987) Ltd.	203 Louisa St Ottawa K1R 6Y9	01-AUG-68			511110	Newspaper Publishers
SCT-3	L'ORA DI OTTAWA	203 LOUISA ST OTTAWA K1R 6Y9	1969	0	4	511110	Newspaper Publishers
SCT-4	Xerox Canada Ltd.	333 Preston St Floor 10 Ottawa K1S 5N4				417910	Office and Store Machinery and Equipment Wholesaler-Distributors
						418210	Stationery and Office Supplies Wholesaler-Distributors
						417910	Office and Store Machinery and Equipment Wholesaler-Distributors
SCT-5	MEAD JOHNSON CANADA	333 PRESTON ST SUITE 700 OTTAWA K1S 5N4	0000	0	300	311990	All Other Food Manufacturing
						312110	Soft Drink and Ice Manufacturing
						312130	Wineries
						312140	Distilleries
						311821	Cookie and Cracker Manufacturing
						2834	PHARMACEUTICAL PREPARATIONS
						311211	Flour Milling
						311230	Breakfast Cereal Manufacturing
						311340	Non-Chocolate Confectionery Manufacturing
						311410	Frozen Food Manufacturing
						311420	Fruit and Vegetable Canning, Pickling and Drying
						311814	Commercial Bakeries and Frozen Bakery Product Manufacturing

Scott's Manufacturing Directory

Map Key	Company	Address	Established	Plant Size (ft²)	Employment	SIC/NAICS Code	Description
SCT-6	Mead Johnson Nutritionals	333 Preston St Unit 700 Ottawa K1S 5N4	1907		70	414520	Toiletries, Cosmetics and Sundries Wholesaler-Distributors
						413190	Other Specialty-Line Food Wholesaler-Distributors
						414510	Pharmaceuticals and Pharmacy Supplies Wholesaler-Distributors
SCT-7	VESUVIO IRON LOGIC CUSTOM	949 GLADSTONE AVE OTTAWA K1Y 3E5	1972	1500	3	332329	Other Ornamental and Architectural Metal Products Manufacturing
SCT-8	VESUVIO IRON WORKS	949 GLADSTONE AVE OTTAWA K1Y 3E5	1972	1500	3	3446	ARCHITECTURAL AND ORNAMENTAL METAL WORK
SCT-9	DAVID BERMAN TYPOGRAPHICS LTD.	950 GLADSTONE AVE OTTAWA K1Y 3E6	0000	0	0	323120	Support Activities for Printing
SCT-10	TRADER MEDIA CORP.	950 GLADSTONE AVE OTTAWA K1Y 3E6	0000	0	20	511120	Periodical Publishers
SCT-11	TITUS	343 Preston St Suite 800 Ottawa K1S 1N4	01-MAR-05			541510	Computer Systems Design and Related Services
						511210	Software Publishers
						511210	Software Publishers
SCT-12	Hummingbird Ltd.	80 Aberdeen St Hummingbird Place Ottawa K1S 5R5		27000	110	417310	Computer, Computer Peripheral and Pre-Packaged Software Wholesaler-Distributors
SCT-13	Open Text Corporation	80 Aberdeen St Ottawa K1S 5R5	01-JUL-83	19000		511210	Software Publishers
						511210	Software Publishers
						541510	Computer Systems Design and Related Services
SCT-14	Overlay TV Inc.	80 Aberdeen St Suite 401 Ottawa K1S 5R5	01-FEB-07			511210	Software Publishers

Ontario Spills

Map Key	Company	Address	Ref No.	Incident Dt	MOE Reported Dt	Contaminant Name	Contaminant Quantity
SPL-1	KENT FUELS	175 LORETTA AVE. RMOC GARAGE TANK TRUCK (CARGO) OTTAWA CITY	79770	12/10/1992	12/10/1992		
SPL-2	UNKNOWN	933 GLADSTONE OTTAWA CITY K1A 0T4	231625	7/11/2002	7/11/2002		
SPL-3	Enbridge Gas<UNOFFICIAL>	Gas main in front of 347 Preston Street<UNOFFICIAL> Ottawa	4553-7JHMNK		9/15/2008	NATURAL GAS (METHANE)	0 other - see incident description
n/a	TOP VALU	PRESTON STREET, SOUTH OF GLADSTONE SERVICE STATION OTTAWA-CARLETON R.M.	42188	10/16/1990	10/16/1990		

SPL-1

Incident Summary: KENT FUELS - 25 L OF DIESEL FUEL TO GROUND DUE TO OVERFILL OF TANK
Incident Cause: UNDERGROUND TANK LEAK
Incident Reason: ERROR
Nature of Impact:
Receiving Medium: LAND
Environmental Impact: NOT ANTICIPATED

SPL-2

Incident Summary: TOW TRUCK:8L HYDRAULIC OIL TO GRD AND STORM SEW-ER, CLEANING
Incident Cause: PIPE/HOSE LEAK
Incident Reason: EQUIPMENT FAILURE
Nature of Impact: Water course or lake
Receiving Medium: LAND, WATER
Environmental Impact: POSSIBLE

SPL-3

Incident Summary: Enbridge, natural gas to atm, gas main strike, had locates
Incident Cause: Other Discharges
Incident Reason: Error- Operator error
Nature of Impact: Air Pollution; Human Health/Safety
Receiving Medium:
Environmental Impact: Possible

n/a

Incident Summary: TOP VALU- 5 L DIESEL FUELTO GROUND
Incident Cause: CONTAINER OVERFLOW
Incident Reason: ERROR
Nature of Impact: Water course or lake
Receiving Medium: LAND
Environmental Impact: POSSIBLE

Appendix: Ontario Database Descriptions

EcoLog Environmental Risk Information Services Ltd can search the following databases. The extent of historical information varies with each database and current information is determined by what is publicly available to EcoLog ERIS at the time of update. **Note:** Databases denoted with "*" indicates that the database will no longer be updated. See the individual database descriptions for more information.

Provincial Government Source Databases:

Abandoned Aggregate Inventory Up to Sept 2002 **AAGR**

The MAAP Program maintains a database of all abandoned pits and quarries. Please note that the database is only referenced by lot and concession and city/town location. The database provides information regarding the location, type, size, land use, status and general comments.

Aggregate Inventory Up to Jun 2011 **AGR**

The Ontario Ministry of Natural Resources maintains a database of all active pits and quarries. Please note that the database is only referenced by lot\concession and city/town location. The database provides information regarding the registered owner/operator, location, status, licence type, and maximum tonnage.

Abandoned Mines Information System 1800-Jan 2012 **AMIS**

The Abandoned Mines Information System contains data on known abandoned and inactive mines located on both Crown and privately held lands. The information was provided by the Ministry of Northern Development and Mines (MNDM), with the following disclaimer: "the database provided has been compiled from various sources, and the Ministry of Northern Development and Mines makes no representation and takes no responsibility that such information is accurate, current or complete". Reported information includes official mine name, status, background information, mine start/end date, primary commodity, mine features, hazards and remediation.

Borehole 1875-Aug 2011 **BORE**

A borehole is the generalized term for any narrow shaft drilled in the ground, either vertically or horizontally. The information here includes geotechnical investigations or environmental site assessments, mineral exploration, or as a pilot hole for installing piers or underground utilities. Information is from many sources such as the Ministry of Transportation (MTO) boreholes from engineering reports and projects from the 1950 to 1990's in Southern Ontario. Boreholes from the Ontario Geological Survey (OGS) including The Urban Geology Analysis Information System (UGAIS) and the York Peel Durham Toronto (YPDT) database of the Conservation Authority Moraine Coalition. This database will include fields such as location, stratigraphy, depth, elevation, year drilled, etc.
For all water well data or oil and gas well data for Ontario please refer to WWIS and OOGW.

Certificates of Approval 1985-Oct 30, 2011* **CA**

This database contains the following types of approvals: Air & Noise, Industrial Sewage, Municipal & Private Sewage, Waste Management Systems and Renewable Energy Approvals. The MOE in Ontario states that any facility that releases emissions to the atmosphere, discharges contaminants to ground or surface water, provides potable water supplies, or stores, transports or disposes of waste, must have a Certificate of Approval before it can operate lawfully. Fields include approval number, business name, address, approval date, approval type and status. This database will no longer be updated, as CofA's have been replaced by either Environmental Activity and Sector Registry (EASR) or Environmental Compliance Approval (ECA). Please refer to those individual databases for any information after Oct.31, 2011.

<u>TSSA Commercial Fuel Oil Tanks</u> 1948-Aug 2011 **CFOT**

Since May 2002, Ontario developed a new act where it became mandatory for fuel oil tanks to be registered with Technical Standards & Safety Authority (TSSA). This data would include all commercial underground fuel oil tanks in Ontario with fields such as location, registration number, tank material, age of tank and tank size.

<u>Inventory of Coal Gasification Plants and Coal Tar Sites</u> April 1987 and November 1988* **COAL**

This inventory includes both the "Inventory of Coal Gasification Plant Waste Sites in Ontario-April 1987" and the "Inventory of Industrial Sites Producing or Using Coal Tar and Related Tars in Ontario-November 1988) collected by the MOE. It identifies industrial sites that produced and continue to produce or use coal tar and other related tars. Detailed information is available and includes: facility type, size, land use, information on adjoining properties, soil condition, site operators/occupants, site description, potential environmental impacts and historic maps available. This was a one-time inventory.*

<u>Compliance and Convictions</u> 1989-2012 **CONV**

This database summarizes the fines and convictions handed down by the Ontario courts beginning in 1989. Companies and individuals named here have been found guilty of environmental offenses in Ontario courts of law.

<u>Certificates of Property Use</u> 1994-2012 **CPU**

This is a subset taken from Ontario's Environmental Registry (EBR) database. It will include all CPU's on the registry such as (EPA s. 168.6) - Certificate of Property Use.

<u>Drill Holes</u> 1886-Oct 2011 **DRL**

The Ontario Drill Hole Database contains information on more than 113,000 percussion, overburden, sonic and diamond drill holes from assessment files on record with the department of Mines and Minerals. Please note that limited data is available for southern Ontario, as it was the last area to be completed. The database was created when surveys submitted to the Ministry were converted in the Assessment File Research Image Database (AFRI) project. However, the degree of accuracy (coordinates) as to the exact location of drill holes is dependent upon the source document submitted to the MNDM. Levels of accuracy used to locate holes are: centering on the mining claim; a sketch of the mining claim; a 1:50,000 map; a detailed company map; or from submitted a "Report of Work".

<u>Environmental Activity and Sector Registry</u> Oct 31, 2011-2012 **EASR**

On October 31, 2011, a smarter, faster environmental approvals system came into effect in Ontario. The EASR allows businesses to register certain activities with the ministry, rather than apply for an approval. The registry is available for common systems and processes, to which preset rules of operation can be applied. The EASR is currently available for: heating systems, standby power systems and automotive refinishing. Businesses whose activities aren't subject to the EASR may apply for an ECA (Environmental Compliance Approval), Please see our ECA database.

<u>Environmental Registry</u> 1994-2012 **EBR**

The Environmental Registry lists proposals, decisions and exceptions regarding policies, Acts, instruments, or regulations that could significantly affect the environment. Through the Registry, thirteen provincial ministries notify the public of upcoming proposals and invite their comments. For example, if a local business is requesting a permit, license, or certificate of approval to release substances into the air or water; these are notified on the registry. Data includes: Approval for discharge into the natural environment other than water (i.e. Air) - EPA s. 9, Approval for sewage works - OWRA s. 53(1), and EPA s. 27 - Approval for a waste disposal site. For information regarding Permit to Take Water (PTTW), Certificate of Property Use (CPU) and (ORD) Orders please refer to those individual databases.

<u>Environmental Compliance Approval</u> Oct 31, 2011-2012 **ECA**

On October 31, 2011, a smarter, faster environmental approvals system came into effect in Ontario. In the past, a business had to apply for multiple approvals (known as certificates of approval) for individual processes and pieces of equipment. Today, a business either registers itself, or applies for a single approval, depending on the types of activities it conducts. Businesses whose activities aren't subject to the EASR may apply for an ECA. A single ECA addresses all of a business's emissions, discharges and wastes. Separate approvals for air, noise and waste are no longer required. This database will also include Renewable Energy Approvals. For CofA's prior to Nov 1st, 2011, please refer to the CA database. For all Waste Disposal Sites please refer to the WDS database.

<u>List of TSSA Expired Facilities</u> Current to Feb 2012 **EXP**

This is a list of all expired facilities that fall under the TSSA (TSS Act & Safety Regulations), including the six regulations that exist under the Fuels Safety Division. It will include facilities such as private fuel outlets, bulk plants, fuel oil tanks, gasoline stations, marinas, propane filling stations, liquid fuel tanks, piping systems, etc. These tanks have been removed and automatically fall under the expired facilities inventory held by TSSA.

<u>TSSA Fuel Storage Tanks</u> Current to Jun 2011 **FST**

The Technical Standards & Safety Authority (TSSA), under the *Technical Standards & Safety Act* of 2000 maintains a database of registered private and retail fuel storage tanks in Ontario with fields such as location, tank status, license date, tank type, tank capacity, fuel type, installation year and facility type.

<u>Ontario Regulation 347 Waste Generators Summary</u> 1986-Apr 2012 **GEN**

Regulation 347 of the Ontario EPA defines a waste generation site as any site, equipment and/or operation involved in the production, collection, handling and/or storage of regulated wastes. A generator of regulated waste is required to register the waste generation site and each waste produced, collected, handled, or stored at the site. This database contains the registration number, company name and address of registered generators including the types of hazardous wastes generated. It includes data on waste generating facilities such as: drycleaners, waste treatment and disposal facilities, machine shops, electric power distribution etc. This information is a summary of all years from 1986 including the most currently available data. Some records may contain, within the company name, the phrase "See & Use…" followed by a series of letters and numbers. This occurs when one company is amalgamated with or taken over by another registered company. The number listed as "See & Use", refers to the new ownership and the other identification number refers to the original ownership. This phrase serves as a link between the 2 companies until operations have been fully transferred.

<u>TSSA Historic Incidents</u> 2006-June 2009 **HINC**

This database will cover all incidences recorded by TSSA with their older system, before they moved to their new management system. TSSA's Fuels Safety Program administers the *Technical Standards & Safety Act* 2000, providing fuel-related safety services associated with the safe transportation, storage, handling and use of fuels such as gasoline, diesel, propane, natural gas and hydrogen. Under this Act, TSSA regulates fuel suppliers, storage facilities, transport trucks, pipelines, contractors and equipment or appliances that use fuels. We also work to protect the public, the environment and property from fuel-related hazards such as spills, fires and explosions. This database will include spills and leaks from pipelines, diesel, fuel oil, gasoline, natural gas, propane and hydrogen recorded by the TSSA.

<u>TSSA Incidents</u> June 2009-Mar 2012 **INC**

TSSA's Fuels Safety Program administers the *Technical Standards & Safety Act* 2000, providing fuel-related safety services associated with the safe transportation, storage, handling and use of fuels such as gasoline, diesel, propane, natural gas and hydrogen. Under this Act, TSSA regulates fuel suppliers, storage facilities, transport trucks, pipelines, contractors and equipment or appliances that use fuels. Includes incidents from fuel-related hazards such as spills, fires and explosions. This database will include spills and leaks from diesel, fuel oil, gasoline, natural gas, propane and hydrogen recorded by the TSSA.

Landfill Inventory Management Ontario 2010 LIMO

The Landfill Inventory Management Ontario (LIMO) database is updated every year, as the ministry compiles new and updated information. The inventory will include small and large landfills. Additionally, each year the ministry will request operators of the larger landfills complete a landfill data collection form that will be used to update LIMO and will include the following information from the previous operating year. This will include additional information such as estimated amount of total waste received, landfill capacity, estimated total remaining landfill capacity, fill rates, engineering designs, reporting and monitoring details, size of location, service area, approved waste types, leachate of site treatment, contaminant attenuation zone and more. The small landfills will include information such as site owner, site location and certificate of approval # and status.

Mineral Occurrences 1846-Nov 2011 MNR

In the early 70's, the Ministry of Northern Development and Mines created an inventory of approximately 19,000 mineral occurrences in Ontario, in regard to metallic and industrial minerals, as well as some information on building stones and aggregate deposits. Please note that the "Horizontal Positional Accuracy" is approximately +/- 200 m. Many reference elements for each record were derived from field sketches using pace or chain/tape measurements against claim posts or topographic features in the area. The primary limiting factor for the level of positional accuracy is the scale of the source material. The testing of horizontal accuracy of the source materials was accomplished by comparing the planimetric (X and Y) coordinates of that point with the coordinates of the same point as defined from a source of higher accuracy.

Non-Compliance Reports 1992(water only), 1994-2010 NCPL

The Ministry of the Environment provides information about non-compliant discharges of contaminants to air and water that exceed legal allowable limits, from regulated industrial and municipal facilities. A reported non-compliance failure may be in regard to a Control Order, Certificate of Approval, Sectoral Regulation or specific regulation/act.

Ontario Oil and Gas Wells 1800-Feb 2012 OOGW

In 1998, the MNR handed over to the Ontario Oil, Gas and Salt Resources Corporation, the responsibility of maintaining a database of oil and gas wells drilled in Ontario. The OGSR Library has over 20,000+ wells in their database. Information available for all wells in the ERIS database include well owner/operator, location, permit issue date, well cap date, licence no., status, depth and the primary target (rock unit) of the well being drilled. All geology/stratigraphy table information, plus all water table information is also provide for each well record.

Ontario Inventory of PCB Storage Sites 1987-Oct 2004 OPCB

The Ontario Ministry of Environment, Waste Management Branch, maintains an inventory of PCB storage sites within the province. Ontario Regulation 11/82 (Waste Management - PCB) and Regulation 347 (Generator Waste Management) under the Ontario EPA requires the registration of inactive PCB storage equipment and/or disposal sites of PCB waste with the Ontario Ministry of Environment. This database contains information on: 1) waste quantities; 2) major and minor sites storing liquid or solid waste; and 3) a waste storage inventory.

Orders 1994-2012 ORD

This is a subset taken from Ontario's Environmental Registry (EBR) database. It will include all Orders on the registry such as (EPA s. 17) - Order for remedial work, (EPA s. 18) - Order for preventative measures, (EPA s. 43) - Order for removal of waste and restoration of site, (EPA s. 44) - Order for conformity with Act for waste disposal sites, (EPA s. 136) - Order for performance of environmental measures.

Pesticide Register 1988-Mar 2011 PES

The Ontario Ministry of Environment maintains a database of all manufacturers and vendors of registered pesticides.

TSSA Pipeline Incidents June 2009-Mar 2012 PINC

TSSA's Fuels Safety Program administers the *Technical Standards & Safety Act* 2000, providing fuel-related safety services associated with the safe transportation, storage, handling and use of fuels such as gasoline, diesel, propane, natural gas and hydrogen. Under this Act, TSSA regulates fuel suppliers, storage facilities, transport trucks, pipelines, contractors and equipment or appliances that use fuels. This database will include spills, strike and leaks from recorded by the TSSA.

Private and Retail Fuel Storage Tanks 1989-1996* PRT

The Fuels Safety Branch of the Ontario Ministry of Consumer and Commercial Relations maintained a database of all registered private fuel storage tanks and licensed retail fuel outlets. This database includes an inventory of locations that have gasoline, oil, waste oil, natural gas and/or propane storage tanks on their property. The MCCR no longer collects this information. This information is now collected by the Technical Standards and Safety Authority (TSSA).

Permit to Take Water 1994-2012 PTTW

This is a subset taken from Ontario's Environmental Registry (EBR) database. It will include all PTTW's on the registry such as OWRA s. 34 - Permit to take water.

Ontario Regulation 347 Waste Receivers Summary 1986-2009 REC

Part V of the Ontario Environmental Protection Act ("EPA") regulates the disposal of regulated waste through an operating waste management system or a waste disposal site operated or used pursuant to the terms and conditions of a Certificate of Approval or a Provisional Certificate of Approval. Regulation 347 of the Ontario EPA defines a waste receiving site as any site or facility to which waste is transferred by a waste carrier. A receiver of regulated waste is required to register the waste receiving facility. This database represents registered receivers of regulated wastes, identified by registration number, company name and address, and includes receivers of waste such as: landfills, incinerators, transfer stations, PCB storage sites, sludge farms and water pollution control plants. This information is a summary of all years from 1986 including the most currently available data.

Record of Site Condition 1997-Sept 2001, Oct 2004-2012 RSC

The Record of Site Condition (RSC) is part of the Ministry of the Environment's Brownfields Environmental Site Registry. Protection from environmental cleanup orders for property owners is contingent upon documentation known as a record of site condition (RSC) being filed in the Environmental Site Registry. In order to file an RSC, the property must have been properly assessed and shown to meet the soil, sediment and groundwater standards appropriate for the use (such as residential) proposed to take place on the property. The Record of Site Condition Regulation (O. Reg. 153/04) details requirements related to site assessment and clean up.
RSCs filed after July 1, 2011 will also be included as part of the new (O.Reg. 511/09).

Ontario Spills 1988-2011 SPL

This database identifies information such as location (approximate), type and quantity of contaminant, date of spill, environmental impact, cause, nature of impact, etc. Information from 1988-2002 was part of the ORIS (Occurrence Reporting Information System). The SAC (Spills Action Centre) handles all spills reported in Ontario. Regulations for spills in Ontario are part of the MOE's Environmental Protection Act, Part X.

Wastewater Discharger Registration Database 1990-2011 SRDS

Information under this heading is combination of the following 2 programs. The Municipal/Industrial Strategy for Abatement (MISA) division of the Ontario Ministry of Environment maintained a database of all direct dischargers of toxic pollutants within nine sectors including: Electric Power Generation; Mining; Petroleum Refining; Organic Chemicals; Inorganic Chemicals; Pulp & Paper; Metal Casting; Iron & Steel; and Quarries. All sampling information is now collected and stored within the Sample Result Data Store (SRDS).

TSSA Variances for Abandonment of Underground Storage Tanks **Current to October 2011** **VAR**

The TSSA, Under the Liquid Fuels Handling Code and the Fuel Oil Code, all underground storage tanks must be removed within two years of disuse. If removal of a tank is not feasible, you may apply to seek a variance from this code requirement. This is a list of all variances granted for abandoned tanks.

Waste Disposal Sites - MOE CA Inventory **1970-2012** **WDS**

The Ontario Ministry of Environment, Waste Management Branch, maintains an inventory of known open (active or inactive) and closed disposal sites in the Province of Ontario. Active sites maintain a Certificate of Approval, are approved to receive and are receiving waste. Inactive sites maintain Certificate(s) of Approval but are not receiving waste. Closed sites are not receiving waste. The data contained within this database was compiled from the MOE's Certificate of Approval database. Locations of these sites may be cross-referenced to the Anderson database described under ERIS's Private Source Database section, by the CA number. All new Environmental Compliance Approvals handed out after Oct 31, 2011 for Waste Disposal Sites will still be found in this database.

Waste Disposal Sites - MOE 1991 Historical Approval Inventory **Up to Oct 1990*** **WDSH**

In June 1991, the Ontario Ministry of Environment, Waste Management Branch, published the "June 1991 Waste Disposal Site Inventory", of all known active and closed waste disposal sites as of October 30st, 1990. For each "active" site as of October 31st 1990, information is provided on site location, site/CA number, waste type, site status and site classification. For each "closed" site as of October 31st 1990, information is provided on site location, site/CA number, closure date and site classification. Locations of these sites may be cross-referenced to the Anderson database described under ERIS's Private Source Database section, by the CA number.

Water Well Information System **1955-2011** **WWIS**

This database describes locations and characteristics of water wells found within Ontario in accordance with Regulation 903. It includes such information as coordinates, construction date, well depth, primary and secondary use, pump rate, static water level, well status, etc. Also included are detailed stratigraphy information, approximate depth to bedrock and the approximate depth to the water table.

Federal Government Source Databases: Diagram Identifier:

Environmental Effects Monitoring **1992-2007*** **EEM**

The Environmental Effects Monitoring program assesses the effects of effluent from industrial or other sources on fish, fish habitat and human usage of fisheries resources. Since 1992, pulp and paper mills have been required to conduct EEM studies under the Pulp and Paper Effluent Regulations. This database provides information on the mill name, geographical location and sub-lethal toxicity data.

Environmental Issues Inventory System **1992-2001*** **EIIS**

The Environmental Issues Inventory System was developed through the implementation of the Environmental Issues and Remediation Plan. This plan was established to determine the location and severity of contaminated sites on inhabited First Nation reserves, and where necessary, to remediate those that posed a risk to health and safety; and to prevent future environmental problems. The EIIS provides information on the reserve under investigation, inventory number, name of site, environmental issue, site action (Remediation, Site Assessment), and date investigation completed.

Federal Convictions **1988-Jun 2007** **FCON**

Environment Canada maintains a database referred to as the "Environmental Registry" that details prosecutions under the Canadian Environmental Protection Act (CEPA) and the Fisheries Act (FA). Information is provided on the company name, location, charge date, offence and penalty.

Contaminated Sites on Federal Land **June 2000-Sept 2012** **FCS**

The Treasury Board of Canada Secretariat maintains an inventory of all known contaminated sites held by various Federal departments and agencies. This inventory does not include properties owned by Crown corporations, but does contain non-federal sites for which the Government of Canada has accepted some or all financial responsibility. All sites have been classified through a system developed by the Canadian Council of Ministers of the Environment. The database provides information on company name, location, site ID #, property use, classification, current status, contaminant type and plan of action for site remediation.

Fisheries & Oceans Fuel Tanks **1964-Sept 2003** **FOFT**

Fisheries & Oceans Canada maintains an inventory of all aboveground & underground fuel storage tanks located on Fisheries & Oceans property or controlled by DFO. Our inventory provides information on the site name, location, tank owner, tank operator, facility type, storage tank location, tank contents & capacity, and date of tank installation.

Indian & Northern Affairs Fuel Tanks **1950-Aug 2003** **IAFT**

The Department of Indian & Northern Affairs Canada (INAC) maintains an inventory of all aboveground & underground fuel storage tanks located on both federal and crown land. Our inventory provides information on the reserve name, location, facility type, site/facility name, tank type, material & ID number, tank contents & capacity, and date of tank installation.

National Analysis of Trends in Emergencies System (NATES) **1974-1994*** **NATE**

In 1974 Environment Canada established the National Analysis of Trends in Emergencies System (NATES) database, for the voluntary reporting of significant spill incidents. The data was to be used to assist in directing the work of the emergencies program. NATES ran from 1974 to 1994. Extensive information is available within this database including company names, place where the spill occurred, date of spill, cause, reason and source of spill, damage incurred, and amount, concentration, and volume of materials released.

National Defence & Canadian Forces Fuel Tanks **Up to May 2001*** **NDFT**

The Department of National Defence and the Canadian Forces maintains an inventory of all aboveground & underground fuel storage tanks located on DND lands. Our inventory provides information on the base name, location, tank type & capacity, tank contents, tank class, date of tank installation, date tank last used, and status of tank as of May 2001. This database will no longer be updated due to the new National Security protocols which have prohibited any release of this database.

National Defence & Canadian Forces Spills **Mar 1999-Aug 2010** **NDSP**

The Department of National Defence and the Canadian Forces maintains an inventory of spills to land and water. All spill sites have been classified under the "Transportation of Dangerous Goods Act - 1992". Our inventory provides information on the facility name, location, spill ID #, spill date, type of spill, as well as the quantity of substance spilled & recovered.

National Defence & Canadian Forces Waste Disposal Sites **2001-April 2007** **NDWD**

The Department of National Defence and the Canadian Forces maintains an inventory of waste disposal sites located on DND lands. Where available, our inventory provides information on the base name, location, type of waste received, area of site, depth of site, year site opened/closed and status.

National Environmental Emergencies System (NEES) **1974-2003** **NEES**

In 2000, the Emergencies program implemented NEES, a reporting system for spills of hazardous substances. For the most part, this system only captured data from the Atlantic Provinces, some from Quebec and Ontario and a portion from British Columbia. Data for Alberta, Saskatchewan, Manitoba and the Territories was not captured. However, NEES is also a repository for all previous Environment Canada spill datasets. NEES is composed of the historic datasets – or Trends – which dates from approximately 1974 to present. **NEES Trends** is a compilation of historic databases, which were merged and includes data from NATES (National Analysis of Trends in Emergencies System), ARTS (Atlantic Regional Trends System), and NEES. In 2001, the Emergencies Program determined that variations in reporting regimes and requirements between federal and provincial agencies made national spill reporting and trend analysis difficult to achieve. As a consequence, the department has focused efforts on capturing data on spills of substances which fall under its legislative authority only (CEPA and FA). As such, the NEES database will be decommissioned in December 2004.

National PCB Inventory **1988-2008** **NPCB**

Environment Canada's National PCB inventory includes information on in-use PCB containing equipment in Canada including federal, provincial and private facilities. All federal out-of-service PCB containing equipment and all PCB waste owned by the federal government or by federally regulated industries such as airlines, railway companies, broadcasting companies, telephone and telecommunications companies, pipeline companies, etc. are also listed. Although it is not Environment Canada's mandate to collect data on non-federal PCB waste, the National PCB inventory includes some information on provincial and private PCB waste and storage sites.

National Pollutant Release Inventory **1993-2010** **NPRI**

Environment Canada has defined the National Pollutant Release Inventory ("NPRI") as a federal government initiative designed to collect comprehensive national data regarding releases to air, water, or land, and waste transfers for recycling for more than 300 listed substances.

Parks Canada Fuel Storage Tanks **1920-Jan 2005** **PCFT**

Canadian Heritage maintains an inventory of all known fuel storage tanks operated by Parks Canada, in both National Parks and at National Historic Sites. The database details information on site name, location, tank install/removal date, capacity, fuel type, facility type, tank design and owner/operator.

Transport Canada Fuel Storage Tanks **1970-March 2007** **TCFT**

With the provinces of BC, MB, NB, NF, ON, PE, and QC; Transport Canada currently owns and operates 90 fuel storage tanks. This inventory will also include The Pickering Lands, which refers to the 7,530 hectares (18,600 acres) of land in Pickering, Markham and Uxbridge - owned by the Government of Canada since 1972. Properties on this land has been leased by the government since 1975, falls under the Site Management Policy of Transport Canada, but administered by Public Works and Government Services Canada. Our inventory provides information on the site name, location, tank age, capacity and fuel type.

Private Source Databases:

Anderson's Waste Disposal Sites **1860s-Present** **ANDR**

The information provided in this database was collected by examining various historical documents which aimed to characterize the likely position of former waste disposal sites from 1860 to present. The research initiative behind the creation of this database was to identify those sites that are missing from the *Ontario MOE Waste Disposal Site Inventory*, as well as to provide revisions and corrections to the positions and descriptions of sites currently listed in the MOE inventory. In addition to historic waste disposal facilities, the database also identifies certain auto wreckers and scrap yards that have been extrapolated from documentary sources. *Please note that the data is not warranted to be complete, exhaustive or authoritive. The information was collected for research purposes only.*

Automobile Wrecking & Supplies **2001-Jun 2010** **AUWR**

This database provides an inventory of all known locations that are involved in the scrap metal, automobile wrecking/recycling, and automobile parts & supplies industry. Information is provided on the company name, location and business type.

Chemical Register **1992, 1999-Jun 2010** **CHEM**

This database includes information from both a one time study conducted in 1992 and private source and is a listing of facilities that manufacture or distribute chemicals. The production of these chemical substances may involve one or more chemical reactions and/or chemical separation processes (i.e. fractionation, solvent extraction, crystallization, etc.).

ERIS Historical Searches **1999-Oct 2012** **EHS**

EcoLog ERIS has compiled a database of all environmental risk reports completed since March 1999. Available fields for this database include: site location, date of report, type of report, and search radius. As per all other databases, the ERIS database can be referenced on both the map and "Statistical Profile" page.

Canadian Mine Locations **1998-2009** **MINE**

This information is collected from the Canadian & American Mines Handbook. The Mines database is a national database that provides over 290 listings on mines (listed as public companies) dealing primarily with precious metals and hard rocks. Listed are mines that are currently in operation, closed, suspended, or are still being developed (advanced projects). Their locations are provided as geographic coordinates (x, y and/or longitude, latitude). As of 2002, data pertaining to Canadian smelters and refineries has been appended to this database.

Oil and Gas Wells **Oct 2001-2012** **OGW**

The Nickle's Energy Group (publisher of the Daily Oil Bulletin) collects information on drilling activity including operator and well statistics. The well information database includes name, location, class, status and depth. The main Nickles' database is updated on a daily basis, however, this database is updated on a monthly basis. More information is available at www.nickles.com.

Canadian Pulp and Paper **1999, 2002, 2004, 2005, 2009** **PAP**

This information is part of the Pulp and Paper Canada Directory. The Directory provides a comprehensive listing of the locations of pulp and paper mills and the products that they produce.

Retail Fuel Storage Tanks **2000-Jun 2010** **RST**

This database includes an inventory of retail fuel outlet locations (including marinas) that have on their property gasoline, oil, waste oil, natural gas and / or propane storage tanks. Information is provided on company name, location and type of business.

Scott's Manufacturing Directory **1992-Mar 2011** **SCT**

Scott's Directories is a data bank containing information on over 70,000 manufacturers in Ontario. Even though Scott's listings are voluntary, it is the most comprehensive database of Ontario manufacturers available. Information concerning a company's address, plant size, and main products are included in this database. This database begins with 1992 information and is updated annually.

Anderson's Storage Tanks **1915-1953*** **TANK**

The information provided in this database was collected by examining various historical documents, which identified the location of former storage tanks, containing substances such as fuel, water, gas, oil, and other various types of miscellaneous products. Information is available in regard to business operating at tank site, tank location, permit year, permit & installation type, no. of tanks installed & configuration and tank capacity. *Data contained within this database pertains only to the city of Toronto and is not warranted to be complete, exhaustive or authoritative. The information was collected for research purposes only.*

APPENDIX C: HLUI Report, Table and Figure

Table: HLUI Results

2005 Activity ID	1998 Activity ID	Name	Street Number	Street Name	Type of Facility	Pin Certainty	PIN	Waste Generator #	Storage Tanks	Comments	Risk
3030	5599	CAPITAL BRASS WORKS LIMITED	530	PARKDALE	Machine Shop Industry	2	04037-0189			M.1900, M.1910, M.1920, M.1930, M.1940, M.1950, Locksmithing at this location	Medium
8550		LIVING SPACES RENOVATION INC.	112	HAMILTON	Residential Building and Development	1	04035-0107			2005 Select Phone	Low
996		AKPAN QUALITY CLEANING SVC	486	PARKDALE	Service Industries Incidental to Air Transport	1	04037-0081			2005 Select Phone	Low
5417		G SAVONE CONSTRUCTION LIMITED	30	FOSTER	Residential Building and Development	1	04092-0050			2001 Employment Survey	Low
3477	2721	CHAS AULD'S SHELL	1088	GLADSTONE	Gasoline Service Stations	2	04092-0200			M.1960, M.1970, M.1980	Low
3963		DECON CONSTRUCTION & DESIGN	77	MELROSE	Residential Building and Development	1	04092-0204			2005 Select Phone	Low
1179	5062	B & N TRANSMISSION INC.	1086	GLADSTONE	Motor Vehicle Repair Shops	1	04092-0212			PID1994; SC98; 2005 Property Assessment	Low
14570	2465	VIAU PLASTERING CONTRACTOR (AT THE REAR)	0	ST. FRANCIS	Other Storage and Warehousing Industries	2	04093-0164			M.1955; FIP1901-116-852,vol2; FIP1912-116-852,vol2; FIP1922-116-852A,vol2; FIP1948-315-852,vol3; FIP1956-315-852,vol3.; Large yard shown on FIPs1948/1956.; 34 and 36, A & B	Low
3711		CONSTRUCT-RIGHT INC.	142	IRVING	Residential Building and Development	1	04099-0083			2005 Select Phone	Low
828		AM-TECH POWER SYSTEMS LIMITED	1041	GLADSTONE	Mechanical Specialty Work	1	04099-0104			2001 Employment Survey	Low
14757	7074	CORNER OF YONGE STREET AND FAIRMONT AVENUE FORMER LANDFILL			Site ID Ur-42; Operational Period around 1928 to 1932		SEE COMMENTS			Ur-42_Comments	High
11302		QUESNEL CONSTRUCTION	1028	GLADSTONE	Residential Building and Development	1	04100-0117			2005 Select Phone	Low
4037		CUROC CONSTRUCTION LIMITED	176	BAYSWATER	Residential Building and Development	1	04100-0224			2005 Select Phone	Low
10288		OTTAWA CHIMNEY SERVICES	152	BAYSWATER	Services to Buildings and Dwellings	1	04100-0233			2001 Employment Survey	Low
10262		PANTUSA TILE & MARBLE	964	GLADSTONE	Interior and Finishing Work	1	04106-0074			2001 Employment Survey	Low
2512		C CHAMPAGNE CARTAGE &	155	LORETTA	Exterior Close In Work	1	04107-0012			2001 Employment Survey	Low
13377	4377	THE CORP. OF THE CITY OF OTTAWA DISTRICT F	938	GLADSTONE	Other Utility Industries n.e.c.	1	04106-0144			M.1920, M.1948, M.1956; FIP1901-121-729,vol2; FIP1912-121-729,vol2; FIP1922-121-729,vol2; FIP1948-319-835; FIP1956-319-4-835; FIP1901 - lists 2 residences @ 128 - 130 & the rest of the block was vacant lots FIP1912, FIP1922 - residences	Low
6674	1296	HODGINS BROS. LIMITED	940	GLADSTONE	Fabricated Structural Metal Products Industries	1	04106-0145			M.1958, M.1960, M.1961, M.1964, M.1970, M.1980, S.1958, S.1961, S.1964, S.1965 Also listed as Hodgins Brothers Heating Equipment Manufactures. Listed at 1950 Scott in M. 1964	Medium
3630		CITY OF OTTAWA	175	LORETTA	Truck Transport Industries	1	04106-0147	ON0303108		2003 PID	Medium
1726		BONSALL COMMUNICATIONS	950	GLADSTONE	Motion Picture Laboratories and Video Production Facilities	1	04106-0148			2001 Employment Survey	Low
2043	7077	BRITISH AMERICAN OIL CO. LIMITED	0	ARLINGTON	Petroleum Products, Wholesale	2	04106-0303			Intera-1988a; The years of operation are not stated in the Intera reference, therefore they are unknown.The years of operation are not stated in the Intera reference, therefore they are unknown.	Medium
1005		ALAN NONTELL - MAINTENANCE SUPPORT	1010	SOMERSET	General Administrative Services	1	04107-0039	ON3451496		2003 PID; PLOUFFE PARK	Low
5492	2217	FEDERAL PAVING CO.	928	GLADSTONE	Highway and Heavy Construction	1	04106-0083			M.1960, M.1970, M.1980	Low
9960		OTTAWA SCHOOL OF ART	35	GEORGE	Elementary and Secondary Education	1	04106-0116	ON1379100		2000 PID	Low
8846	4997	MILANO AUTO BODY LIMITED	75	ABERDEEN	Gasoline Service Stations	1	04106-0136			SC98; 2005 Property Assessment	Low
15010	4219	Cream Clothing Company	95	BEECH	Clothing	1	04106-0143			SC98	Low
11387		PRESTON HARDWARE	248	PRESTON	Interior and Finishing Work	1	04107-0041			2005 Select Phone; #234	Low
15064	227	Servicenter	253	PRESTON	Medicine Manufacture	2	04108-0201			M.1900, M.1910, M.1920, M.1930, M.1940, M.1950	Low
12189	2215	SAL AUTO AND TRUCK SERVICE CENTRE	910	GLADSTONE	Motor Vehicle Repair Shops	1	04106-0079			M.1960, M.1970, M.1980	Low
10140		P B AUTO CENTRE	916	GLADSTONE	Motor Vehicles, Wholesale	1	04106-0080			2005 Select Phone	Low
10498	2729	PELOSO FUEL & HEATING SERVICE	24	GEORGE	Petroleum Products, Wholesale	1	04106-0122	ON1500400		M.1960, M.1970, M.1980; PID1994; 2000 PID	Low
848		A VIDEO MASTERS	356	PRESTON	Motion Picture Laboratories and Video Production Facilities	1	04106-0129			2005 Select Phone	Low
16		1202795 ONTARIO INC.	402	PRESTON	Motor Vehicle Repair Shops	1	04106-0137			2005 Property Assessment	Low
10467	1697	OTTAWA BAKERY LIMITED	0	PRESTON	Bakery Products Industries	1	04106-0097			M.1970, M.1971, S.1970/71	Low
14137	1232	TOP VALUE GASMARTS	284	PRESTON	Gasoline Service Stations	1	04106-0098			M.1960, M.1970, M.1980	Low
636		ADULT HIGH SCHOOL	300	ROCHESTER	Elementary and Secondary Education	1	04105-0001	ON0375211		2000 PID; ADULT HIGH SCHOOL	Low
2663	450	CHRISTIE, BROWN AND CO. LIMITED	355	PRESTON	Bakery Products Industries	1	04104-0027			M.1900, M.1910, M.1920, M.1930, M.1940, M.1950	Low
7777	2010	JOHNSON WELDING WORKS LIMITED	70	BEECH	Leather and Allied Products Industries	1	04104-0061	ON7040704		M.1900, M.1910, M.1920, M.1930, M.1940, M.1949, M.1950, M.1956, M.1960, M.1970, M.1980; SC98; FIP1901-124-742,Vol2; FIP1912-124-742,Vol2; FIP1922-124-742,Vol2; FIP1948-119-742B; FIP1956-119-3-742B 2003 PID	Low
14515		THIS IS A GENERIC FORMER LANDFILL ACTIVITY ID	0								Medium
4768		DOCUMENT COMPANY -XEROX	333	PRESTON	Other Machinery and Equipment Industries	1	04104-0067			2001 Employment Survey	Low
6509	3708	JASON PLUNKETT	261	BELL	Truck Transport Industries	2	04105-0194			M.1900, M.1910, M.1920, M.1930, M.1940, M.1950 - also listed as residence 1920 - Plunkett listed, but no mention of cartage	Medium

2005 Activity ID	1998 Activity ID	Name	Street Number	Street Name	Type of Facility	Pin Certainty	PIN	Waste Generator #	Storage Tanks	Comments	Risk
1959	3233	BUD'S ALIGNMENT AND BRAKE SERVICE	0	ROCHESTER	Motor Vehicle Repair Shops	2	04104-0298			M.1949, M.1956, M.1960, M.1970, M.1980; FIP1901-122-733B,vol2; FIP1912-122-733B,vol2; FIP1922-122-733B,vol2; FIP1948-118-733B,vol1; FIP1956-118-733B,vol1. 352 to 356	Low
2634	1638	CENTRAL IRON WORKS	496	BOOTH	Ornamental and Architectural Metal Products Industries	1	04105-0002			M.1958, M.1960, M.1961, M.1964, M.1970, M.1980; S.1958, S.1961, S.1964, S.1965	Medium
10711	1625	PURE SPRING (CANADA) LIMITED	22	ABERDEEN	Soft Drink Industry	1	04104-0066			M.1900-M.1964; S.1958, S.1961, S.1964, S.1965, S.1970/71; FIP1901-124-742,vol2; FIP1912-124-742,vol2; FIP1922-124-742,vol2; FIP1948-119-742A,vol1; FIP1956-119-1-742A; M.1948, M.1955.; Located at 869 Belfast Rd. in S.1970-1971.	Low
5283	4660	EXPORT LUMBER CO.	0	PRESTON	Lumber and Building Materials, Wholesale	2	04104-0028			M.1900-1956; FIP1901-124-742,vol2; FIP1901-126-750A-vol2; FIP1912-124-742,vol2; FIP1912 125-758A-vol2; FIP1922-124-742,vol2; Fip1922-125-750-vol2; FIP1948-119-742B,750; FIP1956-119-3-742B,750, M. 1949 - lists Ashton Press Manufacturing Co. Ltd. The Export Lumber Company's property is P shaped, therefore it extends further south on the west side than on the east.	Low
7605		LUSO CONSTRUCTION LIMITED	490	ROCHESTER	Residential Building and Development	1	04104-0056			2001 Employment Survey	Low
3070	1299	CARLING MOTORS BODY SHOP	410	ROCHESTER	Motor Vehicle Repair Shops	1	04104-0031			M.1960, M.1970, M.1980	Low
4397		GVT. OF CAN. - ENERGY MINES RESOURCES - MTL	556	BOOTH	General Administrative Services	1	04104-0151	ON0269506		2003 PID; A	Low
6487	925	J. R BOOTH'S LUMBER YARD	0	BOOTH	Lumber and Building Materials, Wholesale	2	04104-0153			M.1900, M.1910, M.1920, M.1930, M.1940, M.1949, M.1950, M.1956; FIP1901-126-752,Vol2; FIP1912-126-752,Vol2; FIP1922-126-752,Vol2; FIP1948-119-752,Vol2; FIP1956-119-4-752; In 1930 Company was located after Plymouth and CPR tracks, before # 619 Booth. In 1920 it was after Plymouth but before the CPR tracks and #619 Booth	Medium
4229	924	CROSSMAN LUDWIG	439	BOOTH	Industrial Chemicals Industries n.e.c.	1	04105-0012			M.1900, M.1910, M.1920, M.1930, M.1940, M.1950	Low
1215		BAIR-BAIR CONSTRUCTION LIMITED	66	LOUISA	Exterior Close In Work	1	04105-0030			2005 Select Phone	Low
6851		HOLLIDAY AUTO CENTRE	411	ARLINGTON	Motor Vehicle Repair Shops	1	04105-0040			2005 Property Assessment	Low
6526	2921	GRANT ELECTRIC OTTAWA LIMITED	204	LEBRETON	Other Repair Services	1	04105-0047			M.1960, M.1970, M.1980	Low
3912		DEPT. OF NATIONAL DEFENSE	360	LEBRETON	Defence Services	1	04104-0156	ON0046565		2000 PID; MAPPING & CHARTING ESTABLISHMENT	Low
14260	311	UNNAMED GARAGE	317	LEBRETON	Motor Vehicle Repair Shops	1	04104-0186			FIP1912-127-746B,vol2. FIP1922-127-746B,vol2. M.1921	Low
1917	4995	BUSINESS CARDS PLUS	221	PLYMOUTH	Commercial Printing Industries	1	04104-0319			SC98; 2005 Select Phone	Low
15082	1553	Department of Energy, Mines & Resources	300	LEBRETON	Government Department	1	04104-0152			M.1960, M.1970, M.1980	Low
14213		TRANS COMPUTER INC.	219	BELL	Electrical and Electronic Machinery, Equipment and Supplies, Wholesale	1	04105-0114			2001 Employment Survey	Low
9771		NEW EPOCH TRANSLATION & GRAPH	520	BRONSON	Combined Publishing and Printing Industries	1	04105-0167			2001 Employment Survey	Low
13076		SPEEDY AUTO SERVICE	540	BRONSON	Motor Vehicles, Wholesale	1	04105-0164			2005 Select Phone	Low
9888	6899	OTTAWA HYDRO	582	BRONSON	Electric Power Systems Industry	2	04104-0254	ON0456607		PID1994; PCBs on site	Medium
5006	661	DRUMMOND R & H S R	609	BRONSON	Gasoline Service Stations	1	04122-0537		FIP1956 -Five (5) underground gasoline tanks FIP1948 -Four (4) USTs	M.1900, M.1910, M.1920, M.1922, M.1930, M.1940, M.1949, M.1950, M.1956, M.1960, M.1970, M.1980; SC98; FIP1901-key,Vol2; FIP1912-129-777,Vol2; FIP1922-129-777; FIP1948-134-774A; FIP1956-134-1-777 2005 Property Assessment	Low
2496	1226	CANADIAN BLOOD SERVICES	85	PLYMOUTH	Medical and Other Health Laboratories	1	04104-0252	ON0269100		M.1960, M.1970, M.1980; SC98; 2000 PID; RIDEAU CENTRE	Low
5011	2588	DRUMMOND'S GAS	635	BRONSON	Gasoline Service Stations	1	04135-0208			M.1960, M.1970, M.1980; SC98 2005 Property Assessment	Low
4868	2589	ESSO	644	BRONSON	Gasoline Service Stations	1	04104-0122	ON8999238		M.1960, M.1970, M.1980; 2003 PID	Low
9468		OLD MARSH ENTERPRISES LIMITED	463	CAMBRIDGE	Laundries and Cleaners	1	04104-0125			2001 Employment Survey	Low
15049	946	Computing Devices Canada Ltd	475	CAMBRIDGE	Electronic Laboratory	2	04104-0127			M.1900, M.1910, M.1920, M.1930, M.1940, M.1950; Cambridge Laundry Ltd at this location in 1920.	Low
10218	4313	OTTAWA-CARLETON DISTRICT SCHOOL BOARD	605	BRONSON	Elementary and Secondary Education	1	04122-0536	ON7280038		MOEE PCB Inventory-1995; 2003 PID; Bronson Maintenance Shops	High
14515		THIS IS A GENERIC FORMER LANDFILL ACTIVITY ID	0								Low
14515		THIS IS A GENERIC FORMER LANDFILL ACTIVITY ID	0								Low
1965	5422, 4249	MCAULIFFE DAVIS LUMBER CO. LIMITED	105	CHAMBERLAIN	Lumber and Building Materials, Wholesale	2	04122-0532			M.1900, M.1910, M.1920, M.1922, M.1930, M.1940, M.1949, M.1950, M.1955, M.1956; FIP1912-73-490; FIP1912-73-492,vol1; FIP1922-73-492,vol1; FIP1948-132-491; FIP1956-132-491; ; FIP1948-132-492; FIP1956-132-492; Lumber shed, shaving shop, dry kiln, contractors yard, factory FIP1948, FIP1956-Rideau Distributors Ltd. hardware and machinery supply co. @ 41-43 Chamberlain St.; Unit 31	Medium
2708	4245, 4727	CITY OF OTTAWA	0	CHAMBERLAIN	Machine Shop Industry	2	04134-0103		2 oil tanks (rectangular), not noted above or below ground (1956, 1948) 6 oil tanks, (FIP1922), not noted under/above ground	M.1900, M.1910, M.1920, M. 1922, M.1930, M.1940, M. 1949, M.1950, M.1956, M.1960, M.1970, M.1980; FIP1912-73-489,vol1; FIP1922-73-489,vol1; FIP1948-132-489; FIP1956-132-489; FIP1912-73-490,vol1; FIP1922-73-490,vol1; FIP1948-132-490; FIP1956-132-490; 80 - 86 - 'FIP1912 - vacant lots 9 buildings include; offices, storage, garages, auto repair garage, machine shop, carpentry shop, paint shop; yard fills center of property - materials & lumber in open piles in yard - M. 1949 & 1960 - lists Sanitation @ #82 Chamberlain	Low
4746		DIVERCITY SERVICES INC.	201	ARLINGTON	Truck Transport Industries	1	04122-0365			2005 Select Phone	Low
14515		THIS IS A GENERIC FORMER LANDFILL ACTIVITY ID	0								Low
9763		NETWORKS UNLIMITED	44	CHAMBERLAIN	Communications and Energy Wire and Cable Industry	1	04134-0130			2001 Employment Survey	Low

2005 Activity ID	1998 Activity ID	Name	Street Number	Street Name	Type of Facility	Pin Certainty	PIN	Waste Generator #	Storage Tanks	Comments	Risk
3267		COMPUPARTS COMPUTERS &	54	CHAMBERLAIN	Electrical and Electronic Machinery, Equipment and Supplies, Wholesale	1	04134-0133			2001 Employment Survey	Low
750	782, 260, 2323	BERNEY & BLACK	10	CHAMBERLAIN	Motor Vehicle Repair Shops	1	04134-0125			FIP1912-73-494B,vol2. FIP1922-73-494B,vol2. FIP1948-136-494. M.1948, M.1900, M.1910, M.1920, M.1930, M.1940, M.1950	Low
3280		CLONES SOCIETY THE	30	CHAMBERLAIN	Electrical and Electronic Machinery, Equipment and Supplies, Wholesale	1	04134-0128			2001 Employment Survey	Low
9950		OXFORD PRODUCTIONS	601	BANK	Motion Picture Laboratories and Video Production Facilities	1	04133-0051			2005 Select Phone	Low
2536	1623	C. H. PETCH AND SONS LIMITED	0	STRATHCONA	Canvas and Related Products Industry	2	04133-0056			M.1900, M.1910, M.1912, M.1920, M.1930, M.1940, M.1948, M.1950, M.1955, M.1958, M.1961, S.1958, S.1961, S.1964, S.1965; FIP1901,Vol2; FIP1912-145-791B,Vol2; FIP1922-145-791B; FIP1948-136-791B; FIP1956-136-791B,Vol1; Tent Factory -Tarpaulins and Flags; 222 to 224	Low
399		ACCESS DIRECT SALES INC.	216	PRETORIA	Electrical and Electronic Machinery, Equipment and Supplies, Wholesale	1	04133-0003			2005 Select Phone	Low
223		ATKINSON STONECRAFT MASONRY	191	STRATHCONA	Exterior Close In Work	1	04133-0040			2005 Select Phone	Low
14492	4911	UNNAMED OIL SHEDS	0	BANK	Petroleum Products, Wholesale	2	04134-0094			M.1900, M.1910, M.1920, M.1930, M.1940, M.1950; - located west side, after CNR crossing, before Patterson's Creek & Clemow Ave.	Low
3556	133	COLONIAL ART GLASS COMPANY	586	BANK	Glass and Glass Products Industries	2	04134-0121			M.1900, M.1910, M.1920, M.1930, M.1940, M.1950	Low
6644	6892	VOYAGEUR COLONIAL LIMITED	265	CATHERINE	Public Passenger Transit Systems Industries	1	04122-0408	ON0340201		PID1994 2000 PID	Low
10123		OTTAWA-CARLETON DISTRICT SCHOOL BOARD - GLASHAN PUBLIC SCHOOL	28	ARLINGTON	Elementary and Secondary Education	1	04122-0407			2005 Property Assessment	Low
12179	3393	SAFETY VERMIN CONTROL	504	KENT	Services to Buildings and Dwellings	1	04122-0227	ON1926332		M.1960, M.1970, M.1980; 2003 PID; A	Low
9043		MCR SIGNS	502	BANK	Sign and Display Industry	1	04122-0199			2005 Select Phone	Low
8297		MACEWEN PETROLEUM INC.	512	BANK	Gasoline Service Stations	1	04122-0200			2005 Select Phone	Low
4896		EUROPEAN GLASS & PAINT CO LIMITED	488	BANK	Motor Vehicle Repair Shops	1	04122-0197			2001 Employment Survey	Low
1302		ARTIFEX DECORATIVE PAINTING	491	BANK	Interior and Finishing Work	1	04123-0003			2005 Select Phone	Low
14325	5695	UNNAMED AUTO PAINT SHOP	84	FLORA	Motor Vehicle Repair Shops	1	04122-0209			M.1949, M.1957; FIP1901-66-467,Vol2; FIP1912-66-467,Vol1; FIP1922-66-467,Vol1; FIP1948-131-467; FIP1956-131-467	Low
5577	1814	FLORA PRINTERS	45	FLORA	Commercial Printing Industries	1	04122-0067			FIP1901-66-466; FIP1912-66-466,vol1; FIP1922-66-466,vol1; FIP1948-131-466; FIP1956-131 466; M.1900, M.1910, M.1912, M.1920, M.1930, M.1940, M.1949, M.1950, M.1957; 1930 - lists Patterson Printers	Low
2924	202	CANE'S CAR SERVICE	390	MCLEOD	Gasoline Service Stations	2	04122-0062			M.1900, M.1910, M.1920, M.1930, M.1940, M.1950, M.1960, M.1970, M.1980; - Welch & Johnston Ltd. likely changed address to 400 in 1980	Low
2431		CBM ELEVATOR LIMITED	258	ARGYLE	Other Trade Work	1	04123-0023	ON7231419		2003 PID	Low
4674		DYNOMIGHT CARTOONS	205	CATHERINE	Motion Picture Laboratories and Video Production Facilities	1	04123-0006			2005 Select Phone	Low
11124	5155	PROCESS PHOTO CENTRE LIMITED	203	CATHERINE	Camera and Photographic Supply Stores	1	04123-0021	ON1426200		PID1994; SC98; 2000 PID	Low
14515		THIS IS A GENERIC FORMER LANDFILL ACTIVITY ID	0								Low
8514	5154	LES FRERES PROULX BROTHERS INC.	141	CATHERINE	Commercial Printing Industries	1	04123-0020	ON1061101		PID1994; SC98; 2000 PID; SUITE 101	Low
9957	578, 3439	SANITARY LAUNDRY & DRY CLEANERS	255	ARGYLE	Laundries and Cleaners	1	04123-0031			FIP1901-66-470; FIP1912-66-470,vol1; FIP1922-66-470,vol1; FIP1948-131-470, FIP1956-131 470; M.1900, M.1910, M.1920, M.1930, M.1940, M.1949, M.1950, M.1957; M.1949 lists as 'Ottawa Sanitary Cleaners'.	Low
3051		CAPITAL PUBLISHERS	226	ARGYLE	Combined Publishing and Printing Industries	1	04123-0015			2005 Select Phone	Low
9065	764	MCDOUGALL MICROFILMS LIMITED	219	ARGYLE	Platemaking, Typesetting and Bindery Industry	1	04123-0036			S.1958, s.1961, S.1964-65, M.1958, M.1961; Listed at 414 Laurier Ave West in Mights 1961 Directory.	Low
9558	442	NATIONAL PRINTERS LIMITED	0	O'CONNOR	Commercial Printing Industries	1	04123-0053			M.1900, M.1910, M.1920, M.1930, M.1940, M.1948, M.1950, M.1955; FIP1901-67-475A; FIP1912-75-475A,Vol1; FIP1922-75-475A,Vol1; FIP1948-137-475A; FIP1956-137-4-475A,Vol1; Company listed at #439-443 in 1930; 437-443	Low
3222		CITY OF OTTAWA (CORPORATE SERVICES)	474	ELGIN	Protective Services	1	04123-0062	ON0303131		2000 PID; OTTAWA-CARLETON POLICE SERVICES	Low
6519	3449	GRAND TRUNK RAILWAY	0	O'CONNOR	Railway Transport and Related Service Industries	2	04123-0074			M.1900, M.1910, M.1920, M.1921, M.1930, M.1940, M.1948, M.1950, M.1955; FIP1901,vol2; FIP1912-74-493,vol1; FIP1912-75-497,vol1; FIP1922-74-494A,vol1; FIP1922-75-497,vol1; FIP1948-133-493; FIP1948-137-497; FIP1956-133-493,vol1; wood working, car building shop/office,large coal bin and cattle pens also listed with ddress on Isabella St and Metcalfe St. Located on both the east and west sides of the street. It takes up the area between Isabella and Catherine, south west from Elgin and the Driveway to O'Connor. Grand Trunk Railway bought by CNR in 1925. CNR also listed with an address on Bank St.(556 Bank St.)	Medium
4744	447	DOMINION LOOSE LEAF CO.	0	METCALFE	Commercial Printing Industries	2	04123-0080			FIP1901-75-499,vol2. FIP1912-75-499,vol1. FIP1922-75-499,vol1. M.1921.; Property occupies entire block from Metcalfe St. (E) to within 100 ft. of Elgin St. (W) & Pretoria St. (S) to Isabella St (N).	Low
1983	2830	CAMPBELL PUMP SERVICE	88	ISABELLA	Gasoline Service Stations	1	04123-0081			M.1960, M.1970, M.1980	Low

2005 Activity ID	1998 Activity ID	Name	Street Number	Street Name	Type of Facility	Pin Certainty	PIN	Waste Generator #	Storage Tanks	Comments	Risk
13109		STERLING MARKING PRODUCTS INC.	112	ISABELLA	Commercial Printing Industries	1	04123-0085			2001 Employment Survey	Low
14793	1753	VENDALL MACHINES LIMITED	110	ISABELLA	Machine Shop Industry	1	04123-0085			M.1948, M.1955, M.1958, M.1961, M.1964, S.1958, S.1961, S.1964, S.1965; FIP1901,Vol2; FIP1912-75-498,Vol1; FIP1922-75-498,Vol1; FIP1948-137-498; FIP1956-137-4-498,Vol1; Machine Shop, Soft Drink Cabinet Assembly	Low
8916	3346	MILLIGAN DENTAL LABORATORY	114	ISABELLA	Medical and Other Health Laboratories	1	04123-0086			M.1960, M.1970, M.1980; SC98; 2001 Employment Survey	Low
3787	2833, 265	ELIE AUTO BODY	120	ISABELLA	Motor Vehicle Repair Shops	1	04123-0088			M.1948, M.1955, M.1960, M.1970, M.1980; SC98; FIP1901,vol2; FIP1912-75-498,Vol1; FIP1922-75-498,Vol1; FIP1948-137-498; FIP1956-137-4-498,Vol1; 2005 Select Phone	Medium
9552		NATIONAL MUSEUMS OF CANADA	240	MCLEOD	Services to Buildings and Dwellings	1	04123-0116	ON0129410		2000 PID; VICTORIA MUSEUM-BOILER ROOM	Low
8907	203	MC AULIFFE-GRIMES LUMBER CO. LIMITED	488	METCALFE	Sawmill, Planing Mill and Shingle Mill Products Industries	2	04132-0017			M.1900, M.1910, M.1920, M.1930, M.1940, M.1950	Low

Legend

- Bridge Site
- High Risk
- Medium Risk
- Low Risk

Ontario
MINISTRY OF TRANSPORTATION

Project Name:
Contamination Overview Study
23 Bridges
417 Queensway

Project Site
basemap by Google Earth

MORRISON HERSHFIELD

Drawing Title:
HLUI Results

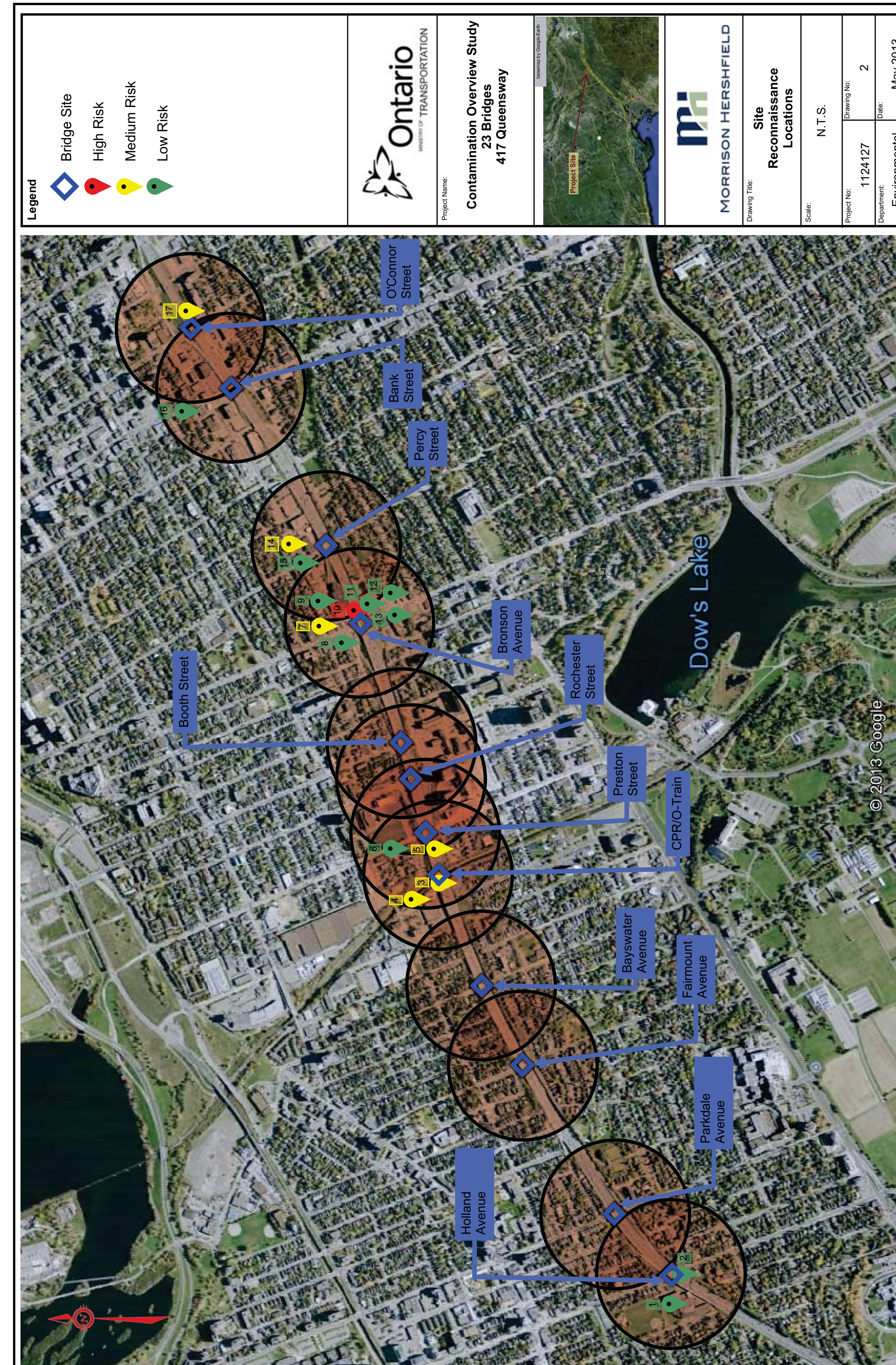
Scale: N.T.S.

Project No: 1124127 | Drawing No: 1

Department: Environmental | Date: May 2013

L:\proj\2124077\Drawings\Location Plans\Template.pdf

APPENDIX D: Locations of Sites Observed During Site Reconnaissance



APPENDIX G: Designated Substances and Hazardous Materials Survey

MORRISON HERSHFIELD

FINAL

DESIGNATED SUBSTANCES & HAZARDOUS MATERIALS SURVEY

Preliminary Design and Environmental Assessment Study for the Rehabilitation / Replacement of Ottawa Queensway Mid-town Bridges from Holland Avenue to O'Connor Street

G.W.P. 4075-11-00

Agreement # 4011-E-0025

MH Project # 1124127.00

Presented to:

Kevin Ogilvie
Senior Environmental Planner

Ministry of Transportation
1355 John Counter Blvd. P.O. 4000
Kingston, ON
K7L 5A3

Project No. 1124127.00 July 12, 2013

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DESIGNATED SUBSTANCES & HAZARDOUS MATERIALS SURVEY

Preliminary Design and Environmental Assessment Study for the Rehabilitation / Replacement of Ottawa Queensway Mid-town Bridges from Holland Avenue to O'Connor Street

MTO Project Number: GWP 4075-11-00

1124127.00

July 2013

Ontario

Prepared By:

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Geo-Environmental Practice Leader
Contaminant/Waste Management Key Contact

Ce document hautement spécialisé n'est disponible qu'en anglais en vertu du règlement 671 / 92, qui en exempte l'application de la Loi sur les services en français. Pour de l'aide en français, veuillez communiquer avec Heather Edwardson, ministère des Transports, au 905 704-2210.

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1. INTRODUCTION

1.1 Purpose

The Ontario Ministry of Transportation (MTO) Eastern Region initiated this Preliminary Design and Environmental Assessment Study to determine the preferred alternative for the rehabilitation and / or replacement of twenty-three (23) bridges (at twelve locations) on Highway 417 (Ottawa Queensway) from Holland Avenue to O'Connor Street.

Through this assignment, MTO will obtain environmental clearances associated with a cleared Transportation Environmental Study Report for the structure rehabilitation or replacement work, including any necessary closures.

An environmental assessment (EA) is being carried out in order to fulfill the requirements under the *Class Environmental Assessment for Provincial Transportation Facilities (2000)*. As per the process outlined in the above noted document, the existing physical, biological, and socio-economic resources within the study area were studied in order to assess the potential impacts of the proposed undertaking. This report partially fulfills the study obligations under the EA.

1.2 Purpose of Report

This Designated Substances & Hazardous Materials Survey Report provides a synopsis of the study area and preliminary design summary, an outline of the environmental assessment methodology, and information regarding the presence or possible presence of designated substances and other hazardous materials. The report is intended to support MTO and others in their duty to protect workers from health and safety hazards on the job, as required by the Ontario *Occupational Health and Safety Act.*

1.3 Regulatory and Background Information

Legal requirements which apply to health and safety on construction projects are set out in the Ontario *Occupational Health and Safety Act (OHSA), R.S.O. 1990, Chapter O.1* and regulations made under the Act. The Act specifies, in general terms, the duties of owners, employers and others to protect workers from health and safety hazards on the job. These duties include taking all reasonable precautions to protect workers and acquainting a worker, or a person in authority over a worker, with any hazard in the workplace and in the handling, storage, use, disposal and transport of hazardous materials. The *Regulation for Construction Projects, O.Reg. 213/91 (amended by 0. Reg. 85/04)*, applies to all construction projects, and requires the use of appropriate personal protection equipment, training in the use of protective equipment, and the provision of adequate washing facilities.

Section 30 of the *OHSA* requires that a list of all "designated substances" at a project site be provided to all bidders at the tendering stage and that the "constructor" for a project shall ensure that each prospective contractor and subcontractor for the project has received a copy of the list before entering into a contract. Under *Regulation 490/09* there are eleven substances which are classified as "designated substances" in Ontario: acrylonitrile, arsenic, asbestos, benzene, coke oven emissions, ethylene oxide, isocyanates, lead, mercury, silica,

Final Designated Substances & Hazardous Materials Survey Report (July 2013)

Preliminary Design and Environmental Assessment Study for the Rehabilitation / Replacement of Ottawa Queensway Mid-town Bridges from Holland Avenue to O'Connor Street - G.W.P. 4075-11-00

and vinyl chloride. Other "hazardous materials" which require special handling during construction or demolition activities include polychlorinated biphenyls (PCBs), ozone-depleting substances (ODS) and mould. Other regulatory requirements (and guidelines) which apply to control of exposure to designated substances and hazardous materials are referenced in the sections below.

1.3.1 Asbestos

Asbestos is a fibrous silicate mineral historically used in building materials due to its properties. Friable asbestos (a friable material is one which can be crumbled, powdered or pulverized by hand pressure) was widely used as sprayed fireproofing and sprayed thermal insulation (ceased use in 1973), sprayed acoustic texture coat finishes (stucco) and mechanical thermal system insulation (ceased use in 1982). Non-friable asbestos was used in plaster finishes (ceased use circa 1960's); acoustic ceiling tile, and drywall joint compound (ceased use circa 1980); vinyl floor tile, vinyl sheet flooring, floor adhesives and roofing materials (ceased use circa 1992), and limited quantities of cement sheeting, piping, and gasket materials. Chronic exposure due to inhalation of asbestos can lead to adverse health effects (i.e., asbestosis, mesothelioma), and in Ontario asbestos is designated under the *OHSA* and *Regulation 490/09*.

Management of asbestos containing materials (ACMs) is regulated in Ontario under *Regulation 278/05, Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations*. The regulation defines an ACM as containing 0.5 per cent or more asbestos by dry weight, and sets out responsibilities for management of such. The regulation requires that all ACMs be removed prior to demolition work, and protects workers with potential exposure to asbestos by classifying work procedures by type (Type 1, 2, or 3). Precautionary measures are defined for each type of work procedure, as well as minimum requirements for sampling to establish the presence of ACMs.

Disposal of asbestos waste is regulated under R.R.O. 1990, *Regulation 347 General – Waste Management*. This regulation specifies procedures for the safe transportation of asbestos waste and specifies that the waste must be disposed at a licensed waste disposal site, following proper notification.

In highway structures, the following are the principal potential areas of ACM:

- Coated or asbestos-cement utility lines (e.g., electrical or drainage).
- Waterproofing mastics, caulk, coatings, membranes.
- Insulation or joint compounds (fiber board and sealants).
- Felt bearing pads on pan girders or flat slab bridges.
- Painted or coated steel or wood.
- Concrete stain, paint, opaque sealer or coating.
- Abutment forms.
- Isolator pad on bridge rail.
- Geotextiles.

1.3.2 Lead

Lead is a heavy metal that can be found in construction materials such as interior and exterior paints, coatings, mortar, solder, packings, sheet metal, caulking, ceramic glazes, mechanical and electrical equipment, lead-acid batteries and munitions. Exposure to lead can cause lead poisoning and damage to a number of systems in the body such as the blood, nervous system, and reproductive system. In Ontario, lead is designated under the *OHSA* and *Regulation 490/09*.

Guidance on handling lead-containing materials during construction projects is contained in the document *Guideline: Lead on Construction Projects*, published by the Occupational Health and Safety Branch of the Ministry of Labour, dated April 2011. In the guideline, lead-containing construction operations are classified into three groups - Type 1 (low risk), Type 2 (medium risk) and Type 3 (high risk) based on presumed airborne concentrations of lead generated during the work. Different levels of respiratory protection and work procedures are required for each classification. The guideline does not provide a criterion for classifying materials based on lead content.

In Canada, the lead content of paints and other liquid coatings on furniture, household products, children's products, and surfaces (exterior and interior) of any building frequented by children was restricted to 0.5% (5,000 ppm) in 1976. The Federal Hazardous Product Act has recently lowered the allowable concentration of lead in paints for new consumer products from 0.06% lead content by weight (600 ppm) to 0.009% lead content by weight (90 ppm), but these limits do not apply to anti-corrosive or an anti-weathering coating applied on any structure, other than a building, that is used for an agricultural, industrial or public purpose. For the purpose of this assessment, a criterion of 0.06% lead content by weight (600 ppm) is used to flag lead containing paint.

In highway structures, lead may mainly be found in painted surfaces.

1.3.3 Silica

Silica is among the most common mineral on earth and is the primary constituent of “rock” and “sand”. Silica exists in many forms—one of these, “crystalline” silica (including quartz, cristobalite, tridymite, and Tripoli), is the most abundant and poses the greatest concern for human health.

Silica is ubiquitous in construction materials such as concrete, soil, cement, mortar, brick, aggregate, and asphalt. Operations such as abrasive blasting, chipping, hammering, grinding, dumping, sweeping and demolition of concrete structures all have the potential to cause airborne silica dust. Exposure to silica dust can cause silicosis which is a disease characterized by progressive thickening and scarring of the lung tissue. In Ontario silica is designated under the *OHSA* and *Regulation 490/09*.

Guidance on handling silica-containing materials during construction projects is contained in the document *Guideline: Silica on Construction Projects*, published by the Occupational Health and Safety Branch of the Ministry of Labour, dated April 2011. In the guideline, methods for the control of silica dust are set out and construction operations are classified into three groups - Type 1 (low risk), Type 2 (medium risk) and Type 3 (high risk) based on

presumed airborne concentrations of respirable crystalline silica. Different levels of respiratory protection and work procedures are required for each classification.

1.3.4 PCB-Containing Equipment

The use of polychlorinated biphenyls (PCBs) as dielectric fluids in electrical equipment such as transformers, fluorescent lamp ballasts and capacitors was common up to about 1980. PCBs were also used in closed-loop equipment such as hydraulic equipment. The Federal Chlorobiphenyls Regulations (SOR/91-152, now repealed) prohibited PCB use in electrical equipment and closed loop systems circa 1980 because of evidence of bioaccumulation in species and harmful health effects. Federal PCB Regulations (SOR/2008-273) set timelines for further phasing out of existing PCBs and PCB-containing equipment.

Removal of PCB-containing equipment on MTO projects is controlled by Ontario Standard Specification 180. Sampling of this equipment to determine presence or absence of PCB is not practical and is not typically conducted at this stage.

1.3.5 Other Designated Substances

Due to the materials and methods of bridge construction, the following Designated Substances are not expected to be present at any of the bridges within the study area in forms or quantities that would be of concern to future work:

- Acrylonitrile
- Arsenic
- Benzene
- Coke Oven Emissions
- Ethylene Oxide
- Isocyanates
- Mercury
- Vinyl Chloride

2. PROJECT DETAILS

2.1 Project Location and Study Area

The study area includes twenty-three (23) bridges (twelve locations) along Highway 417 (Ottawa Queensway) from Holland Avenue to O'Connor Street which are highlighted on Figure 2.1. A field inspection and a designated substances and hazardous materials survey was carried out on April 17th and 18th, 2013, on the bridge structures themselves including the soffits, abutments, wingwalls, deck, and barrier walls. A follow-up field inspection was carried out on May 2nd and 3rd, 2013. Specifically not included in the study area were the sound barriers and retaining walls. As this is a planning study, the survey has been scoped to include visual inspection and sampling of easily accessible materials without the requirement for special equipment and traffic control.

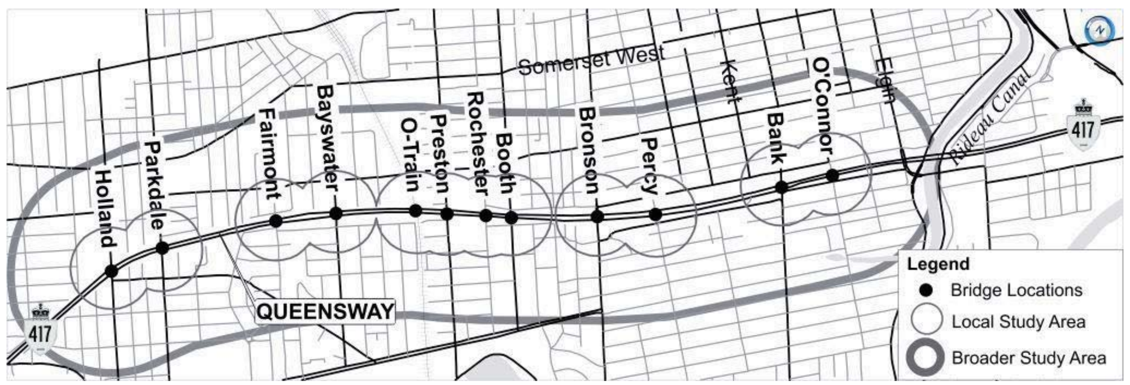

Figure 2.1. Study Area

2.2 Design Summary

This project involves the preliminary design for the replacement or rehabilitation of twenty-three (23) bridge structures on the Ottawa Queensway from Holland Avenue to O'Connor Street in the urban core of Ottawa. The replacement of the O-Train overpass (based on the decision by the MTO Eastern Region Structural Section) may provide staging opportunities to address the rehabilitation of adjacent rigid frame structures. Replacement and rehabilitation approaches are being considered as "alternatives to" the project, and it is likely that rehabilitation and repairs will cost effectively extend the useful lives of these rigid frame structures. Key considerations for the project will be detouring and traffic staging. The high volumes of traffic on the Queensway will require that the methods used for the various stages of implementation of the construction ensure the safety of both the travelling public and of the workers undertaking the work.

3. METHODOLOGY

3.1 Drawings and Reports Review

Where available, construction drawings and as-built drawings for original construction and / or renovation / rehabilitation are useful sources of information on the potential presence of designated substances and other hazardous materials. Condition reports are useful for the same purpose.

All available information was reviewed prior to the field inspection to familiarize the survey staff with the conditions that they would encounter and to ascertain the possible presence of designated and hazardous substances that may be inaccessible during the inspection.

3.2 Initial and Detailed Inspections

The field inspection and designated substances and hazardous materials survey was completed in accordance with standard protocols for designated substance surveys, and in accordance with a project or task specific health and safety plan.

An initial visual and photographic assessment was made of surfaces and exterior and interior parts, using non-destructive techniques during the field inspection. If structure elements or materials with suspect designated or hazardous materials were noted, then a more detailed assessment was carried out.

In the detailed assessment during field inspection, point locations with a unique ID were documented on a survey plan and table (ID, location, material, sample #, suspect material, condition (poor, fair, or good), friability, and comments). The sample # was assigned to bagged and labeled samples collected using non-destructive, non-powered, hand sampling techniques. Where a similar material had already been sampled, the sample # column was used to indicate this similarity, and a sample was not collected. Photographs of specific sample locations were taken and noted, as applicable, and can be seen in Appendix A.

The survey was conducted at each bridge site to the greatest extent possible without the use of traffic control or special equipment for improving access. Samples were taken only where they could be obtained without effect on the function or durability of the structure. These protocols are appropriate for planning studies, and consider the fact that drawings were available to determine information about inaccessible areas. Additional testing may be required to confirm the presence of designated or hazardous substances where they have been assumed by this assessment or in areas inaccessible during this assessment.

The location of possible PCB containing equipment was noted.

3.3 Laboratory Analysis

Samples were submitted to Caduceon Environmental Laboratories of Ottawa, Ontario. Caduceon conducted the analysis for lead in-house, and contracted the analysis for asbestos to EMC Scientific Incorporated of Mississauga Ontario. Bulk samples are analyzed for asbestos using Polarized Light Microscopy and dispersion staining techniques. The analytical procedures were in accordance with EPA 600/R-93/116 method.

3.4 Assessment and Reporting

Based on the results of the initial visual and photographic inspection as well as the detailed inspection, where applicable, the presence and possible quantities of designated and hazardous materials were estimated, and were reported on structure specific report sheets with associated photographs. This information is detailed in this report in Section 4.3 and data is found in Appendix A.

Ontario

Final Designated Substances & Hazardous Materials Survey Report (July 2013)

Preliminary Design and Environmental Assessment Study for the Rehabilitation / Replacement of Ottawa Queensway Mid-town Bridges from Holland Avenue to O'Connor Street - G.W.P. 4075-11-00

4. RESULTS

4.1 Drawings and Reports Review

The following sets of drawings and/or reports provided by MTO were reviewed by the consultant team.

1. Original Drawings by the Department of Highways of Ontario dated between 1959 and 1962.

2. Rehabilitation Drawings prepared for MTO dated between 1982 and 1984.

3. Condition Survey Reports prepared for MTO dated between 1982 and 1984.

The actual list of drawings reviewed for each site is available in Appendix A.

The original drawings for each site indicate one (1) 2.5” (6.35 cm) transite electrical duct embedded in the sidewalk / coping on the north and south side of each bridge, and three (3) 4” (10.16 cm) transite electrical ducts embedded below the sidewalk / coping on the north side of each bridge. The rehabilitation drawings for each site indicate that all these ducts were to be left in place and filled with expanding cement grout. These ducts are suspected ACM and were observed at several sites during the follow-up field inspection. Samples were collected and sent to Caduceon for analysis.

The original drawings indicate the presence of 1” (2.54 cm) thick cork asphalt board in the expansion joint between the eastbound lane and westbound lane structures (except for O’Connor Street). The rehabilitation drawings indicate that this material was to have been removed, and replaced by a pre-compressed joint sealant at the top of the new median barrier. There was no way to verify that it was entirely removed during this assessment, and there is some potential for ACM in the expansion joint.

The original drawings for each site indicate the presence of 0.5” (1.27 cm) thick cork asphalt board in the expansion joint between the retaining and abutment walls. There is some potential for ACM in the expansion joint, however they were sampled and tested in this assessment and found to be non-ACM.

The original drawings for each site indicate the presence of 4” (10.16 cm) transite drainage ducts through the retaining walls on 12’ (3.66 m) centres. This was observed on the southeast retaining wall at the Bank Street bridge during the follow-up field inspection. These ducts are also suspected ACM and a sample was collected and sent to Caduceon for analysis.

For the O-Train site, the original drawings indicate the presence of a bearing block composed of rubber and steel. There is some potential for ACM. The original drawings for this site also indicate the 0.75” x 0.75” (1.9 x 1.9 cm) vee filled with asphalt sealing compound (Flintkote CR10 or equal) along the wing walls. The rehabilitation drawings indicate that some or all of this material was to have been removed, although it was not possible to determine the status during the site visit. The sealing compound is suspected ACM. The Flintkote Company filed for bankruptcy in 2004 due to asbestos-related lawsuits.

The original drawings for each site showed painted hand-railings which have all been subsequently removed. Other than some steel parts at the O-Train site these hand railings were the only significant painted and potentially lead-containing surfaces on the bridges.

The original drawings for each site indicated internally ducted electrical supply to light fixtures built into the abutment walls. The rehabilitation drawings indicated that all electrical fixtures were to be removed and replaced with externally ducted electrical supply. This was confirmed during field inspection. All ducts installed during the rehabilitation were specified to be made of PVC, and this was confirmed during field inspection.

4.2 Initial and Detailed Inspections

The bridges were inspected for potential lead and asbestos containing material.

Lead is mostly suspected in paint and surface coatings. Most paint on the bridges was due to graffiti and graffiti removal. This paint was sampled and taken to the lab for analysis.

The Preston Street Overpass site contained murals; the painter was available on site at the time of the site visit and he confirmed that all paint used at the site was lead free latex paint. A paint sample was taken to the lab for analysis.

Asbestos is mostly suspected in the expansion joints, caulking, coatings and utility lines. Samples were taken from the expansion joint material and utility lines and taken to the lab.

For the O-Train site, samples were taken from the rubberised bearing blocks, expansion joints, and the drain pipe coating and insulation. These were taken to the lab to be analyzed for asbestos.

A detailed list of findings from the inspection for each site is available in Appendix A.

4.3 Summary of Findings (All Bridges)

Table 4.1 below provides a summary of findings for the Designated Substances and Hazardous Materials Survey for each of the twelve (12) sites based on lab results. Suspected materials detected during lab analysis have been highlighted. A detailed list of findings from the inspection for each site is available in Appendix A. The laboratory Certificate of Analysis is included in Appendix B.

Table 4.1. Summary of Findings

Site And MTO Structure #	Lead		Asbestos	
	Suspected Material	Confirmed	Suspected Material	Confirmed
Holland Ave 3-050.1 & 2	Paint on abutment wall	Below Threshold	Embedded electrical ducts	Not Tested
			Expansion joint cork asphalt board	Non Detected
			Transite drainage ducts in retaining wall	Not Tested
Parkdale Ave 3-051.1 & 2	Paint on abutment wall	Below Threshold	Embedded electrical ducts	Not Tested
			Expansion joint cork asphalt board	Non Detected
			Transite drainage ducts in retaining wall	Not Tested
Fairmont Ave 3-052.1 & 2	Paint on abutment wall	Below Threshold	Embedded electrical ducts	Not Tested
			Expansion joint cork asphalt board	Non Detected
			Transite drainage ducts in retaining wall	Not Tested
Bayswater Ave 3-053.1 & 2	Paint on abutment wall	Below Threshold	Embedded electrical ducts	Not Tested
			Expansion joint cork asphalt board	Non Detected
			Transite drainage ducts in retaining wall	Not Tested
O-Train 03-054.1&2			Embedded electrical ducts	Not Tested
			Expansion joint cork asphalt board	Not Tested
			Transite drainage ducts in retaining wall	Not Tested
			Rubberised bearing block	Non Detected

Site And MTO Structure #	Lead		Asbestos	
	Suspected Material	Confirmed	Suspected Material	Confirmed
			Asphalt sealing compound along wing walls	Not Tested
			Drain Pipe Coating	5 % Chrysotile Asbestos Detected
			Drain Pipe Isolator	Non Detected
			Polystyrene in Expansion Joints	Non Detected
			Cork Asphalt Board in Expansion Joints	Non Detected
Preston St 03-055.1&2	Paint on abutment wall	Below Threshold	Embedded electrical ducts	Not Tested
			Expansion joint cork asphalt board	Non Detected
			Transite drainage ducts in retaining wall	Not Tested
Rochester St 03-056.1&2	Paint on abutment wall	Below Threshold	Embedded electrical ducts	Not Tested
			Expansion joint cork asphalt board	Non Detected
			Transite drainage ducts in retaining wall	Not Tested
			Polystyrene in Barrier Wall Expansion Joints	Non Detected
Booth St 03-057.1&2	Paint on abutment wall	Below Threshold	Embedded electrical ducts	Not Tested
			Expansion joint cork asphalt board	Non Detected
			Transite drainage ducts in retaining wall	Not Tested
Bronson Ave 3-060.1&2	Paint on abutment wall	Below Threshold	Embedded electrical ducts	Not Tested
			Expansion joint cork asphalt board	Non Detected
			Transite drainage ducts in retaining wall	Not Tested

Site And MTO Structure #	Lead		Asbestos	
	Suspected Material	Confirmed	Suspected Material	Confirmed
			Transite electrical duct embedded in sidewalk	Not Tested
Percy St 3-061.1&2	Paint on abutment wall	Below Threshold	Embedded electrical ducts	Not Tested
			Expansion joint cork asphalt board	Non Detected
			Transite drainage ducts in retaining wall	Not Tested
			Transite electrical duct embedded in sidewalk	Tested, Result Pending.
Bank St 3-063.1&2	Paint on abutment wall	Below Threshold	Embedded electrical ducts	Not Tested
			Expansion joint cork asphalt board	Non Detected
			Transite drainage ducts in retaining wall	Tested, Result Pending
			Transite electrical duct embedded in sidewalk	Not Tested
O'Conner St 3-064	Paint on abutment wall	Below Threshold	Embedded electrical ducts	Not Tested
			Expansion joint cork asphalt board	Non Detected
			Transite drainage ducts in retaining wall	Not Tested
			Transite electrical duct embedded in sidewalk	Tested, Result Pending.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Asbestos

Based on the results of the drawings review, the initial and detailed inspection and the laboratory analysis, it is concluded that structures contain the following potential or confirmed asbestos containing material:

- 2.5” (6.35 cm) transite electrical duct embedded within the coping/sidewalk on both north and south sides (suspected ACM, all structures)
- Three (3) 4” (10.16 cm) transite electrical ducts embedded below the sidewalk/coping on the north side of each bridge (suspected ACM, all structures)
- Below grade 4” (10.16 cm) transite drainage ducts through the retaining walls on 12’ (3.66 m) centres (suspected ACM, all structures).
- Coating on steel deck drains (confirmed ACM, O-Train Bridge only).
- Expansion joint between eastbound lanes and westbound lanes structures (possible ACM, only if these materials were not fully removed during previous rehabilitation as was specified in drawings, all structures except O’Connor Street).

The following recommendations apply to all suspected and confirmed ACM:

- Materials must be maintained in good condition.
- Any work with the potential to disturb ACM shall be carried out in accordance with O. Reg. 278/05, as amended: Designated Substances – Asbestos on Construction Projects and in Buildings and Repair Operations.
- Asbestos containing waste must be handled in accordance with R.R.O. 1990, Regulation 347 General – Waste Management.
- Appropriate work procedures and precautionary measures should be carried out in accordance with Ontario Regulation 278/05.

5.2 Lead

Paint with lead in concentration above 600 ppm was not found on any structure.

5.3 Silica

By weight, the majority of the structure is silica, and it is likely that any work on the structure will generate silica dust. All construction activities should be conducted in accordance with *Guideline: Silica on Construction Projects*, published by the Occupational Health and Safety Branch of the Ministry of Labour, dated April 2011.

5.4 PCB-Containing Equipment

Original light fixtures were removed during the rehabilitation of the mid-1980s. No PCB-containing equipment (i.e., transformers) was noted on the drawings or during the inspection.

Removal of PCB-containing equipment on MTO projects is controlled by OPSS 180 and *R.R.O. 1990, Regulation 347 General – Waste Management*.

5.5 Other Designated Substances

Based on the scope of work performed, there are no other designated substances suspected to exist within the structures.

6. REFERENCES

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Booth St. Overpass Structure Repairs, 1982. W.P. No. 176-80-10, (Rehabilitation Drawings).

Bronson Ave. Overpass Structure Repairs, 1984. W.P. No. 176-80-02, (Rehabilitation Drawings).

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Department of Highways of Ontario, 1959. Ottawa Queensway, Limited-Access Highway, Ottawa, Canada. Bridge No. 13 at Bayswater Ave., W.P. No. 937-59, (Original Drawings).

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Department of Highways of Ontario, 1961. Ottawa Queensway, Limited-Access Highway, Ottawa, Canada. Bridge No. 15 at Preston St., W.P. No. 939-59, (Original Drawings).

Department of Highways of Ontario, 1961. Ottawa Queensway, Limited-Access Highway, Ottawa, Canada. Bridge No. 16 at Rochester St., W.P. No. 940-59, (Original Drawings).

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Department of Highways of Ontario, 1962. Ottawa Queensway Limited-Access Highway. Ottawa, Canada, Bridge No. 22 at O'Connor St., W.P. No. 948-59, March, (Original Drawings).

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Detailed Condition Survey, 2010. C.P.R. at Preston EBL. Prepared for MTO

Detailed Bridge Deck Condition Survey, 2012. Bank St. Overpass. Prepared for MTO

Detailed Bridge Deck Condition Survey, 2012. Bayswater Ave. Overpass. Prepared for MTO

Detailed Bridge Deck Condition Survey, 2012. Booth St. Overpass. Prepared for MTO

Detailed Bridge Deck Condition Survey, 2012. Fairmont Ave. Overpass. Prepared for MTO

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Detailed Bridge Deck Condition Survey, 2012. Parkdale Ave. Overpass. Prepared for MTO

Detailed Bridge Deck Condition Survey, 2012. Percy St. Overpass. Prepared for MTO

Detailed Bridge Deck Condition Survey, 2012. Rochester St. Overpass. Prepared for MTO

Detailed Condition Survey, 2012. Bronson Ave. Overpass. Prepared for MTO

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O'Connor St. Overpass Structure Repairs, 1984. W.P. No. 176-80-06, September (Rehabilitation Drawings).

Parkdale Ave. Overpass Structure Repairs, 1982. W.P. No. 175-80-03, (Rehabilitation Drawings).

Percy St. Overpass Structure Repairs, 1984. W.P. No. 176-80-03, (Rehabilitation Drawings).

Preston St. Overpass Structure Repairs, 1982. W.P. No. 175-80-07, (Rehabilitation Drawings).

Rochester St. Overpass Structure Repairs, 1984. W.P. No. 175-80-08, (Rehabilitation Drawings).

APPENDIX A: Site Specific Designated and Hazardous Substances Assessment

HOLLAND AVENUE OVERPASS: SITE NO. 3-050: 1 & 2

DRAWINGS AND REPORTS REVIEWED

1. Department of Highways of Ontario. Ottawa Queensway, Limited-Access Highway, Ottawa, Canada. Bridge No. 10 at Holland Ave., W.P. No. 904-59, 1959. (Original Drawings).
2. Holland Ave. Overpass Structure Repairs, W.P. No. 175-80-02, 1982. (Rehabilitation Drawings).
3. Detailed Bridge Deck Condition Survey, Holland Ave. Overpass. Prepared for MTO, 2012.

FINDINGS

Lead

Material	Location	Condition	Sampled #	Concentration (limit 600 µg/g)	Comment
Paint	Abutment walls	Good	No *(Similar to Percy #Pb S3)*	14 µg/g	See Photo 01

Asbestos

Material	Location	Friable	Sampled #	Asbestos Type and % Present (limit 0.5%)	Comment
Cork Asphalt Board	Abutment – Retaining Wall Joints & Expansion Joints	Yes	No *(similar to Booth #Ab S2)*	Non Suspected	See Photo 02

PHOTOS

Photo 01: Paint on abutment walls

Photo 02: Cork asphalt board in expansion joint

PARKDALE AVENUE OVERPASS: SITE NO. 3-051: 1 & 2

DRAWINGS AND REPORTS REVIEWED

1. Department of Highways of Ontario. Ottawa Queensway, Limited-Access Highway, Ottawa, Canada. Bridge No. 11 at Parkdale Ave., W.P. No. 905-59, 1959. (Original Drawings).
2. Parkdale Ave. Overpass Structure Repairs, W.P. No. 175-80-03, 1982. (Rehabilitation Drawings).
3. Detailed Bridge Deck Condition Survey, Parkdale Ave. Overpass. Prepared for MTO, 2012.

FINDINGS

Lead

Material	Location	Condition	Sampled #	Concentration (limit 600 µg/g)	Comment
Paint	Abutment walls	Good	No *(Similar to Percy #Pb S3)*	14 µg/g	See Photo 01

Asbestos

Material	Location	Friable	Sampled #	Asbestos Type and % Present (limit 0.5%)	Comment
Cork Asphalt Board	Abutment – Retaining Wall Joints & Expansion Joints	Yes	No *(similar to Booth #Ab S2)*	Non Suspected	See Photo 02
Transite Electrical Duct	Embedded in Sidewalk on Parkdale	Yes	No (similar to Percy St #Ab S9)	Chrysotile - 15%, Crocidolite - 10%	Similar to others

PHOTOS

Photo 01: Paint on abutment walls

Photo 02: Cork asphalt board in expansion joint

FAIRMONT AVENUE OVERPASS: SITE NO. 3-052: 1 & 2

DRAWINGS AND REPORTS REVIEWED

1. Department of Highways of Ontario. Ottawa Queensway, Limited-Access Highway, Ottawa, Canada. Bridge No. 12 at Fairmont Ave., W.P. No. 906-59, 1959. (Original Drawings).
2. Fairmont Ave. Overpass Structure Repairs, W.P. No. 175-80-04, 1983. (Rehabilitation Drawings).
3. Detailed Bridge Deck Condition Survey, Fairmont Ave. Overpass. Prepared for MTO, 2012.

FINDINGS

Lead

Material	Location	Condition	Sampled #	Concentration (limit 600 µg/g)	Comment
Paint	Abutment walls	Poor	No *(Similar to Bayswater #Pb S6)*	< 5 µg/g	See Photo 01

Asbestos

Material	Location	Friable	Sampled #	Asbestos Type and % Present (limit 0.5%)	Comment
Cork Asphalt Board	Abutment – Retaining Wall Joints & Expansion Joints	Yes	No *(similar to Booth #Ab S2)*	Non Suspected	See Photo 02

PHOTOS

Photo 01: Paint on abutment walls

Photo 02: Cork asphalt board in expansion joint

Designated Substances & Hazardous Materials Survey: Site Summary Sheet

Preliminary Design and Environmental Assessment Study for the Rehabilitation / Replacement of Ottawa Queensway Mid-town Bridges from Holland Ave. to O'Connor St. G.W.P. 4075-11-00

BAYSWATER AVENUE OVERPASS: SITE NO. 3-053: 1 & 2

DRAWINGS AND REPORTS REVIEWED

1. Department of Highways of Ontario. Ottawa Queensway, Limited-Access Highway, Ottawa, Canada. Bridge No. 13 at Bayswater Ave., W.P. No. 937-59, 1959. (Original Drawings).
2. Bayswater Ave. Overpass Structure Repairs, W.P. No. 176-80-05, 1982. (Rehabilitation Drawings).
3. Detailed Bridge Deck Condition Survey, Bayswater Ave. Overpass. Prepared for MTO, 2012.

FINDINGS

Lead

Material	Location	Condition	Sampled #	Concentration µg/g (limit 600 µg/g)	Comment
Paint	Abutment walls	Poor	Yes #Pb S6	< 5 µg/g	See Photo 01

Asbestos

Material	Location	Friable	Sampled #	Asbestos Type and % Present (limit 0.5%)	Comment
Cork Asphalt Board	Abutment – Retaining Wall Joints & Expansion Joints	Yes	No (similar to Booth #Ab S2)	Non Suspected	See Photo 02

PHOTOS

Photo 01: Paint on abutment walls

Photo 02: Cork asphalt board in expansion joint

O-TRAIN OVERPASS: SITE NO. 3-054. 1 & 2

DRAWINGS AND REPORTS REVIEWED

1. Department of Highways of Ontario. Ottawa Queensway, Limited-Access Highway, Ottawa, Canada. Bridge No. 14 at C.P.R., W.P. No. 938-59, 1961. (Original Drawings).
2. C.P.R. Overpass Structure Repairs, W.P. No. 175-80-06, 1982. (Rehabilitation Drawings).
3. Detailed Condition Survey, C.P.R. at Preston EBL. Prepared for MTO, 2010.

SURVEY FINDINGS

Lead

Material	Location	Condition	Sampled	Concentration µg/g (limit 600 µg/g)	Comment
Paint (Graffiti)	Abutment walls	Good	No	n/a	See photo 01 Not suspected to contain lead

Asbestos

Material	Location	Friable	Sampled	Asbestos Type and % Present (limit 0.5%)	Comment
Cork Asphalt Board	Expansion Joints	Yes	No	n/a	Similar to others
Polystyrene	Retaining wall-Barrier wall Expansion Joints	No	Yes	Non Detected	See Photo 02
Rubberised Bearing Block	Bridge and Abutment Wall Joints	No	Yes	Non Detected	See Photo 03
Rubberised Isolator	Drain Pipe	No	Yes	Non Detected	See Photo 04
Pipe Coating	Drain Pipe	No	Yes	Chrysotile - 5%	See Photo 05

Designated Substances & Hazardous Materials Survey: Site Summary Sheet

Preliminary Design and Environmental Assessment Study for the Rehabilitation / Replacement of Ottawa Queensway Mid-town Bridges from Holland Ave. to O'Connor St. G.W.P. 4075-11-00

PHOTOS


Photo 01: Paint on abutment walls (graffiti)


Photo 02: Polystyrene Expansion Joint


Photo 03: Rubberised Bearing Block


Photo 05: Drain Pipe Rubberised Isolator


Photo 05: Drain Pipe Coating

PRESTON STREET OVERPASS: SITE NO. 3-055: 1 & 2

DRAWINGS AND REPORTS REVIEWED

1. Department of Highways of Ontario. Ottawa Queensway, Limited-Access Highway, Ottawa, Canada. Bridge No. 15 at Preston St., W.P. No. 939-59, 1961. (Original Drawings).
2. Preston St. Overpass Structure Repairs, W.P. No. 175-80-07, 1982. (Rehabilitation Drawings).
3. Detailed Bridge Deck Condition Survey, Preston St. Overpass. Prepared for MTO, 2010.

FINDINGS

Lead

Material	Location	Condition	Sampled #	Concentration µg/g (limit 600 µg/g)	Comment
Paint	Abutment walls	Good	Yes #Pb S5	10 µg/g	See Photo 01

Asbestos

Material	Location	Friable	Sampled #	Asbestos Type and % Present (limit 0.5%)	Comment
Cork Asphalt Board	Abutment – Retaining Wall Joints & Expansion Joints	Yes	No (similar to Booth #Ab S2)	Non Suspected	See Photo 02

PHOTOS

Photo 01: Paint on abutment walls

Photo 02: Cork asphalt board in expansion joint

ROCHESTER STREET OVERPASS: SITE NO. 3-056: 1 & 2

DRAWINGS AND REPORTS REVIEWED

1. Department of Highways of Ontario. Ottawa Queensway, Limited-Access Highway, Ottawa, Canada. Bridge No. 16 at Rochester St., W.P. No. 940-59, 1961. (Original Drawings).
2. Rochester St. Overpass Structure Repairs, W.P. No. 175-80-08, 1984. (Rehabilitation Drawings).
3. Detailed Bridge Deck Condition Survey, Rochester St. Overpass. Prepared for MTO, 2012.

FINDINGS

Lead

Material	Location	Condition	Sampled #	Concentration µg/g (limit 600 µg/g)	Comment
Paint	Abutment walls	Good	No (Similar to Percy #Pb S3)	14 µg/g	See Photo 01

Asbestos

Material	Location	Friable	Sampled #	Asbestos Type and % Present (limit 0.5%)	Comment
Cork Asphalt Board	Abutment – Retaining Wall Joints & Expansion Joints	Yes	No (similar to Booth #Ab S2)	Non Suspected	Similar to Booth
Polystyrene	Barrier wall Expansion Joints	No	Yes #Ab S3	Non Detected	See Photo 02

PHOTOS

Photo 01: Paint on abutment walls

Photo 02: Polystyrene Expansion Joint

BOOTH STREET OVERPASS: SITE NO. 3-057: 1 & 2

DRAWINGS AND REPORTS REVIEWED

1. Booth St. Overpass Structure Repairs, W.P. No. 176-80-10, 1982. (Rehabilitation Drawings).
2. Detailed Bridge Deck Condition Survey, Booth St. Overpass. Prepared for MTO, 2012.

FINDINGS

Lead

Material	Location	Condition	Sampled #	Concentration µg/g (limit 600 µg/g)	Comment
Paint	Abutment walls	Good	No (Similar to Percy #Pb S3)	14 µg/g	See Photo 01

Asbestos

Material	Location	Friable	Sampled #	Asbestos Type and % Present (limit 0.5%)	Comment
Cork Asphalt Board	Abutment – Retaining Wall Joints & Expansion Joints	Yes	Yes #Ab S2	Non Detected	See Photo 02

PHOTOS

Photo 01: Paint on abutment walls

Photo 02: Cork asphalt board in expansion joint

BRONSON AVENUE OVERPASS: SITE NO. 3-060: 1 & 2

DRAWINGS AND REPORTS REVIEWED

1. Department of Highways of Ontario. Ottawa Queensway, Limited-Access Highway, Ottawa, Canada. Bridge No. 18 at Bronson Ave., W.P. No. 944-59, 1962. (Original Drawings).
2. Bronson Ave. Overpass Structure Repairs, W.P. No. 176-80-02, 1984. (Rehabilitation Drawings).
3. Detailed Condition Survey, Bronson Ave. Overpass. Prepared for MTO, 2012.

FINDINGS

Lead

Material	Location	Condition	Sampled #	Concentration µg/g (limit 600 µg/g)	Comment
Paint	Abutment walls	Poor	Yes #Pb S4	17 µg/g	See Photo 01

Asbestos

Material	Location	Friable	Sampled #	Asbestos Type and % Present (limit 0.5%)	Comment
Cork Asphalt Board	Abutment – Retaining Wall Joints & Expansion Joints	Yes	No (Similar to Bank St. #Ab S1)	Non Suspected	See Photo 02
Transite Electrical Duct	Embedded in Sidewalk on Bronson	Yes	No (Similar to Percy St. #Ab S9)	Chrysotile - 15%, Crocidolite - 10%	Similar to Others

PHOTOS

Photo 01: Paint on abutment walls

Photo 02: Cork asphalt board in expansion joint

PERCY STREET OVERPASS: SITE NO. 3-061: 1 & 2

DRAWINGS AND REPORTS REVIEWED

1. Percy St. Overpass Structure Repairs, W.P. No. 176-80-03, 1984. (Rehabilitation Drawings).
2. Detailed Bridge Deck Condition Survey, Percy St. Overpass. Prepared for MTO, 2012.

FINDINGS

Lead

Material	Location	Condition	Sampled #	Concentration µg/g (limit 600 µg/g)	Comment
Paint	Abutment walls	Poor	Yes #Pb S3	14 µg/g	Similar to others

Asbestos

Material	Location	Friable	Sampled #	Asbestos Type and % Present (limit 0.5%)	Comment
Cork Asphalt Board	Abutment – Retaining Wall Joints & Expansion Joints	Yes	No (Similar to Bank #Ab S1)	Non Suspected	See Photo 01
Transite Electrical Duct	Embedded in Sidewalk on Percy	Yes	Yes #Ab S9	Chrysotile - 15%, Crocidolite - 10%	See Photo 02

PHOTOS

Photo 01: Cork asphalt board in expansion joint

Photo 02: Transite electrical duct embedded in sidewalk

Designated Substances & Hazardous Materials Survey: Site Summary Sheet

Preliminary Design and Environmental Assessment Study for the Rehabilitation / Replacement of Ottawa Queensway Mid-town Bridges from Holland Ave. to O'Connor St. G.W.P. 4075-11-00

BANK STREET OVERPASS: SITE NO. 3-063: 1 & 2

DRAWINGS AND REPORTS REVIEWED

1. Department of Highways of Ontario. Ottawa Queensway, Limited-Access Highway, Ottawa, Canada. Bridge No. 21 at Bank St., W.P. No. 947-59, 1962. (Original Drawings).
2. Bank St. Overpass Structure Repairs, W.P. No. 176-80-05, 1984. (Rehabilitation Drawings).
3. Detailed Bridge Deck Condition Survey, Bank St. Overpass. Prepared for MTO, 2012.

FINDINGS

Lead

Material	Location	Condition	Sampled #	Concentration µg/g (limit 600 µg/g)	Comment
Paint	Abutment walls	Poor	Yes #Pb S2	11 µg/g	Similar to others

Asbestos

Material	Location	Friable	Sampled #	Asbestos Type and % Present (limit 0.5%)	Comment
Cork Asphalt Board	Abutment – Retaining Wall Joints & Expansion Joints	Yes	Yes #Ab S1	Non Detected	See Photo 01
Transite Drainage Ducts	Retaining Wall	Yes	Yes #Ab S8	Chrysotile - 15%, Crocidolite - 10%	See Photo 02
Transite Electrical Duct	Embedded in Sidewalk on Bank	Yes	No (Similar to Percy St #Ab S9)	Chrysotile - 15%, Crocidolite - 10%	Similar to others

PHOTOS

Photo 01: Cork asphalt board in expansion joint

Photo 02: Transite Drainage Duct in Retaining Wall

O'CONNOR STREET OVERPASS: SITE NO. 3-064

DRAWINGS AND REPORTS REVIEWED

1. Department of Highways of Ontario. Ottawa Queensway Limited-Access Highway. Ottawa, Canada, Bridge No. 22 at O'Connor St., W.P. No. 948-59, March 1962. (Original Drawings).
2. O'Connor St. Overpass Structure Repairs, W.P. No. 176-80-06, September 1984. (Rehabilitation Drawings).
3. Detailed Bridge Deck Conditional Survey, O'Connor St. Overpass. Prepared for MTO, September 2012.

FINDINGS

Lead

Material	Location	Condition	Sampled #	Concentration µg/g (limit 600 µg/g)	Comment
Paint	Abutment walls	Poor	Yes # Pb S1	261 µg/g	See Photo 01

Asbestos

Material	Location	Friable	Sampled #	Asbestos Type and % Present (limit 0.5%)	Comment
Cork Asphalt Board	Abutment – Retaining Wall Joints	Yes	No (Similar to Bank #Ab S1)	Non Suspected	Similar to others
Transite Electrical Ducts	Embedded in Sidewalk on O'Connor	Yes	Yes #Ab S10	Chrysotile - 15%, Crocidolite - 10%	See Photo 02

PHOTOS

Photo 01: Paint on abutment walls

Photo 02: Transite electrical duct embedded in sidewalk

APPENDIX B: Laboratory Certificate of Analysis

CADUCEON ENVIRONMENTAL LABORATORIES Client committed. Quality assured.

TESTING REQUIREMENTS

☐ O.Reg 153/09 ☐ O.Reg 153/04 Table ______ ☐ MISA Guidelines
☐ Surface Soil ☐ Sub Surface Soil (O.Reg 153/09) ☐ O.Reg 558 Leachate Analysis
☐ Yes ☐ No Record of Site Condition (O.Reg 153/09) Disposal Site: ______
☐ Provincial Water Quality Objectives ☐ Landfill Monitoring
☐ Sewer Use By-Law: ______ ☐ Other:

REPORT NUMBER (Lab Use) B13-08761 APR 18.13

Indicate Laboratory Samples are submitted to: ☐ Kingston ☑ Ottawa ☐ Richmond Hill ☐ Windsor

Organization: Morrison Hershfield
Contact: Adel Chowdhury
Tel: 613 668 6248
Fax:
Email: AChowdhury@morr...

Address and Invoicing Address (if different): 2440 Don Reid
Quote No.:
P.O. No.: 1124127.00
Project Name: PD&EA Queensway Bridges
Additional Info:

ANALYSES REQUESTED (Print Test In Boxes): Asbestos, Lead; Suspected Highly Contaminated

TURNAROUND SERVICE REQUESTED (see back page)
☐ Platinum 200% Surcharge**
☐ Gold 100% Surcharge
☐ Silver 50% Surcharge
☐ Bronze 25% Surcharge
☑ Standard 5-7 days
☐ Specific Date: ______

Are any samples to be submitted intended for Human Consumption? ☐ Yes ☐ No (If yes, submit all drinking water samples on a drinking water Chain of Custody)

* Sample Matrix Legend: WW=Waste Water SW=Surface Water GW=Groundwater LS=Liquid Sludge SS=Solid Sludge S=Soil Sed=Sediment PC=Paint Chips F=Filter Oil = Oil

Lab No:	Sample Identification	Sample Matrix*	Date Collected (yy-mm-dd)	Time Collected	Asbestos	Lead	Field pH	Field Temp.	# Bottles/ Sample	Field Filtered(Y/N)
7	Ab S1		13-4-17		✓					
8	Ab S2		"		✓					
9	Ab S3		"		✓					
10	Ab S4		13-4-18		✓					
11	Ab S5		"		✓					
12	Ab S6		"		✓					
13	Ab S7		"		✓					
1	Pb S1	PC	13-4-17			✓				
2	Pb S2	PC	"			✓				
3	Pb S3	PC	"			✓				
4	Pb S4	PC	"			✓				
5	Pb S5	PC	"			✓				

SAMPLE SUBMISSION INFORMATION
Sampled By (print): A. Chowdhury
Submitted By (print): A. Chowdhury
Signature: [signature]
Date(yy-mm-dd): 13-04-18 Time:

SHIPPING INFORMATION
Courier (Client account) ☐
Courier (Caduceon account) ☐
Drop Off ☑
Caduceon (Pick-up) ☐
# of Pieces Shipped

REPORTING / INVOICING
Report by Fax ☐
Report by Email ☑
Invoice by Email ☑
Invoice by Mail ☐

SAMPLE RECEIVING INFORMATION (LABORATORY USE ONLY)
Received By (print): Go-d Signature: [signature]
Date Received (yy-mm-dd): Apr/18/13 Time Received: 1743
Laboratory Prepared Bottles: ☐ Yes ☐ No
Sample Temperature °C: 20 Labeled by: JJ
Comments: 13 bag

Laboratory Locations/Shipping Addresses
Kingston Lab - 285 Dalton Ave., Kingston, ON K7K 6Z1, Tel: (613) 544-2001 Fax: (613) 544-2770 Email: contactkingston@caduceonlabs.com
Ottawa Lab - 2378 Holly Lane, Ottawa, ON K1V 7P1, Tel: (613) 526-0123 Fax: (613) 526-1244 Email: contactottawa@caduceonlabs.com
Richmond Hill Lab - #14-110 West Beaver Creek Rd., ON L4B 1J9, Tel: (289) 475-5442 Fax: (866) 562-1963 Email: contactrichmondhill@caduceonlabs.com
Windsor Lab - 65-3201 Marentette Ave., Windsor, ON N8X 4G3, Tel: (519) 966-9541 Fax: (519) 966-9567 Email: contactwindsor@caduceonlabs.com

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CofC., Sep 2011, Revision No: 14

CADUCEON ENVIRONMENTAL LABORATORIES Client committed. Quality assured.

TESTING REQUIREMENTS

☐ O.Reg 153/09 Table ______ ☐ MISA Guidelines
☐ Surface Soil ☐ Sub Surface Soil (O.Reg 153/09) ☐ O.Reg 558 Leachate Analysis
☐ Yes ☐ No Record of Site Condition (O.Reg 153/09) Disposal Site: ______
☐ Provincial Water Quality Objectives ☐ Landfill Monitoring
☐ Sewer Use By-Law: ______ ☐ Other: ______

REPORT NUMBER (Lab Use) B13-08761 APR 19 13

Indicate Laboratory Samples are submitted to: ☐ Kingston ☑ Ottawa ☐ Richmond Hill ☐ Windsor

Organization: Morrison Hershfield
Contact: Adel Chowdhury
Tel: 613 668 6248
Fax:
Email: AChowdhury@morr...
Address and Invoicing Address (if different): 2440 Don Reid
Quote No.:
P.O. No.: 1124127.00
Project Name: PD&EA Queensway Bridges
Additional Info:

ANALYSES REQUESTED (Print Test in Boxes): Lead

Suspected Highly Contaminated

TURNAROUND SERVICE REQUESTED (see back page)
☐ Platinum 200% Surcharge**
☐ Gold 100% Surcharge
☐ Silver 50% Surcharge
☐ Bronze 25% Surcharge
☑ Standard 5-7 days
☐ Specific Date:

Are any samples to be submitted intended for Human Consumption under any Drinking Water Regulations? ☐ Yes ☐ No (If yes, submit all drinking water samples on a drinking water Chain of Custody)

* Sample Matrix Legend: WW=Waste Water SW=Surface Water GW=Groundwater LS=Liquid Sludge SS=Solid Sludge S=Soil Sed=Sediment PC=Paint Chips F=Filter Oil = Oil

Lab No:	Sample Identification	Sample Matrix *	Date Collected (yy-mm-dd)	Time Collected	Indicate Test For Each Sample By Using A Check Mark In The Box Provided	✓	Field pH	Field Temp.	# Bottles/Sample	Field Filtered (Y/N)
6	P6 S6	PC	13-04-17		✓				1	

SAMPLE SUBMISSION INFORMATION

	Sampled by:	Submitted by:
Print:	A. Chowdhury	A. Chowdhury
Sign:		
Date (yy-mm-dd)/Time:		

SHIPPING INFORMATION: Client's Courier ☐ Caduceon's Courier ☐ Drop Off ☑ Caduceon (Pick-up) ☐ Invoice ☑ # of Pieces

REPORTING / INVOICING: Report by Fax ☐ Report by Email ☑ Invoice by Email ☑ Invoice by Mail ☐

SAMPLE RECEIVING INFORMATION (LABORATORY USE ONLY)
Received By (print): Gord Signature:
Date Received (yy-mm-dd): Apr 18/13 Time Received: 1743
Laboratory Prepared Bottles: ☒ Yes ☐ No
Sample Temperature °C: 12 Labeled by: 7D
Comments:

Laboratory Locations/Shipping Addresses:
Kingston Lab - 285 Dalton Ave., Kingston, ON K7K 6Z1, Tel: (613) 544-2001 Fax: (613) 544-2770 Email: contactkingston@caduceonlabs.com
Ottawa Lab - 2378 Holly Lane, Ottawa, ON K1V 7P1, Tel: (613) 526-0123 Fax: (613) 526-1244 Email: contactottawa@caduceonlabs.com
Richmond Hill Lab - #14-110 West Beaver Creek Rd., ON L4B 1J9, Tel: (289) 475-5442 Fax: (866) 562-1963 Email: contactrichmondhill@caduceonlabs.com
Windsor Lab - #5-3201 Marentette Ave., Windsor, ON N8X 4G3, Tel: (519) 966-9541 Fax: (519) 966-9567 Email: contactwindsor@caduceonlabs.com

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G 35281

White: Lab Copy / Yellow: Invoicing Copy / Pink: Client Copy CofC., Sep 2012, Revision No: 15 GF-10/12

CADUCEON ENVIRONMENTAL LABORATORIES Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G27923, 35281 **REPORT No. B13-08761**

Report To:
Morrison Hershfield Ltd
2440 Don Reid Drive,
Ottawa ON K1H 1E1 Canada
Attention: Adel Chowdury

Caduceon Environmental Laboratories
2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 19-Apr-13
DATE REPORTED: 23-Apr-13
SAMPLE MATRIX: Paint Chips

JOB/PROJECT NO.: PD&EA Queensway Bridges
P.O. NUMBER: 1124127.00
WATERWORKS NO.

		Parameter	Lead				
		Units	µg/g				
		M.D.L.	5				
		Reference Method	EPA 6010				
		Date Analyzed/Site	23-Apr-13/O				
Client I.D.	**Sample I.D.**	**Date Collected**					
P6 S1	B13-08761-1	17-Apr-13	261				
P6 S2	B13-08761-2	17-Apr-13	11				
P6 S3	B13-08761-3	17-Apr-13	14				
P6 S4	B13-08761-4	17-Apr-13	17				
P6 S5	B13-08761-5	17-Apr-13	10				
P6 S6	B13-08761-6	17-Apr-13	< 5				

M.D.L. = Method Detection Limit
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

emcscientific INCORPORATED

Laboratory Analysis Report

To:

Greg Clarkin
Caduceon Enterprises Inc.
2378 Holly Lane
Ottawa, Ontario
K1V 7P1

EMC LAB REPORT NUMBER: A10352
Job/Project Name:
Analysis Method: Polarized Light Microscopy – EPA 600
Date Received: Apr 22/13 **Date Analyzed:** Apr 26/13
Analyst: Bethany Schofield, *Analyst*
Reviewed By: Banu Gurgen-Keough, *Laboratory Manager*

Job No: 130419-EMC
Number of Samples: 7
Date Reported: Apr 26/13

Client's Sample ID	Lab Sample No.	Description/Location	Sample Appearance	SAMPLE COMPONENTS (%) Asbestos Fibres		Non-asbestos Fibres	Non-fibrous Material
B13-08761-7	A10352-1	A6 S1	Non-homogeneous, black, tar material	ND		0.5	99.5
B13-08761-8	A10352-2	A6 S2	Non-homogeneous, black, tar material	ND		0.5	99.5
B13-08761-9	A10352-3	A6 S3	Blue, foam	ND			100
B13-08761-10	A10352-4	A6 S4	Blue, foam	ND			100
B13-08761-11	A10352-5	A6 S5	Black, rubbery material	ND		<0.5	100
B13-08761-12	A10352-6	A6 S6	Black, rubbeyr material	ND		<0.5	100
B13-08761-13	A10352-7	A6 S7	Non-homogeneous, black, tar material	**Chrysotile**	**5**	1	94

Note:
1. Bulk samples are analyzed using Polarized Light Microscopy (PLM) and dispersion staining techniques. The analytical procedures are in accordance with EPA 600/R-93/116 method.
2. The results are only related to the samples analyzed. **ND** = None Detected, **NA** = Not Analyzed (analysis stopped due to a previous positive result).
3. The Ontario Regulatory Threshold for asbestos is 0.5%

APPENDIX B-2

SUMMARY OF ENVIRONMENTAL CONDITIONS REPORT - ADDENDUM

MORRISON HERSHFIELD

SUMMARY OF ENVIRONMENTAL CONDITIONS REPORT- ADDENDUM

Preliminary Design and Environmental Assessment Study for the Rehabilitation / Replacement of Ottawa Queensway Mid-town Bridges from Holland Avenue to O'Connor Street

G.W.P. 4075-11-00

Agreement Number: 4011-E-0025

MH Project Number: 1124127.00

Presented to:

Kevin Ogilvie
Senior Environmental Planner

Ministry of Transportation
1355 John Counter Boulevard
Postal Bag 4000
Kingston, ON
K7L 5A3

Project No. 1124127.00 February 2015

L:\PROJ\1124127\300-DELIVERABLES\306-ENVIRONMENTAL\REPORTING\SECR_ADDENDUM\FINAL_MAY_2015\GWP_4075-11-00_SECR_ADDENDUM_FINAL_FEB_2015.DOCX

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APPENDIX A: Photographic Record

APPENDIX B: Contamination Overview Study (COS) – Addendum

APPENDIX C: Designated Substances and Hazardous Materials Survey (DSHMS) - Addendum

1. INTRODUCTION

1.1 Project Description

The Ministry of Transportation of Ontario (MTO) has initiated a preliminary design and environmental assessment study (GWP 4075-11-00) for the rehabilitation / replacement of twenty-three (23) bridges at twelve (12) locations along the Queensway (Highway 417) between Holland Avenue and O'Connor Street in Ottawa. The project is being undertaken in partnership with Morrison Hershfield Limited (MH) and Bytown Engineering (BTE).

As part of this assignment, the MH / BTE team prepared the following report:

- Summary of Environmental Conditions Report, Preliminary Design and Environmental Assessment Study for the Rehabilitation / Replacement of Ottawa Queensway Mid-town Bridges from Holland Avenue to O'Connor Street, Morrison Hershfield., July, 2013

Subsequent to the issuance of the Summary of Environmental Conditions Report (SECR), the project scope was amended to include the planning, preliminary design and environmental assessment activities to review options for an existing retaining wall along the north right-of-way of the Queensway, east of Bronson Avenue, located adjacent to a privately owned property at 458 Catherine Street (Site 3-748rw).

The added scope of work will be to include the retaining wall as a 24th structure in the preliminary design study. The preliminary design study of the retaining wall will satisfy all requirements of the Ministry's Class EA and include a standalone Structural Design Report.

1.2 Project Location, Broader Study Area, and Local Study Areas

The SECR included the assessment of twenty-three (23) bridges at twelve (12) locations, with each bridge location surrounded by a Local Study Area (LSA) with limits defined as 200 m from the bridge locations. The Broader Study Area (BSA) has limits defined as 500 m from the bridge locations although selected parts of the review extend beyond this area. The BSA, LSAs, and bridge locations are shown in Figure 1-1 below.

Ontario
Summary of Environmental Conditions Report - Addendum (February 2015)
Preliminary Design and Environmental Assessment Study for the Rehabilitation / Replacement of Ottawa Queensway Mid-town Bridges from Holland Avenue to O'Connor Street - G.W.P 4075-11-00

Figure 1-1. Project Broader Study Area and Local Study Areas

The added scope of work necessitates an amendment to the existing study area in order to include the Bronson Avenue retaining wall LSA. As the Bronson Avenue bridge and the Percy Street bridge are less than 300 m apart, their LSAs overlap significantly. Furthermore, the Bronson Avenue retaining wall lies between both bridges and hence, the retaining wall LSA is almost entirely contained within the existing study area. The small area of extension of extension of the study area is shown in Figure 1.2.

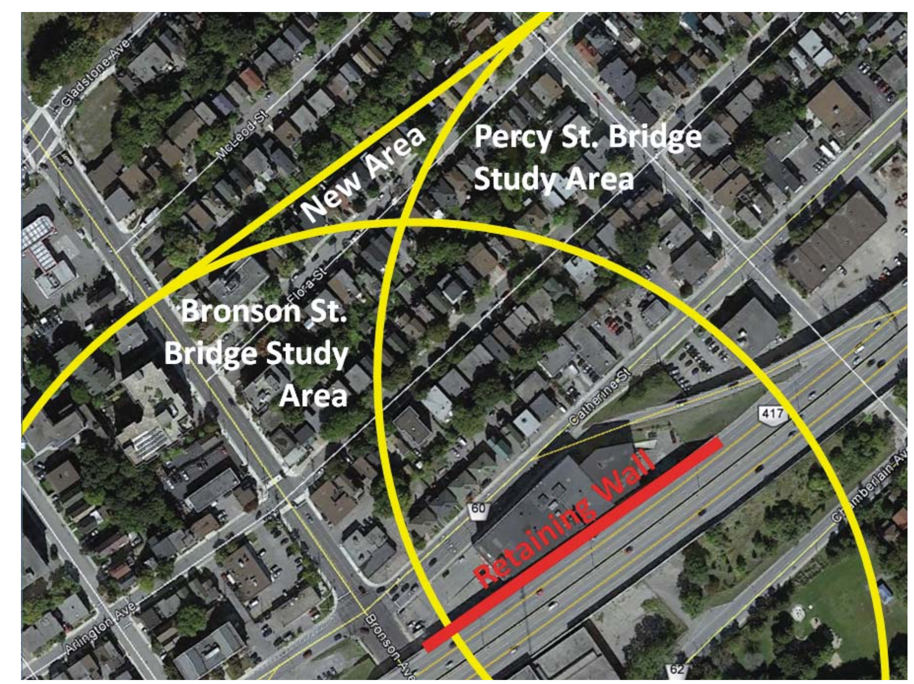

Figure 1-2 Additional Local Study Area for Bronson Avenue Retaining Wall

1.3 Purpose and Layout of Report

This SECR Addendum has been prepared to fulfill the requirements of the Class Environmental Assessment for Provincial Transportation Facilities (2000) – an approved planning process under the Ontario Environmental Assessment Act. The overall Queensway Mid-town Bridges study proposed works are classified as a Group "B" Project and are defined as being projects with major improvements to existing facilities, and/or, potential for significant project effects. Given the potential for significant project effects as well as the potential inter-relationship with at least the Bronson Avenue Queensway bridge sites it is appropriate that the additional study of the Bronson Avenue Retaining Wall be included as part of the Group "B" EA process for the overall Queensway Mid-town Bridges study.

This SECR Addendum, prepared in accordance with the MTO Environmental Reference for Highway Design (2006), provides information regarding the existing LSA of the Bronson Avenue retaining wall. Environmental information used for the production of this report has been assembled from the review of secondary source information as well as from current field investigations conducted specifically for this project. The purpose of the review was to determine the significance of the environmental features found in the LSA and to allow for the identification of potential impacts resulting from the removal or modification of the structure.

2. STAKEHOLDER CORRESPONDENCE

A consultation program has been initiated for the overall Queensway Mid-town Bridges study. Various stakeholders that may have an interest in the project, or that may have background information that could be pertinent to the project, were contacted at the initiation of the consultation program. Property owners at 458 Catherine Street will be contacted as part of the consultation program. Results of the study consultation program will be detailed in the overall study Transportation Environmental Study Report (TESR) as appropriate.

3. PLANNING CONTEXT

3.1 Ministry of Transportation of Ontario Plans

Various MTO plans, guidelines and policy documents as well as standards and specifications are relevant to the planning and implementation of provincial infrastructure projects. Several of these are referenced in the SECR.

3.2 City of Ottawa Plans

3.2.1 City of Ottawa Community Design Plans

One City of Ottawa Community Design Plan (CDP) has been prepared for the Centretown community which overlaps with the Bronson Avenue retaining wall LSA.

Centretown CDP

The Centretown CDP (March 2013) covers a study area that lies north of the Queensway between Bronson Avenue and the Rideau Canal. It addresses many land use / planning issues. Some of the elements of the CDP that may be relevant to the current SECR Addendum include:

- Proposed pedestrian, cycling and/or streetscaping enhancements along Bank Street, O'Connor Street and Catherine Street
- Potential greening / park space opportunities along the Queensway
- Potential intensification / high-rise development along Catherine Street
- Recommendation for a separate Bronson Avenue Community Design Plan to address the entire length of Bronson Avenue's Traditional Mainstreet designation as per the City of Ottawa Official Plan

3.2.2 Zoning Bylaw Amendment

During 2014, the City of Ottawa initiated the Bronson Avenue Traditional Mainstreet Zoning Review to ensure that the Zoning By-law is consistent with the policies of the City's Official Plan, approved by Council in November 2013.

The site at 458 Catherine Street is currently zoned for General Mixed Use - Subzone 3 (GM3) which allows a range of land uses. The City of Ottawa is proposing to change the zoning to Traditional Main Street as part of the Zoning Review (with an exception to permit the existing warehouse use).

3.3 Previous Studies

Numerous other provincial, municipal and other federal projects and studies have been undertaken within the limits of the current overall study. The studies noted below are considered to be of particular relevance to the current memorandum.

3.3.1 MTO Highway 417 (Ottawa Queensway) TESR

MTO completed the Highway 417 (Ottawa Queensway) - from Highway 416 Easterly to Anderson Road - Preliminary Design Study and Environmental Assessment - G.W.P. 663-93-00 - Transportation Environmental Study Report (TESR) in January 2007.

The study examined the highway mainline (i.e. eastbound and westbound through lanes), as well as all interchanges and crossing streets within the interchange limits and provided a recommended plan to 2021 which included:

- Retain the existing number of mainline lanes from Carling Avenue to Metcalfe Street

- Retain the existing basic horizontal and vertical mainline geometry throughout
- Modify the interchanges – including at Parkdale Avenue and Bronson Avenue (south side only for the latter) – to improve safety and traffic operations
- Replace / enhance landscaping

4. EXISTING ENVIRONMENTAL CONDITIONS

The following summary of factor-specific reports and assessments includes relevant subjects related to the natural or built environment, as well as socio-economic conditions within the LSA of the Bronson Avenue retaining wall. For a more detailed review of existing environmental conditions for the overall project BSA and Bronson and Percy LSAs, refer to the SECR.

4.1 Natural environment

4.1.1 Species at Risk (SAR)

The information in the SECR Terrestrial Existing Conditions Report and site specific details were reviewed in more detail for the study area. As well, another review of information from the Natural Heritage Information Centre web site was conducted on December 17, 2014.

There was a confirmed nesting site for Chimney Swift (a threatened species with habitat protection) on the west side of Bronson approximately 190 m north of Highway 417, however, only the chimney the bird is occupying is protected according to the Endangered Species Act (2007) and associated regulations. This is outside the study area.

The area adjacent to the retaining wall to the north currently contains a paved parking lot and a flat-topped building. Based on the results of the review, no rare species or Species at Risk were present on the property parcel north of Highway 417 and east of Bronson during the biophysical field review, and the area does not contain any habitat for any rare species or Species at Risk.

4.2 Cultural Environment

4.2.1 Archaeological Resources

The Stage I Archaeological Assessment undertaken for the overall study (April 2013) found no evidence of archaeological resources within the existing rights-of-way (ROW's) of the Queensway bridge sites, all of which have been significantly disturbed. Further, a search of the archaeological sites database at the Ministry of Tourism, Culture and Recreation indicated that there are no registered sites within one kilometre of any of the bridge sites – which include the area of the Bronson Avenue retaining wall. The study also stated that areas capped by fill or hard paving (i.e. such as the parking lot at 458 Catherine Street),

which had not already been assessed are considered unlikely to need any additional archaeological work if no disturbance to the underlying ground is expected.

The Stage I Archaeological Assessment Report (August 2002) and the Stage II Archaeological Assessment Report (October 2004) undertaken as part of the previous MTO Highway 417 (Ottawa Queensway) TESR (2007) also found no evidence of archaeological resources within the existing ROW of the Queensway which has been significantly disturbed.

4.2.2 Built Heritage and Cultural Heritage Resources

The building at 458 Catherine Street is greater than 50 years old and was previously a bakery owned by Morrison Lamothe (and later by Dempsters). The building does not hold Built Heritage status within any of the following databases:

- Ottawa Built Heritage Advisory Committee – City of Ottawa
- Ontario Heritage Property Database – Ontario Ministry of Culture
- Directory of Federal Heritage Designations – Parks Canada
- Canadian Register of Historic Places – Parks Canada

Although there is not a specific trigger under the Heritage Act to require a heritage screening there may be merit in conducting further heritage screening given that the historic land use of the site may be of local interest.

4.3 Socio-Economic Environment

4.3.1 Land Use

At the time of the original Queensway construction there was a large commercial bakery business in operation adjacent to the Queensway at the site of the retaining wall. The original retaining wall design, which cantilevers out from underneath the Queensway, provided mitigation of the potential economic effects to the business by minimizing the loss of parking and maintaining vehicular access along the south side of the business to the east end of the site.

4.3.1.1 Existing Land Use

The cantilevered retaining wall within the northeast quadrant of the Ottawa Queensway and Bronson Avenue interchange is located adjacent to the A-1 Mini U-Store-It business at 458 Catherine Street, where the commercial bakery once operated. The two-storey building has a footprint area of approximately 3600 m^2. Twenty-five or so parking spaces are dispersed around three sides of the building, eight of which are located beneath the cantilevered section of the retaining wall.

The cantilevered section measures 145 m in length, 4.5 m in depth, and 4 m in height, and extends between Bronson Avenue and the Queensway westbound off-ramp to the east. The area underneath the cantilever is currently utilized for parking spaces as well as the storing of garbage dumpsters. See **Appendix A** for a Photographic Record of the area of the Bronson Avenue Retaining Wall.

Since the City of Ottawa's Bronson Avenue Traditional Mainstreet Review conducted in 2014, all lots abutting Bronson Avenue in the LSA will now have a Traditional Mainstreet zoning designation, including the property located at 458 Catherine Street. An exception to permit the existing warehouse at 458 Catherine has been granted as part of the zoning review. The LSA also contains a General Mixed Use Zone along Catherine Street and a Residential Fourth Density zone along Arlington and Flora Streets.

Northwest of the Queensway / Bronson Avenue interchange, existing land use includes commercial and residential. To the northeast, the area is zoned for General Mixed Use and has a mix of commercial and residential uses. A small parcel of land abutting the south edge of the Queensway, east of Bronson, has recently been rezoned as a Parks and Open Spaces Zone. Existing land uses are depicted in **Figure 4.1** below.

Summary of Environmental Conditions Report - Addendum (February 2015)

Preliminary Design and Environmental Assessment Study for the Rehabilitation / Replacement of Ottawa Queensway Mid-town Bridges from Holland Avenue to O'Connor Street - G.W.P 4075-11-00

Figure 4-1. Figure 4 1. Bronson Avenue Retaining Wall - Existing Land Use

4.3.1.2 Future Land Use

The LSA is subject to a City of Ottawa Special Infill Provision. Although infill is generally considered desirable as it has less need for additional City services and infrastructure, it must also be compatible with existing adjacent communities and land uses. Further information and recommendations from the City regarding infill can be found in the SECR.

Both east and west sides of Bronson Avenue are considered to be Design Priority Areas by the City. Design Priority Areas are mixed-use nodes and corridors that are significant to the City's overall design. They are subject to design review by the City's Urban Design Review Panel.

The storage warehouse at 458 Catherine Street does not meet land use criteria outlined by the Bronson Avenue Traditional Mainstreet Review but retains non-conforming rights to continue its industrial use on the property. If the existing use is eventually discontinued, the non-conforming rights will be lost and non-permitted uses will not be re-established.

4.4 Contaminated Property and Waste Management

4.4.1 Contamination Overview

A Contamination Overview Study (COS) was originally conducted for an area encompassing 250 m from the bridge sites and is documented in the SECR. However, the addition to the study of the Bronson Avenue retaining wall adjacent to 458 Catherine Street requires an extension of the original study area for the COS to include the retaining wall and 250 m buffer. Additional records review, site reconnaissance, data analysis and reporting were conducted and results are compiled in a COS Addendum.

No additional land uses with medium or high risk rating were noted. A 10th area of potential concern was included due to the potential for existing or former underground storage tanks (USTs) as well as potential for soil and/or groundwater contamination. Recommendations of the COS addendum include the development of an Excess Materials Management Plan (EMMP) and additional soil and groundwater investigation (Phase II ESA) at the Bronson Avenue retaining wall. See **Appendix A** for the Addendum to the Contamination Overview Study.

4.4.2 Designated Substances and Hazardous Materials

A Designated Substance and Hazardous Materials Survey (DSHMS) was originally conducted for an area encompassing 250 m from the bridge sites and is documented in the SECR. However, the addition to the study of the Bronson Avenue retaining wall adjacent to 458 Catherine Street requires an extension of the original study area for the DSHMS to include the retaining wall and 250 m buffer. Additional drawings review, site inspection, and laboratory analysis were conducted and results of the survey are compiled in a DSHMS Addendum. These results include suspected and confirmed asbestos containing material (ACM) as well as the probable generation of silica dust during construction. See **Appendix B** for the Addendum to the Designated Substance & Hazardous Materials Survey.

5. SUMMARY OF SIGNIFICANT ENVIRONMENTAL CONDITIONS

The following provides a brief summary of key findings.

In terms of natural environment, the LSA contains no features of significant environmental concern. No habitat for rare species of species at risk has been identified in the Bronson Avenue retaining wall LSA.

In terms of the cultural environment, there is no evidence of archaeological resources within the existing right-of-way of the Queensway, which has been significantly disturbed. There are no registered sites within one kilometre of the retaining wall.

No built heritage or cultural heritage resources been identified as being likely to be affected by the project. The building at 458 Catherine Street is not listed within any municipal, provincial, or federal heritage building databases. Although there is not a specific trigger under the Heritage Act to require a heritage screening there may be merit in conducting further heritage screening given that the historic land use of the site may be of local interest.

In terms of the socio-economic environment, land use within the LSA is mostly commercial with some residential use. Land use at 458 Catherine Street is industrial in the form of a private A-1 Mini U-Store-It business.

The City of Ottawa Land Use designation categorizes Bronson Avenue as a Traditional Mainstreet Zone, with a small parcel of land abutting the south edge of the Queensway, east of Bronson, as a Parks and Open Spaces Zone. Other portions of the LSA include a General Mixed Use Zone along Catherine Street and a Residential Fourth Density zone along Arlington and Flora Streets.

An addendum to the Contaminated Overview Study (COS) was completed in order to assess the extension of the study area associated with the retaining wall. An additional area of potential concern was included due to the potential for existing or former underground storage tanks (USTs) as well as potential for soil and/or groundwater contamination at 458 Catherine Street. An addendum to the Designated Substance and Hazardous Materials Survey (DSHMS) was also completed and found confirmed and suspected asbestos containing material at the site within the area of the MTO retaining wall.

6. REFERENCES

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APPENDIX A: Photographic Record

MEMORANDUM

MORRISON HERSHFIELD

TO:	Project File	ACTION BY:	N/A
FROM:	Karine Bertrand, Environmental Planner	FOR INFO OF:	MTO
PLEASE RESPOND BY:	N/A	PROJECT No.:	1124127.00
RE:	Queensway Mid-Town Bridges, Bronson Avenue Retaining Wall - Photographic Record	DATE:	January 8, 2015

L:\PROJ\1124127\300-DELIVERABLES\306-ENVIRONMENTAL\BRONSON_AVE_RETAINING_WALL\APPENDICES\APPENDIX A - PHOTOGRAPHIC RECORD\DRAFT_BRONSON AVENUE RETAINING WALL_PHOTOGRAPHIC RECORD_GWP4075-11-00_JAN 8 2015

The following images have been collected as part of the Bronson Avenue Retaining Wall Photographic Record for the Ottawa Queensway Mid-town Bridges Preliminary Design and Environmental Assessment Study (GWP 4075-11-00).

Bronson Avenue

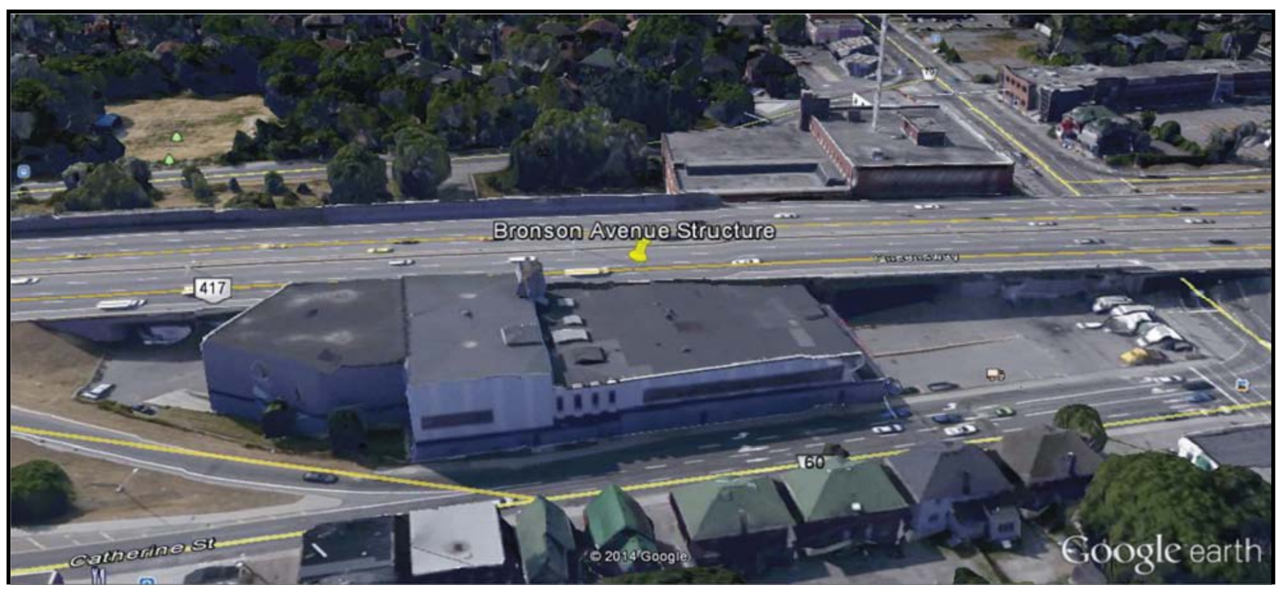

Figure 1. Bronson Avenue Aerial Photo (looking south) - Google Earth

Figure 2. Bronson Avenue Retaining Wall (looking east from west end)

Figure 3. Bronson Avenue Retaining Wall (looking west from east end)

Figure 4. Bronson Avenue Retaining Wall (looking east, underneath cantilevered section)

APPENDIX B: Contamination Overview Study (COS) – Addendum

MORRISON HERSHFIELD

May 25, 2015 Ref: 1124127

Kevin Ogilvie
Senior Environmental Planner
Ministry of Transportation
1355 John Counter Blvd. P.O. 4000
Kingston, ON
K7L 5A3

Dear Mr. Ogilvie:

Re: G.W.P. 4075-11-00, Agreement # 4011-E-0025
Contamination Overview Study (COS) - Addendum
Bronson Avenue Retaining Wall (458 Catherine Street)

Background

Morrison Hershfield (MH) has been retained by the Ontario Ministry of Transportation (MTO) for the Preliminary Design and Environmental Assessment Study for the Rehabilitation / Replacement of Ottawa Queensway Mid-town Bridges from Holland Avenue to O'Connor Street, GWP 4075-11-00.

As part of this assignment, MH prepared the following report:

- Contamination Overview Study, Preliminary Design and Environmental Assessment Study for the Rehabilitation / Replacement of Ottawa Queensway Mid-town Bridges from Holland Avenue to O'Connor Street, Morrison Hershfield., July, 2013.

The study area for that Contamination Overview Study (COS) included twenty-three (23) bridges (twelve locations) with a 250 m buffer along the Queensway from Holland Avenue to O'Connor Street, which are highlighted on Figure 1.

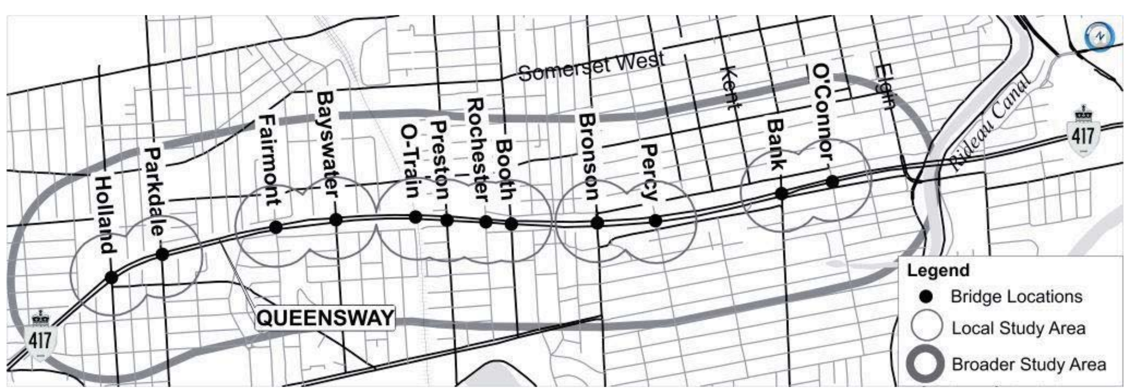

Figure 1 - Original Study Area

Subsequent to the issuance of the COS, the following structure was added to the scope of the project:

- +/- 200 m Retaining Wall at the northeast quadrant of the Ottawa Queensway and Bronson Avenue interchange – adjacent to A-1 Mini U-Store-It at 458 Catherine Street.

Scope of Work

The scope of work for a COS is described in detail in the COS report. The scope of work for the work reported in this letter was to extend the study area for the COS to include the retaining wall and 250 m buffer, and to update the findings of the COS accordingly. Since the retaining wall lies between the Bronson Avenue bridge and the Percy Street bridge, and since these two bridges are less than 300 m apart, the extended study, including 250 m buffer was almost entirely contained within the existing study area. The small area of extension of the study area is shown in Figure 2.

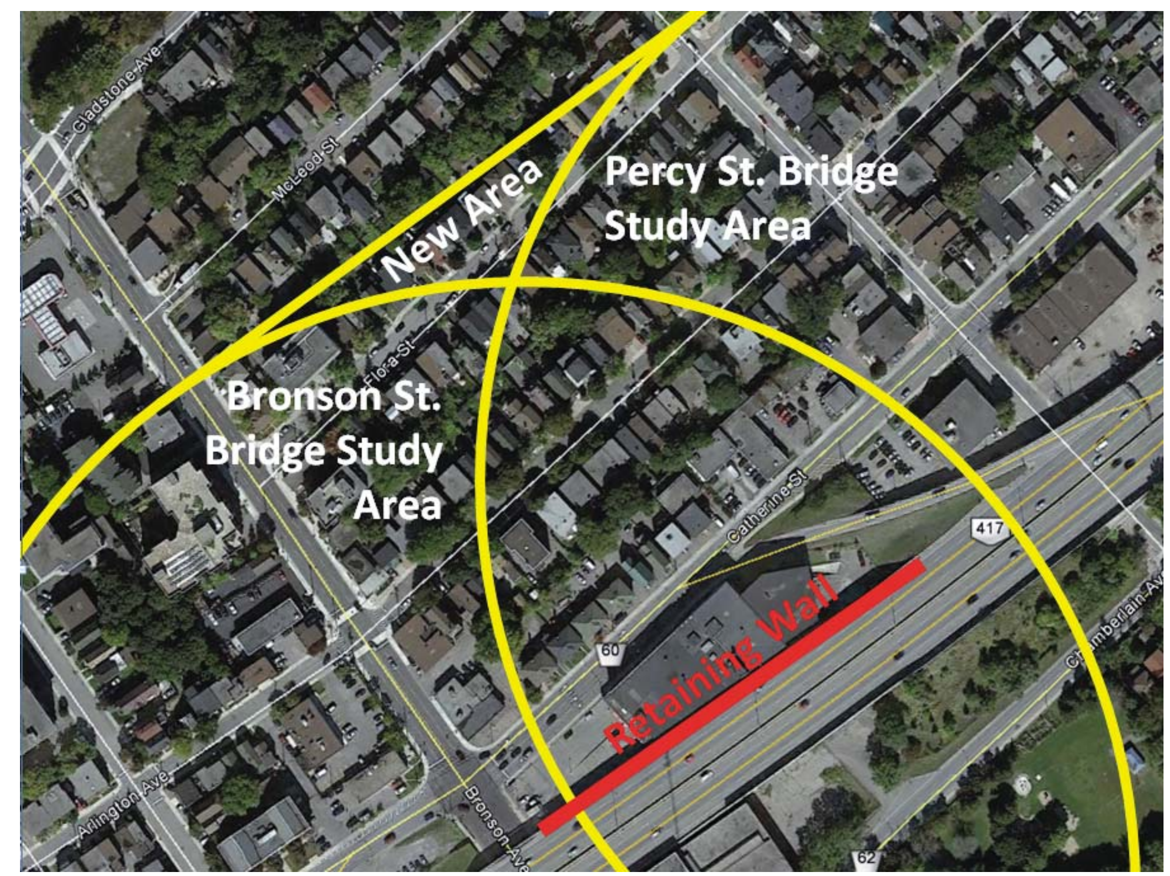

Figure 2 - Additional Study Area

Methodology

The methodology for the work is described in the COS report. The methods include a records review, site reconnaissance, data analysis and reporting. The remainder of this letter is an addendum with section headings as in the COS report.

Physical Setting

The physical setting is the same as in the COS report.

Records Review

The records review is unchanged from the COS report with the exception that the original drawing for the retaining wall dated 1962 was reviewed. The drawing indicated that the building currently occupied by A-1 Mini U-Store-It (self-storage warehouse) was the Canada Bread Company in 1962.

Site Reconnaissance

The site reconnaissance was performed on November 11th, 2014. No additional land uses with medium or high risk rating were noted during the site reconnaissance.

Key Findings

The key finding is that current and historical land use on, adjacent to and in proximity to the retaining wall site has varying potential to impact soil and/or groundwater quality during construction. Activities or land uses with a medium or high risk rating determined from the records review and/or site reconnaissance are summarized in this addendum to Table 5.1 of the COS report.

Table 5.1 - Addendum. Summary of Activity or Land Use with Medium to High Risk Rating

Site	Factor with Medium or High Risk
Retaining Wall NE Quadrant Bronson Ave. and Highway 417	• High: A-1 Storage, adjacent to retaining wall site, risk of fuel tanks • Medium: Modern Dry Cleaners, solvent use over decades • Medium: Vacant Institutional (former OCDSB), 35 m south of retaining wall, risk of fuel tanks • Medium: Jason Plunkett in HLUI, prior industrial land use • Medium: McAuliffe Davis Lumber Co. Limited, prior industrial land use • Medium: Generic Former Landfill ID in HLUI • Medium: Ottawa Hydro from HLUI, location uncertain

Areas of Potential Environmental Concern

Based on the findings, there is potential site contamination within the study area, which could have an impact on construction activities. To guide in management of these potential impacts, a new area of potential environmental concern (APEC) is identified (as a part of Section 6 of the previous COS report - G.W.P. 4075-11-00):

- **Area 10 – A-1 Self Storage/Former Canada Bread Company Building, at the Bronson Retaining Wall.** The property is currently occupied by A1 Self Storage, and the building is situated a few metres north of the Bronson Avenue retaining wall. Given the past use of the property as the Canada Bread Company, there is some potential for existing or former underground storage tanks (USTs). There is also some potential for soil and/or groundwater contamination.

Recommendations

Based on the results of this study, one (1) APEC was identified, which has potential for site contamination which could impact construction activities. Recommendations to manage these potential impacts are as follows:

1. An Excess Materials Management Plan (EMMP) should be developed prior to construction to manage excess materials and groundwater generated during replacement or rehabilitation of the Bronson Avenue retaining wall.

2. The requirement for additional soil and groundwater investigation (Phase II ESA) at the Bronson Avenue retaining wall site to address the APEC identified in this study should be determined once the scope of work to be conducted. The number and location of boreholes and the selection of chemical parameters (Contaminants of Concern) should be determined considering the proposed construction activities, the specifics of the APEC, and the geological and hydrogeological setting. The Phase II ESA can be coordinated with the geotechnical investigation, where feasible.

See next page…

Closure

The qualifications for the assessors and the limitations and use of this letter are as stated in the COS report.

Yours truly,
Morrison Hershfield Limited

Anthony West

Anthony (Ant) West, Ph.D., P.Eng.
Senior Geo-Environmental Engineer / Practice Leader
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613 739 2910 Ext. 1022424

APPENDIX C: Designated Substances and Hazardous Materials Survey (DSHMS) - Addendum

MORRISON HERSHFIELD

May 25, 2015 Ref: 1124127

Kevin Ogilvie
Senior Environmental Planner
Ministry of Transportation
1355 John Counter Blvd. P.O. 4000
Kingston, ON
K7L 5A3

Dear Mr. Ogilvie:

Re: G.W.P. 4075-11-00, Agreement # 4011-E-0025
Designated Substance & Hazardous Materials Survey (DSHMS) - Addendum
Bronson Avenue Retaining Wall (adjacent to 458 Catherine Street)

Background

Morrison Hershfield (MH) has been retained by the Ontario Ministry of Transportation (MTO) for the Preliminary Design and Environmental Assessment Study for the Rehabilitation / Replacement of Ottawa Queensway Mid-town Bridges from Holland Avenue to O'Connor Street, GWP 4075-11-00.

As part of this assignment, MH prepared the following report:

- Designated Substance & Hazardous Materials Survey, Preliminary Design and Environmental Assessment Study for the Rehabilitation / Replacement of Ottawa Queensway Mid-town Bridges from Holland Avenue to O'Connor Street, Morrison Hershfield, July, 2013.

The study area for that Designated Substance and Hazardous Materials Survey (DSHMS) included twenty-three (23) bridges (twelve locations) along the Queensway from Holland Avenue to O'Connor Street, which are highlighted on Figure 1.

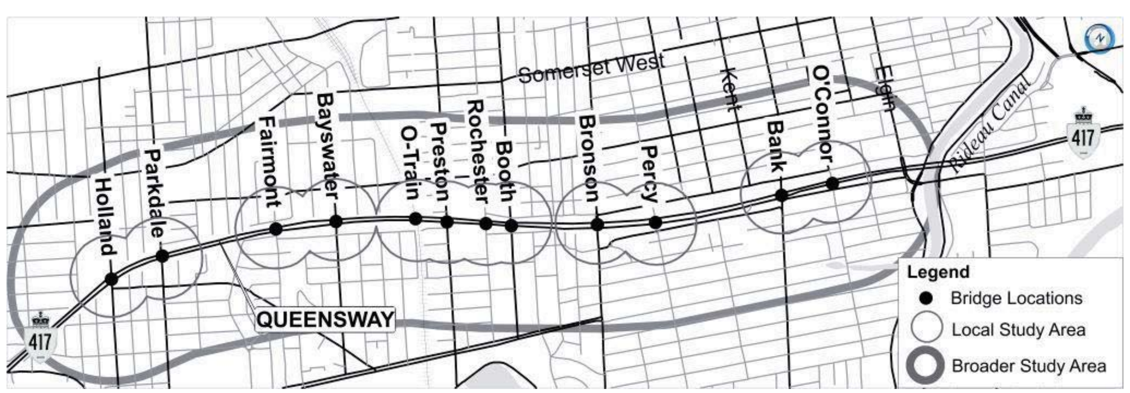

Figure 1 - Original Study Area

Subsequent to the issuance of the DSHMS report, the following structure was added to the scope of the project:

- +/- 200 m Retaining Wall at the northeast quadrant of the Ottawa Queensway and Bronson Avenue interchange - adjacent to A-1 Mini U-Store-It at 458 Catherine Street.

Scope of Work

The scope of work for a DSHMS is described in detail in the DSHMS report. The scope for the work reported in this letter was to extend the study area to include the retaining wall, and to update the findings of the DSHMS accordingly.

Methodology

The methodology for the work is described in the DSHMS report. The methods include a drawings and reports review, site inspection, laboratory analysis, assessment and reporting. The remainder of this letter is an addendum with section headings as in the DSHMS report.

Drawings and Reports Review

The General Arrangement Drawing for Ottawa Queensway Limited Access Highway, Bridge No. 18 at Bronson Avenue, dated 1962 identifies 48 4” diameter transite drainage ducts near the base of the retaining wall, one (1) 2.5” (6.35 cm) transite electrical duct embedded in the sidewalk / coping at the top of the retaining wall, and three (3) 4” (10.16 cm) transite electrical ducts embedded below the sidewalk / coping, also at the top of the retaining wall. The rehabilitation drawings for the retaining wall (WP 176-80-02, Bronson Avenue Overpass Structure Repairs, Barrier Wall – Exterior, Delcan, 1984) indicate that all these ducts were to be left in place and filled with expanding cement grout.

Site Inspection

The site inspection was performed on November 11th, 2014. The retaining wall was inspected for potential lead and asbestos containing material.

Summary of Findings

Table 4.1 below provides a summary of findings for the Designated Substances and Hazardous Materials Survey for each of the twelve (12) sites based on lab results. Suspected materials detected during lab analysis have been highlighted. A detailed list of findings from the inspection for each site is available in Attachment A. The laboratory Certificate of Analysis is included in Attachment B.

Table 4.1. Summary of Findings

Site And MTO Structure #	Asbestos	
	Suspected Material	**Confirmed**
Bronson Ave. Retaining Wall	Embedded electrical ducts	Not Tested
	Construction Joint Caulking	No Asbestos
	Construction Joint Mortar	No Asbestos
	4 " Transite drainage ducts in retaining wall at multiple locations	**15-20 % Chrysotile and 3-5 % Crocidolite Above Threshold (0.5%)**

Conclusions and Recommendations

Based on the results of the drawings review, the initial and detailed inspection, and the laboratory analysis, it is concluded that structures contain the following potential or confirmed asbestos containing material (ACM):

- 2.5" (6.35 cm) transite electrical duct embedded within the coping/sidewalk at top of retaining wall (suspected ACM)
- Three (3) 4" (10.16 cm) transite electrical ducts embedded below the sidewalk/coping at top of retaining wall (suspected ACM)
- Forty-eight (48) 4" (10.16 cm) transite drainage ducts through the retaining walls on 12' (3.66 m) centres (confirmed ACM).

The following recommendations apply to all suspected and confirmed ACM:

- Materials must be maintained in good condition.
- Any work with the potential to disturb ACM shall be carried out in accordance with O. Reg. 278/05, as amended: Designated Substances – Asbestos on Construction Projects and in Buildings and Repair Operations.
- Asbestos containing waste must be handled in accordance with R.R.O. 1990, Regulation 347 General – Waste Management.
- Appropriate work procedures and precautionary measures should be carried out in accordance with Ontario Regulation 278/05.

Lead

No evidence of lead was noted during the site inspection.

Silica

By weight, the majority of the structure is silica, and it is likely that any work on the structure will generate silica dust. All construction activities should be conducted in accordance with Guideline: Silica on Construction Projects, published by the Occupational Health and Safety Branch of the Ministry of Labour, dated April 2011.

PCB

No PCB-containing equipment (i.e., transformers) was noted on the drawings or during the inspection.

Other Designated Substances

Based on the scope of work performed, there are no other designated substances suspected to exist within the structures.

Closure

The qualifications for the assessors and the limitations and use of this letter are as stated in the DSHMS report.

Yours truly,
Morrison Hershfield Limited

Anthony West

Anthony (Ant) West, Ph.D., P.Eng.
Senior Geo-Environmental Engineer / Practice Leader
awest@morrisonhershfield.com
613 739 2910 Ext. 1022424

Attach:
A - Site Summary Sheet – Bronson Retaining Wall
B - Analytical Results

L:\PROJ\1124127\300-DELIVERABLES\306-ENVIRONMENTAL\REPORTING\SECR_ADDENDUM\FINAL_MAY_2015\APPENDICES\APPENDIX C - DSHMS - ADDENDUM\BRONSON RETAINING WALL DSHMS ADDENDUM_DEC_16_2014.DOCX

ATTACHMENT A

BRONSON AVENUE RETAINING WALL (Adjacent to 458 Catherine Street)

DRAWINGS AND REPORTS REVIEWED

1. Department of Highways of Ontario. Ottawa Queensway, Limited-Access Highway, Ottawa, Canada. Bridge No. 18 at Bronson Ave., W.P. No. 944-59, 1962. (Original Drawings).
2. Bronson Ave. Overpass Structure Repairs, W.P. No. 176-80-02, 1984. (Rehabilitation Drawings).
3. Detailed Condition Survey, Bronson Ave. Overpass. Prepared for MTO, 2012.

FINDINGS

Asbestos

Material	Location	Friable	Sampled #	Asbestos Type and % Present (limit 0.5%)	Comment
Construction Joint Caulking	Retaining Wall Joints	No	Yes Abs-S1	None	See Photo 01a
Construction Joint Mortar	Retaining Wall Joints	No	Yes Abs-S2	None	See Photo 01b
Transite Drainage Duct	Multiple locations of the retaining wall	Yes	Yes Abs-S4 - Abs-S7	**15-20 % Chrysotile and 3-5 % Crocidolite Above Threshold (0.5%)**	See Photo 02

PHOTOS

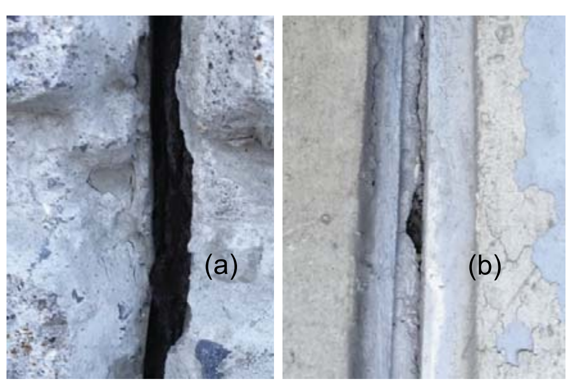

Photo 01: Caulking and mortar in construction joints

Photo 02: Transite drainage duct

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Certificate of Analysis

Morrison Hershfield Ltd. (Ottawa)
2440 Don Reid Dr.
Ottawa, ON K1H 1E1
Attn: Cindy Zhao

Phone: (613) 739-2910
Fax: (613) 739-4926

Client PO: 1124127
Project:
Custody: 8869

Report Date: 17-Nov-2014
Order Date: 11-Nov-2014

Order #: 1446127

This Certificate of Analysis contains analytical data applicable to the following samples as submitted :

Paracel ID	Client ID
1446127-01	Abs-S1
1446127-02	Abs-S4
1446127-03	Abs-S5
1446127-04	Abs-S6
1446127-05	Abs-S7
1446127-06	Abs-S8
1446127-07	Abs-S2

Approved By:

Emma Diaz For Heather S.H. McGregor, BSc
Laboratory Director - Microbiology

PARACEL LABORATORIES LTD.

Client: Morrison Hershfield Ltd. (Ottawa)
2440 Don Reid Dr.
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Attn: Cindy Zhao
Tel: (613) 739-2910
Fax: (613) 739-4926

Project:
Paracel Report No.: 1446127
Received Date: 11-Nov-14
Report Date: 17-Nov-14

Asbestos, PLM Visual Estimation **MDL - 0.5%**

Paracel I.D.	Sample Date	Layers Analyzed	Colour	Description	Asbestos Detected:	Material Identification	% Content
1446127-01	11-Nov-14	sample homogenized	Black	Caulking	No	Client ID: Abs-S1 [AS-PRE]	
						Cellulose	30
						Non-Fibers	70
1446127-02	11-Nov-14	sample homogenized	Grey	Duct	**Yes**	Client ID: Abs-S4	
						Chrysotile	15
						Crocidolite	3
						Non-Fibers	82
1446127-03	11-Nov-14	sample homogenized	Grey	Duct	**Yes**	Client ID: Abs-S5	
						Chrysotile	20
						Crocidolite	5
						Non-Fibers	75
1446127-04	11-Nov-14	sample homogenized	Grey	Duct	**Yes**	Client ID: Abs-S6	
						Chrysotile	20
						Crocidolite	3
						Non-Fibers	77
1446127-05	11-Nov-14	sample homogenized	Grey	Duct	**Yes**	Client ID: Abs-S7	
						Chrysotile	20
						Crocidolite	3
						Non-Fibers	77
1446127-06	11-Nov-14	sample homogenized	Black	Caulking	No	Client ID: Abs-S8 [AS-PRE]	
						Non-Fibers	100
1446127-07	11-Nov-14	sample homogenized	Grey	Joint Mortar	No	Client ID: Abs-S2 [AS-PRE]	
						Non-Fibers	100

MMVF: Man Made Vitreous Fibers: Fiberglass, Mineral Wool, Rockwool, Glasswool
Analytes in bold indicate asbestos content which may include:
Actinolite, Amosite, Anthophyllite, Chrysotile, Crocidolite and/or Tremolite.

PARACEL LABORATORIES LTD.

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Project:
Paracel Report No.: 1446127
Received Date: 11-Nov-14
Report Date: 17-Nov-14

Analysis Summary Table

Analysis	Method Reference/Description	Lab Location	NVLAP Lab Code *	Analysis Date
Asbestos, PLM Visual Estimation	by EPA 600/R-93/116	Ottawa West Lab	200812-0	17-Nov-14

** Reference to the NVLAP term does not permit the user of this report to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.*

Report Notes

AS-PRE Due to the difficult nature of the bulk sample (interfering fibers/binders), additional NOB preparation was required prior to analysis

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Nº 8869

Page 1 of 1

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TAT: [X] Regular [ ] 3 Day [ ] 2 Day [ ] 1 Day [ ] Same Day

Date Required: ______

ASBESTOS ANALYSIS

Matrix: [ ] Air [ ] Other **Regulatory Guideline:** ______ **Required Analyses:** [ ]PCM [X]PLM [ ]PLM 400PC [ ]PLM 1000PC [ ]Chatfield [ ]TEM

Paracel Order Number: 1446127

	Sample ID	Matrix Description	Sampling Date	Air Volume (L)	Positive Stop? (Y/N)	Is the Sample Layered? (Y/N)	If layered, Describe Layer(s) to be Analyzed Separately* or Homogenize all **
1	Abs-S1	Caulk	11-Nov-14		N	N	
2	Abs-S4	Duct	"		"	"	
3	Abs-S5	"	"		"	"	
4	Abs-S6	"	"		"	"	
5	Abs-S7	"	"		"	"	
6	Abs-S8	Caulk	"		"	"	
7	Abs-S2	Joint	"		"	"	
8							
9							
10							
11							
12							
13							
14							
15							

* Each layer is charged as a separate analysis ** Homogenize = Sample is combined to a uniform mixture

Comments:

Method of Delivery: Walkin

Relinquished By (Sign): [signature]	Received at Depot: [signature]	Received at Lab: Karen Cull	Verified By: Karen Cull
Relinquished By (Print): Cindy Zhao			
Date/Time: 11-Nov-14	Date/Time: Nov 11/14 1:47pm	Date/Time: Nov 12/14 8:30	Date/Time: Nov 12/14 9:12

Copy of Chain of Custody (Asbestos) - Rev 0.4 July 2014 xlsx.xlsx

APPENDIX C

ANALYSIS & EVALUATION REPORT

ANALYSIS AND EVALUATION REPORT

Preliminary Design and Environmental Assessment Study for the Rehabilitation / Replacement of Ottawa Queensway Mid-town Bridges from Holland Avenue to O'Connor Street

G.W.P. 4075-11-00

Agreement # 4011-E-0025

BTE Project # 2013-001

Presented to:

Ministry of Transportation
1355 John Counter Boulevard
Postal Bag 4000
Kingston, ON
K7L 5A3

Project No. 2013-001 June 12, 2015

Ce document hautement spécialisé n'est disponible qu'en anglais en vertu du règlement 671 / 92, qui en exempte l'application de la Loi sur les services en français. Pour de l'aide en français, veuillez communiquer avec Heather Edwardson, ministère des Transports, au 905 704-2210.

EXECUTIVE SUMMARY

A Group 'B' Environmental Assessment (EA) is being undertaken by the Ministry of Transportation (MTO), under their Class Environmental Assessment for Provincial Transportation Facilities (July 2000), for a bridge management plan for structural improvements (rehabilitation or replacements) to bridges on the Ottawa Queensway (Highway 417) from Holland Avenue easterly to O'Connor Street. The project is being described as the Ottawa Queensway Mid-town Bridges Project.

The MTO's Provincial Class EA is a planning process developed to ensure that all potential natural, social/cultural and economic environments as well as property and land use effects are considered in undertaking Ministry Class EA projects.

This document summarizes the analysis and evaluation process used to systematically analyze, evaluate and select Technically Preferred Alternatives (TPAs) for the 23 bridges. This sequential methodology includes community and stakeholder input at all key stages of the study. The effects and mitigation as a result of the TPA for each bridge site may be modified during subsequent stages of public consultation and will be further defined at the detail design stage. This document will become a component of the single Transportation Environmental Study Report (TESR) which will address all 23 bridges.

This report reflects the technical evaluation process up to the preliminary identification of Technically Preferred Alternatives (TPA's). The preliminary TPA's will be presented to the public at PIC No. 2. They may by modified following PIC No. 2.

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GLOSSARY OF TERMS

AASHTO	American Association of State and Highway Transportation Officials
Adjacent	Adjacent indicates lying near MTO or Municipal roadway rights-of-way, although not necessarily contiguous to them.
Aesthetics	Methods of providing visual relief and appealing characteristics to planned noise barriers thorough the application of landscaping designs.
Alternative	Well-defined and distinct course of action that fulfills a given set of requirements. The EA Act distinguishes between Alternatives to the Undertaking and <u>Alternative Methods of Carrying out the Undertaking.</u>
Coarse Screening	Initial screening of a group of alternatives. Also see Screening.
Criterion(a)	Explicit feature or consideration used for comparison of alternatives.
Dichotomous Utility Function	A utility function that represents a desirable or undesirable response from a criterion (yes/no, present/absent, true/false).
Dimensionless Number	A number that does not have a unit of measurement, such as length (m), time (s), mass (kg) associated with it. Examples include Utility Score and Overall Score.
Do Nothing Alternative	This alternative is a mandatory requirement of the Class EA. This option is the null or no action alternative and it becomes the baseline to which all alternatives are compared.
Double Counting	Unintentional accounting for a particular factor or attribute more than once in the evaluation.
EA	Environmental Assessment
Evaluation	The outcome of a process that appraises the advantages and disadvantages of alternatives.
Evaluation Criteria	See Criteria.
Evaluation Process	The process involving the identification of criteria, rating of predicted impacts, assignment of weights to criteria, aggregation of weights, and rating to produce an ordering of preference of alternatives.
Factor	See Global Factors.
Freeway	Freeway is defined as an existing completed, partially developed (staged) or proposed divided highway with full control of access and grade separated intersections. This definition may include some highways that are not officially designated as freeways.
Function Form	See Utility Function
Global Factors	The main categories of factors, (i.e. Transportation, Economic Environment, Natural Environment, Social and Cultural, Land Use and Property and Cost). All sub-factors are components or a subset of global factors.
Jack and Slide	An accelerated bridge method which laterally moves a replacement bridge in place from an adjacent staging area.
Linear Utility Function	A function that can be defined using a linear equation of the form: $y = a + bx$, where y is the dependent variable (raw score) x is the independent variable (measurement) b is the slope of the function, and a is the y intercept, normalized in this study to be equal to one or zero
MAC	Municipal Advisory Committee
Matrix	A rectangular array of criteria and values.
Mitigation	Taking actions that either remove or alleviate to some degree the negative impacts associated with the implementation of alternatives.

MUP	Multi-use pathway
Overall Score	The final value of an alternative's score derived by summing all of the weighted scores.
PAC	Public Advisory Committee
Performance Factor	See Utility Function
PIC	Public Information Centre
Ranking	The ordering of alternatives from first to last for comparison purposes.
Raw Data	The measurement of the impact, or measured data, under each criterion.
RBR	Rapid Bridge Replacement
Risk	Probability that a given outcome will or will not materialize. Distinct from uncertainty in that the alternative outcomes are known or defined and that the probability of each is measureable.
Screening	Process of eliminating alternatives from further consideration, which do not meet minimum conditions or categorical requirements.
Semi Integral abutments	A bridge superstructure design that removes the use of expansion joints for a simply supported bridge deck.
Step Function	A utility function can be defined by several linear functions within separate ranges that have a slope equal to zero. For this study, two step functions are used: Case A: y = 1, for x = desirable and y = 0, for x = undesirable Case B: y = 1 for x = desirable, y = 0.5 for x = medium performance and y = o for x = undesirable
Sub-factor	A single criterion used for the evaluation. Each sub-factor is grouped under one of the factors.
TAC	Technical Advisory Committee
TPA	Technically Preferred Alternative
Traceability	Characteristic of an evaluation process which enables its development and implementation to be followed with ease.
Transportation Environmental Study Report (TESR)	This report is prepared in compliance with the EA Act requirements and the Ministry of the Environment for acceptance, approval, informational or monitoring purposes and the public record.
Utility Function	A function (linear, step, dichotomous) that represents the Utility Score versus the criterion measurement or desirableness.
Utility Score	The "y" value derived from the Utility Function of the measurement of the impact induced by a particular alternative's criterion. A measurement of the usefulness or attractiveness of an alternative with respect to an individual evaluation criterion based on its measured effect (a number between 0 and 1). The utility score is dimensionless.
Weight	The importance attributed to a criterion relative to other criterion. The value of the weight is expressed in a percentage and the sum of all criterion weights is equal to 100%.
Weighted Additive Method	The method used in the quantitative evaluation of alternatives, which reduces the project's numerous criteria into a dimensionless number for each alternative suitable for comparison.
Weighted Score	A raw score that has been multiplied by the criterion weights. The weighted scores reflect the social value or importance of the specific group providing weights.

1 INTRODUCTION

The purpose of this report is to summarize the analysis and evaluation of structural alternatives for 23 bridge sites along the Ottawa Queensway (Highway 417) from Holland Avenue easterly to O'Connor Street in the City of Ottawa. This report is a component of the Group B Provincial Class Environmental Assessment (EA).

The EA process requires that all candidate alternatives be evaluated in a manner that is systematic, traceable and transparent. This includes a commitment to open and meaningful public consultation. The analysis and evaluation process must recognize public and agency input as well as MTO standards and requirements. This report documents the decision-making process used to select the Technically Preferred Alternative (TPA), including the following activities:

- Assessment of Alternatives to the Undertaking;
- Dividing the Study Area into three study sub-sections with similar land uses and/or characteristics;
- Development of a long-list of structural and highway staging alternatives for each roadway section and bridge site;
- Identification of the candidate long-list of assessment factors and sub-factors and screening out those where there were no meaningful and measurable differences among the alternatives as well as those that do not apply to the study area, based on the site inventories carried out;
- Screening out of alternatives which do not achieve the basic project requirements and/or do not comply with MTO standards/requirements (refer to Section 6.1);
- Identification of the benefits and potential impacts for the short-listed alternatives;
- Evaluation of short-listed alternatives using a recognized evaluation technique including weighting the relative importance of criteria;
- Ranking alternatives;
- Sensitivity testing to assess the robustness of the evaluation and alternative scores; and
- Selection of the TPA based on the evaluation results.

2 STUDY PURPOSE

The context for the overall network "planning" for the Queensway corridor was previously reviewed and defined as part of an EA Study completed in 2007. That study concluded that there would be no expansion (widening for additional lanes) within the current study area being considered as part of this EA. The 2007 EA study completed the "planning" phase of the Queensway corridor plan. Subsequent post-2007 EA studies are being undertaken to consider follow-up preliminary design phase. This current study is a preliminary design study that focuses on 23 bridges in the Study Area (**Figure 3.1**). Other post-2007 projects are also being implemented that focus on ramp operational improvements and bridge replacements (e.g. the Kent Street Bridge).

2.1 Scope

This project will identify a bridge management strategy to address the structural needs of the Queensway Mid-town bridges. These overpass bridges include:

- Site No. 3-050.1 - Highway 417 Eastbound Lanes (EBL) over Holland Avenue
- Site No. 3-050.2 - Highway 417 Westbound Lanes (WBL) over Holland Avenue
- Site No. 3-051.1 - Highway 417 EBL over Parkdale Avenue
- Site No. 3-051.2 - Highway 417 WBL over Parkdale Avenue
- Site No. 3-052.1 - Highway 417 EBL over Fairmont Avenue
- Site No. 3-052.2 - Highway 417 WBL over Fairmont Avenue
- Site No. 3-053.1 - Highway 417 EBL over Bayswater Avenue
- Site No. 3-053.2 - Highway 417 WBL over Bayswater Avenue
- Site No. 3-054.1 - Highway 417 EBL over CPR/O-Train
- Site No. 3-054.2 - Highway 417 WBL over CPR/O-Train
- Site No. 3-055.1 - Highway 417 EBL over Preston Street
- Site No. 3-055.2 - Highway 417 WBL over Preston Street
- Site No. 3-056.1 - Highway 417 EBL over Rochester Street
- Site No. 3-056.2 - Highway 417 WBL over Rochester Street
- Site No. 3-057.1 - Highway 417 EBL over Booth Street
- Site No. 3-057.2 - Highway 417 WBL over Booth Street
- Site No. 3-060.1 - Highway 417 EBL over Bronson Avenue
- Site No. 3-060.2 - Highway 417 WBL over Bronson Avenue
- Site No. 3-061.1 - Highway 417 EBL over Percy Street
- Site No. 3-061.2 - Highway 417 WBL over Percy Street
- Site No. 3-063.1 - Highway 417 EBL over Bank Street
- Site No. 3-063.2 - Highway 417 WBL over Bank Street
- Site No. 3-064 - Highway 417 WBL and EBL over O'Connor Street

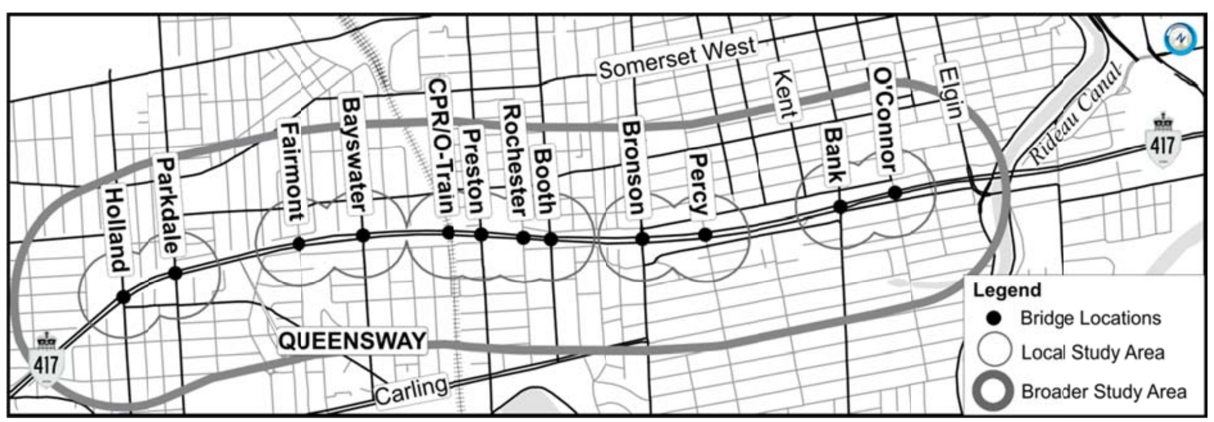
This study is following the Class EA process for Group B projects under MTO's Class Environmental Assessment for Provincial Transportation Facilities, 2000. At the completion of this study, a Transportation Environmental Study Report (TESR) will be prepared and published for public review.

Several alternatives will be reviewed for each bridge site including structural and construction staging options in order to minimize disruption to the Queensway and the modes of travel that use the municipal streets under the Queensway. In addition, engineering, environmental, and property requirements will be established, along with the identification of mitigation measures to reduce or negate short and long term residual effects.

3 STUDY AREA

The preliminary design and environmental assessment study for the rehabilitation and / or replacement of twenty-three bridges (twelve locations) on Ottawa Queensway extends from Holland Avenue to O'Connor Street, in the City of Ottawa. This study will determine the appropriate strategy for the rehabilitation or replacement of the bridges. The Study Area, as shown in **Figure 3.1**, is located in the City of Ottawa.

Figure 3.1: Study Area



4 ASSESSMENT OF ALTERNATIVES TO THE UNDERTAKING

The analysis and evaluation process involves a 2-step decision-making process. Initially the study documents the analysis and evaluation of Alternatives to the Undertaking (Alternative Planning Solutions) and then this is followed by the subsequent assessment of preliminary design alternatives ("Alternative Methods" of carrying out the preferred Alternative Undertaking).

The generalized planning process is presented in **Figure 4.1** illustrating the step where the assessment of Alternatives to the Undertaking is undertaken. The documentation of this assessment is presented in a separate report in **Appendix A (Assessment of Alternatives to the Undertaking)**.

From this initial assessment, the recommendation was to carry forward only replacement alternatives for the CPR/O-Train site, but to carry forward both replacement and rehabilitation alternatives for all rigid frame bridges. During this stage of the evaluation, the study recommendation was to not carry forward the Do Nothing alternative which would not have defined a future bridge management strategy.

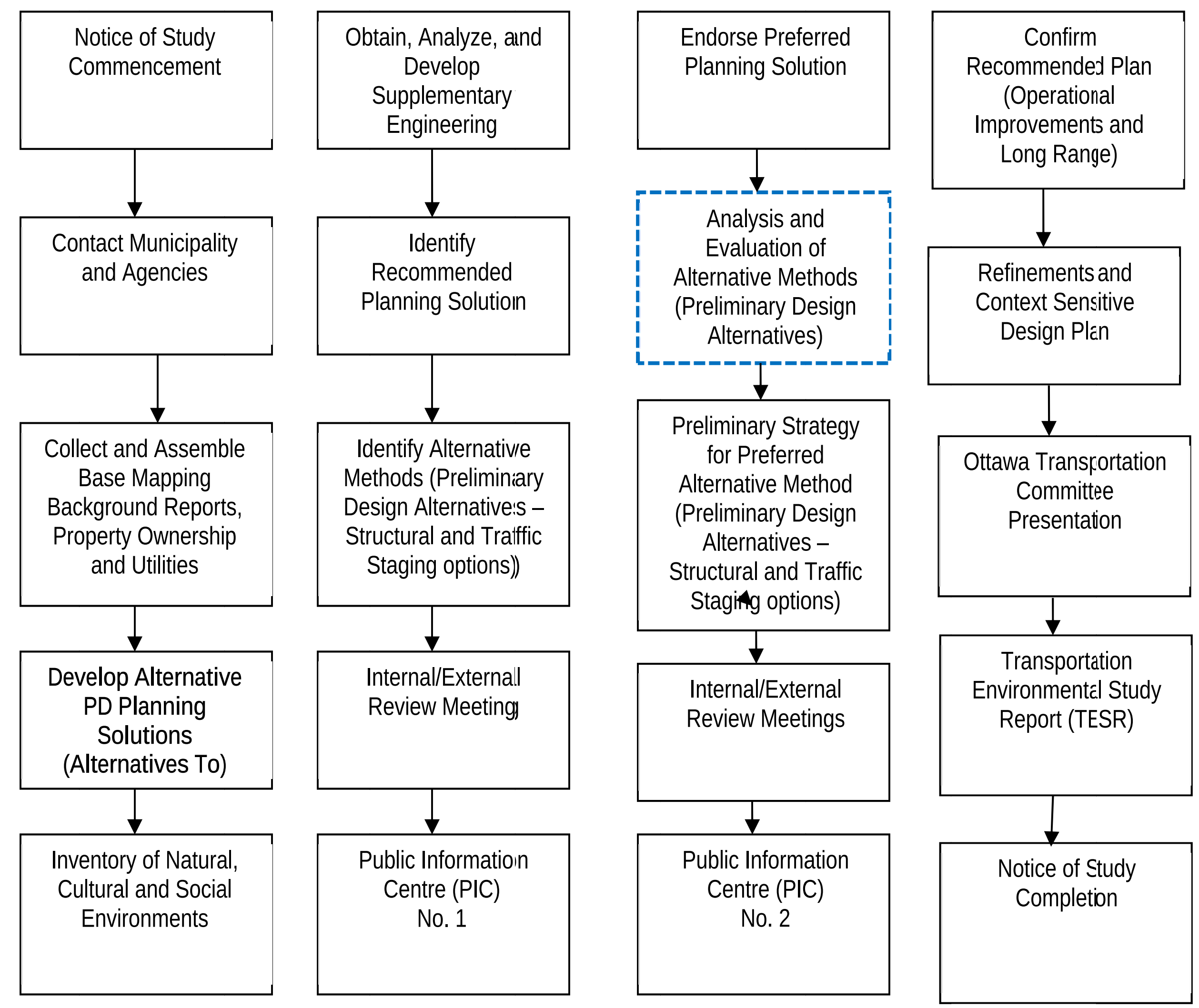


Figure 4.1: Generalized Preliminary Design (PD) Planning Process

5 STUDY AREA SUB-SECTIONS

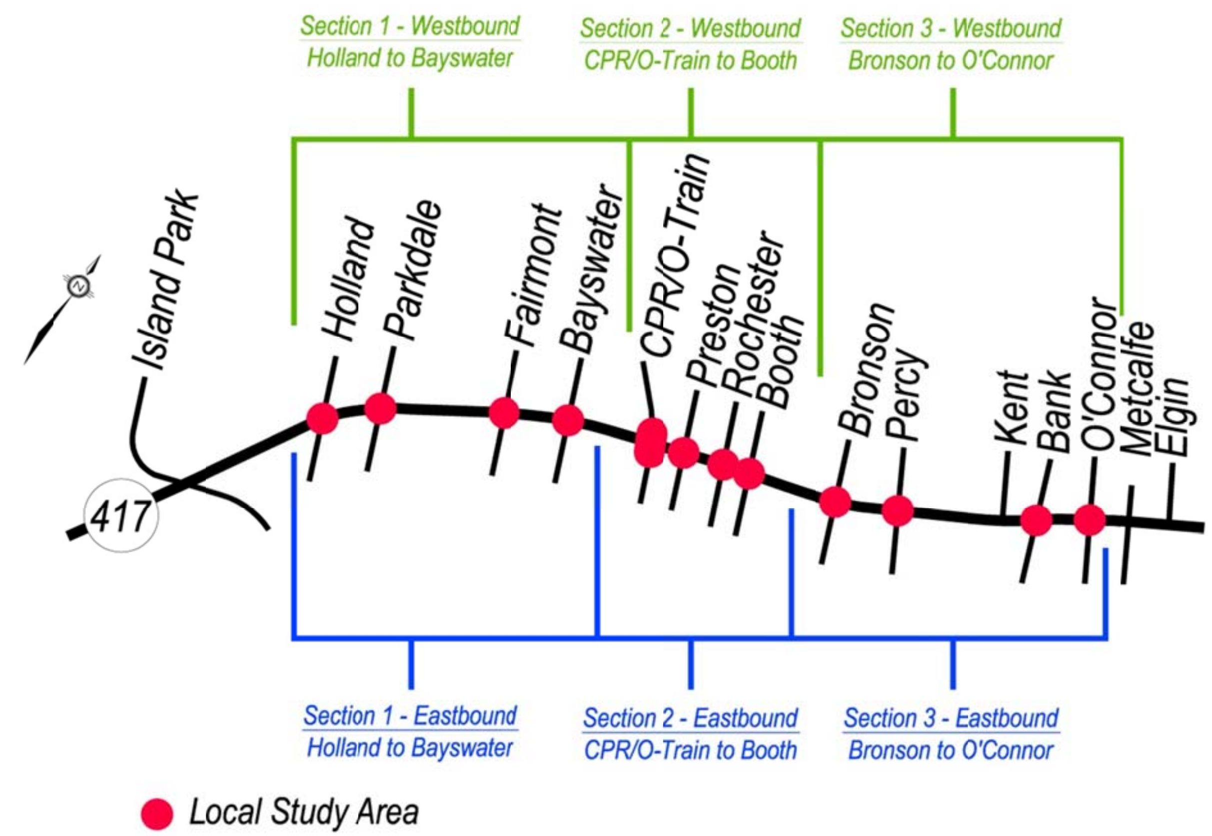
The first step of the analysis and evaluation process for the preliminary design alternatives involved the division of the study area into three study area sub-sections. The study sub-sections were selected as follows:

- Section 1: Holland Avenue to Bayswater Avenue
- Section 2: CPR/O-Train to Booth Street
- Section 3: Bronson Avenue to O'Connor Street

The sub-sections reflect the inter-relationship of bridges which have the potential to either be clustered with a common traffic management plan or be constructed as a standalone project. The CPR/O-Train structure is the highest need bridge identified to-date, and the consideration of clustering adjacent bridges began with considering the close proximity of several adjacent rigid frame bridges. Because the CPR/O-Train bridge replacement will consider several options to remove the existing bridge, necessitating lane closures that will run across adjacent bridges, this led to the identification of a middle section of the study area with several bridges that could be potentially grouped together. The CPR/O-Train group of bridges is described as Section 2. The bridges to the west are described as Section 1 and the bridges to the east as Section 3. Note the eastbound Bayswater structure has been grouped in Section 2 as the proximity of the lane development will dictate it being considered with the CPR/O-Train.

Within each of the Study Area sub-sections there were also individual local study areas (red dots shown in **Figure 5.1**) surrounding each bridge. These study areas considered the environmental context around each of the bridges as well as locations for temporary staging areas.

Figure 5.1: Study Area Sub-sections



6 GENERATION AND ASSESSMENT OF PRELIMINARY DESIGN ALTERNATIVES (ALTERNATIVE METHODS OF CARRYING OUT THE UNDERTAKING)

Within each of the study area sub-sections, several alternatives have been generated for consideration. The long list of alternatives, a description of each alternative, as well as a coarse screening of the alternatives, are found in this section of the report.

An enhanced description as well as drawings of the alternatives are provided in standalone technical reports as follow:

- Structural Design Reports (SDRs) – one for each of the individual sites (Holland, Parkdale, Fairmont, Bayswater, CPR/O-Train, Preston, Rochester, Booth, Bronson, Percy, Bank, and O'Connor). Where two bridges are located at a cross road, both the eastbound and westbound bridges are described in the same report.
- Preliminary Highway Engineering Traffic Staging Report.

Within each of the above technical reports several alternatives have been identified. These include:

Bridge Alternatives - Rigid Frame Sites:

- Rehabilitation (Alternative A)
- Replacement conventional construction (Alternative B)
- Rapid Bridge Replacement (RBR) (Alternative C)
- Rapid Replacement semi-integral abutments (Alternative D)

For each of these alternatives there are variations in spans (shorter, same and longer)

Bridge Replacements - CPR/O-Train Site

- 1, 2 and 3 span rigid frame bridges over CPR/O-Train (with multi-use pathway within a span or standalone concrete box) (Alternatives A-F)
- 1 and 3 span Jack and Slide rapid bridge replacements (Alternatives H and I respectively)
- 1 span 2-storey rigid frame bridge (level 1 span over CPR/O-Train and level 2 for multi-use pathway) (Alternative G)
- Pathway alignment within existing corridor or relocated to Preston Street (Path alternatives e or r respectively)

Traffic Staging Alternatives on Freeway

- Rehabilitation conventional with 2 lanes/direction (Alternative 1)
- Rapid rehabilitation with 3 lanes/direction during weekdays and accelerated rehabilitation and curing with 2 lanes/direction during a weekend (Alternative 2)
- Rehabilitation conventional with 3 lanes/direction (Alternatives 3, 4 and 5)
- 1 stage rapid replacement full closure (Alternative 6)
- 1 stage rapid replacement (2 lanes/direction) (Alternative 7)
- 1 stage rapid replacement (3 lanes/direction) (Alternative 8)
- 2 stage conventional replacement (3 lanes/direction) (Alternative 9)

Staging Area Alternatives for Temporary Works

At each of the 23 bridge sites an initial review of feasible Rapid Bridge Replacement (RBR) staging areas was undertaken and a staging area that would be preferred with the RBR bridge option was recommended. This assessment is presented in **Appendix C**. This initial screening will be presented at PIC 1 for public review and comments.

6.1 Coarse Screening of Alternatives

The long list of alternatives was generated in an attempt to consider a wide range of alternatives of addressing the structural needs identified (i.e. all reasonable alternatives). This wide range of alternatives was subjected to a coarse screening analysis before proceeding with a detailed evaluation of the alternatives.

This screening eliminated those alternatives with significant negative impacts in comparison to the other alternatives carried forward. This review included the following rigid frame criteria alternatives: **Table 6.1** - rigid frame bridge spans (for Rapid Bridge Deck replacements); **Table 6.2** - traffic staging; and **Table 6.3** - traffic staging for CPR/O-Train.

Those alternatives that had significantly poorer performance, a magnitude higher cost, unacceptable environmental or safety effects, and/or did not comply with MTO/City of Ottawa standards/requirements were not carried forward for further analysis.

Table 6.1 illustrates the preliminary screening analysis of rigid frame bridge span alternatives.

Table 6.1: Ottawa Queensway Midtown Bridges Preliminary Rigid Frame Bridge Span Coarse Screening Analysis

Site	Official Plan Road Type	Traffic AADT	RBR Carried Forward			Comment
			Existing Span	Longer Span	Shorter Span	
Holland	Major Collector	9200	✓	✓	✗	Shorter Span not carried forward.
Parkdale	Arterial	12100	✓	✓	✗	Shorter Span not carried forward.
Fairmont	Local	3600	✓	✓	✓	This is a low volume local road in the City of Ottawa. The reallocation of lanes under the structure could be done based on traffic demand.
Bayswater	Local	2000	✓	✓	✓	This is a low volume local road in the City of Ottawa. The reallocation of lanes under the structure could be done based on traffic demand.
Preston	Arterial	12500	✓	✓	✗	Shorter Span not carried forward.
Rochester	Major Collector	6500	✓	✓	✗	Shorter Span not carried forward.
Booth	Major Collector	7700	✓	✓	✗	Shorter Span not carried forward.
Bronson	Arterial	30000	✓	✓	✗	Shorter Span not carried forward.
Percy	Local	1500	✓	✓	✓	This is a low volume road in the City of Ottawa. The reallocation of lanes under the structure could potentially be done based on the current vehicular, pedestrian and bicyclist uses within the corridor.
Bank	Arterial	12500	✓	✓	✗	Shorter Span not carried forward.
O'Connor	Arterial	11500	✓	✓	✗	Shorter Span not carried forward.

Legend: **RBR**: Rapid Bridge Replacement

✓ Carried Forward ✗ Not Carried Forward

The types of bridge management approaches included Rapid Bridge Replacement (RBR); Conventional (Conv) and Rehabilitation (Rehab). The detailed description of these alternatives is included in the Queensway Mid-town Bridges Traffic Staging Report, dated November 18, 2014.

Table 6.2 illustrates the range of Traffic Staging alternatives considered for each bridge management approach and the coarse screening of the preliminary long list of alternatives.

Traffic staging options considered for the CPR/O-Train site included maintaining all the lanes of traffic on the Queensway (Alternative 1), closing one lane per direction to complete strip removal of the existing CPR/O-Train rigid frame (Alternatives 2-5), or closing multiple lanes (2 or 4) in order to Jack and Slide in the new CPR/O-Train rigid frame (Alternatives 6 and 7).

Table 6.2: Ottawa Queensway Midtown Bridges Rigid Frame Traffic Staging Coarse Screening Analysis

Bridge Management Approach	Traffic Staging Alternative No.	Description	Preliminary Recommendation to Carry Forward	Comments and Rationale for Recommendation
Rehabilitation	Alternative 1 – Rehab conventional 2-lane detour	-2-lane detour crossing to opposite side of median -10 week duration of detour	✗	This alternative is not recommended to be carried forward as it requires a longer term closure of the Queensway to 2 lanes when compared to Alt 2 and a higher cost associated with the median crossing. Based on this alternative having significantly poorer performance, higher cost and no benefits over Alternative 2 it was not carried forward.
	Alternative 2 - Rehab Rapid 3 and 2-lane detours	-4 stage rehabilitation with 3 week durations and single lane closures of the outside lanes while the deck is rehabilitated and barrier walls are replaced (applies to lanes 1 and 4) -interior lanes (lanes 2 and 3) are rehabilitated using rapid rehabilitation and completed on a weekend -curing required for 7 days during 1 week and Queensway closed to 2 lanes during the cure time -alternative materials to accelerate cure time may be possible	✓	
	Alternative 3 Rehabilitation 3 lane detour	-This alternative involves a 4 stage rehabilitation while maintaining 3 lanes per direction for EBL or WBL structures. -This alternative requires the use of the unconventional division of lanes of traffic to hourglass around the work zone using the AASHTO interior lane closure design.	✗	This alternative is not recommended to be carried forward as it requires the use of the unconventional traffic staging approach that is considered to have reduced safety performance. Alternative 5 provides better 3-lane detour performance, greater safety performance and has a lower cost. See Alt 5 for the preferred 3-lane detour alternative.
	Alternative 4 Rehabilitation 3 lane detour (median crossover)	-This alternative maintains 3 lanes per direction. - It includes a median crossover for a single express lane to bypass the short construction zone. -This alternative requires the use of the unconventional division of lanes of traffic to hourglass around the work zone using the AASHTO interior lane closure design.	✗	This alternative is not recommended to be carried forward as it requires the use of the unconventional traffic staging approach that is considered to have reduced safety performance. Alternative 5 provides better 3-lane detour performance, greater safety performance and has a lower cost. See Alt 5 for the preferred 3-lane detour alternative.
	Alternative 5 Rehabilitation 3-lane detour	-3 stage traffic management plan that rehabilitates the full 8-lane cross section and replaces the median and lighting system within the limits of the detour -3 lanes maintained per direction	✓	
RBR (Rapid Bridge Replacement)	Alternative 6 Replacement RBR Full Closure	-Full closure of Queensway (one direction) -estimated duration 40 to 60 h -scheduled for a weekend	✓	
	Alternative 7 Replacement RBR 2-lane detour	-Relocation of 2 lanes to opposite side of median -operates with 2 lanes/direction -duration 40 to 60 h -scheduled for a weekend	✓	
	Alternatives 8 Replacement RBR 3-lane detour	-temporary bailey bridge to carry 2 lanes of traffic over work zone -single lane of traffic as bypass lane on far side of median using AASHTO temporary conditions design -operates with 3 lanes during replacement -duration 40 to 60 h	✗	-This alternative is not recommended to be carried forward as it has a magnitude higher capital cost ($2-3 million) greater than those recommended to be carried forward -The alternative would have been more appropriate if the duration of the RBR construction had required a longer duration of Queensway closure -Based on the other reasonable alternatives that can stage traffic over a weekend this more complex and more expensive alternative was recommended not to be carried forward

Conventional 2-stage Replacement	Alternative 9 Replacement Conv 3-lane detour	-conventional 2 stage replacement approach where 2 lanes of traffic are maintained on half of the existing bridge and 1 lane bypasses the work zone on the far side of the median while half of the bridge is constructed in place -the second half of the bridge can be constructed when 2 lanes of traffic are shifted to the newly constructed half of the bridge -traffic staging in place for a season	✓	

Legend:

✓ Carried Forward ✗ Not Carried Forward

Several of the traffic staging approaches for removal of the CPR/O-Train Bridge were not carried forward. The review of these options is described in the Preliminary Highway Engineering Traffic Staging Alternatives Report and is summarized in **Table 6.3**. Three alternatives were not carried forward including Alternative 1 (poor durability), Alternative 3 (poor traffic safety), and Alternative 4 (poor traffic safety).

Table 6.3 illustrates the coarse screening analysis of traffic staging alternatives at the CPR/O-Train bridge site.

Table 6.3: Ottawa Queensway Midtown Bridges CPR/O-Train Removal Traffic Staging Coarse Screening Analysis

Bridge Management – Removal for new Rigid Frame Bridge	Alternative Description	Preliminary Recommendation to Carry Forward	Comments and Rationale for Recommendation
Maintain **Alternative 1**	Place non-shrink fill and leave existing bridge in place. Duration: 10 days No. Lanes Closed: None Durability: Long term deterioration within pavement Safety: Use of unconventional division of lanes (AASHTO battleship design through construction zone) less preferred Cost: $290,000	✗	Although this results in no traffic effects on the Queensway during peak hours, it will leave a long term durability issue for the continued maintenance of the pavement. It is recommended not to be carried forward.
Strip Removal **Alternative 2**	4-stage strip removal with accelerated mid lane removal on 2 weekends Duration: 6-7 weeks No. Lanes Closed: 1 lane per direction with 2 lanes closed on 2 weekends Durability: Good, no long term issues Safety: Good Cost:$810,000	✓	This alternative carried forward for all non-jack and slide alternatives.
Strip Removal **Alternative 3**	4-stage strip removal with battleship design Duration: 6-10 weeks No. Lanes Closed: 1 lane per direction Durability: Good, no long term issues Safety: Use of unconventional division of lanes (AASHTO battleship design through construction	✗	This alternative is considered to be less safe than the 4 stage strip removal option (Alternative 2) with no significant advantages.

	zone) less preferred Cost:$590,000		
Strip Removal **Alternative 4**	3 stage traffic management plan that rehabilitates the full 8-lane cross section and replaces the median and lighting system within the limits of the detour Duration: 9 weeks No. Lanes Closed:1 Durability: No long term durability issues Safety: Large lane shifts to introduce median crossovers includes greater crossfall Cost: $1.25 million	✘	This alternative is considered to have reduced safety as a result of the increased lane shifts of the detour. Introducing reverse horizontal curves with cross fall changes is undesirable. In addition the temporary changes for drainage may create the potential for surface water ponding which is a safety concern. These concerns are not present for the Alternative 3 strip removal option and it has a lower capital cost. Based on this option having poorer performance and greater cost than Alternative 3 it is not recommended at the CPR/O-Train location.
Strip Removal **Alternative 5**	Structure Removed in Thirds This approach could be used in parallel with adjacent rigid frames should they be rehabilitated using traffic staging option 5.	✓	
Jack and Slide **Alternative 6**	Full closure Duration: 3 days No. Lanes Closed: 4 Durability: No long term durability issues Safety: Conventional Cost: $200,000	✓	
Jack and Slide **Alternative 7**	2-lane detour with median crossing Duration: 3 days No. Lanes Closed: 2 (each direction) Durability: No long term durability issues Safety: Conventional Cost: $1.4 million	✓	
Jack and Slide **Alternative 8**	3-lane detour using a bailey bridge and AASHTO battleship design. Not feasible at CPR/O-Train site. 2-lane bailey bridges not realistic for an 86 m span.	✘	Not carried forward - unfeasible at CPR/O-Train site
Jack and Slide **Alternative 9**	The 3-lane conventional 2-stage replacement staging alternative was not feasible for a jack and slide approach. Structure required to be slid in one piece.	✘	Not carried forward - unfeasible at CPR/O-Train site
Legend: ✓ Carried Forward ✘ Not Carried Forward			

6.1.1 *Conclusions:*

Following the coarse screening analysis, the following were carried forward:

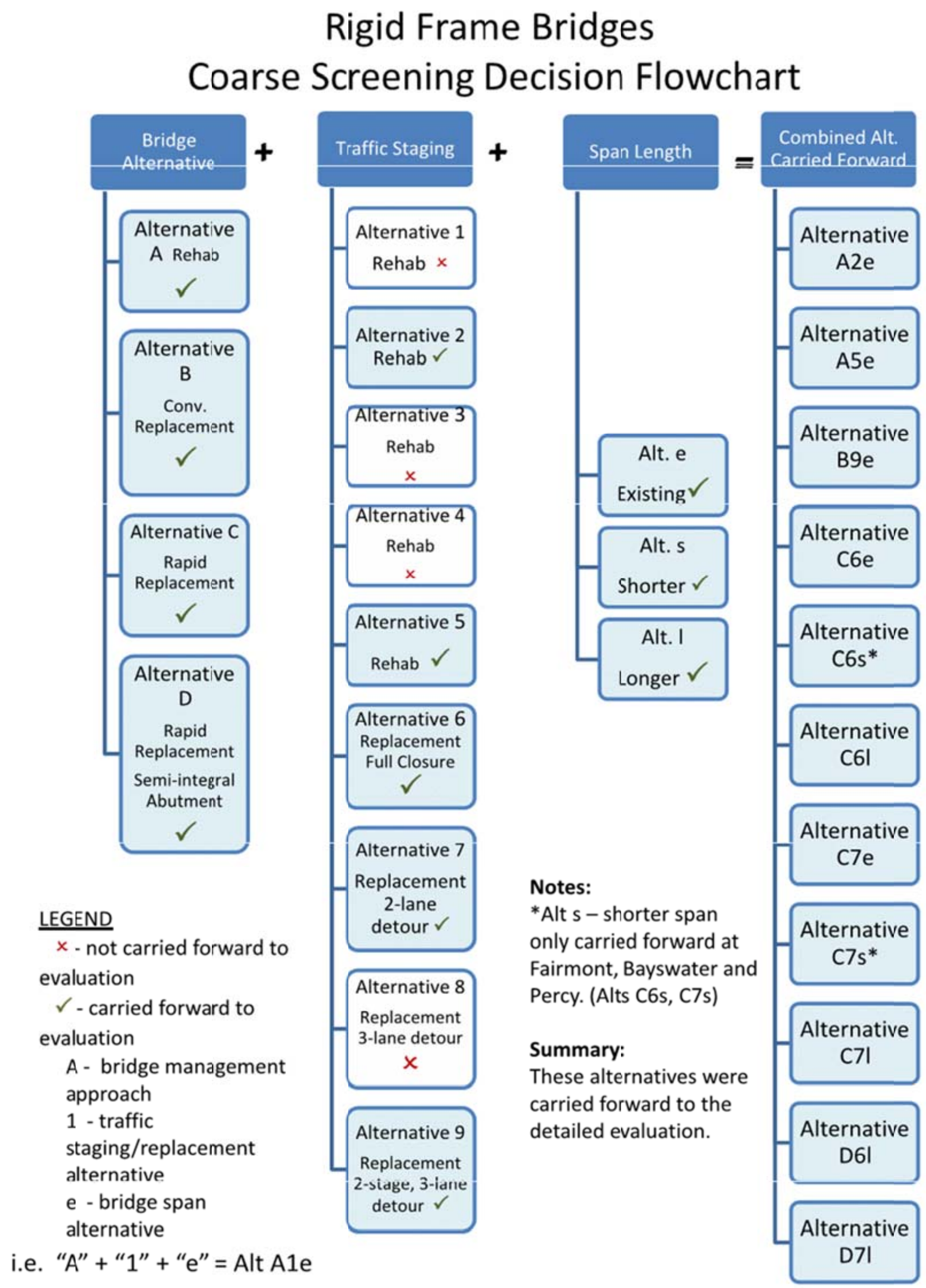
- All structural alternatives (replacement and rehabilitation for rigid frames)
- All structural replacement options for CPR/O-train
- Structural span alternatives only carried forward for those consistent with City of Ottawa standards
- Traffic staging alternatives only carried forward for alternatives which minimized traffic delays and avoided use of unconventional traffic staging when possible.

6.2 Short Listed Alternatives

6.2.1 *Rigid Frame Bridge Sites*

The combined short list of alternatives involves a combination of a structural alternative for the bridge + traffic staging alternative + a bridge span alternative for each of the rigid frame sites, as outlined in **Tables 6.1** and **6.2**. The generic combination of the 11 combined alternatives is illustrated in **Figure 6.1** for the rigid frame sites. This is reduced at select sites where a reduced span has not been recommended. The traffic staging short listed alternatives for all sites except O-Train and O'Connor Street can be seen in **Figure 6.2** to **Figure 6.5**. O'Connor Street traffic staging short listed alternatives can be seen in **Figures 6.6** to **6.9**. The alternatives for each bridge can be seen in **Figures 6.10** to **6.15.**

Figure 6.1: Rigid Frame Bridge Site Alternatives Coarse Screening Decision Flowchart



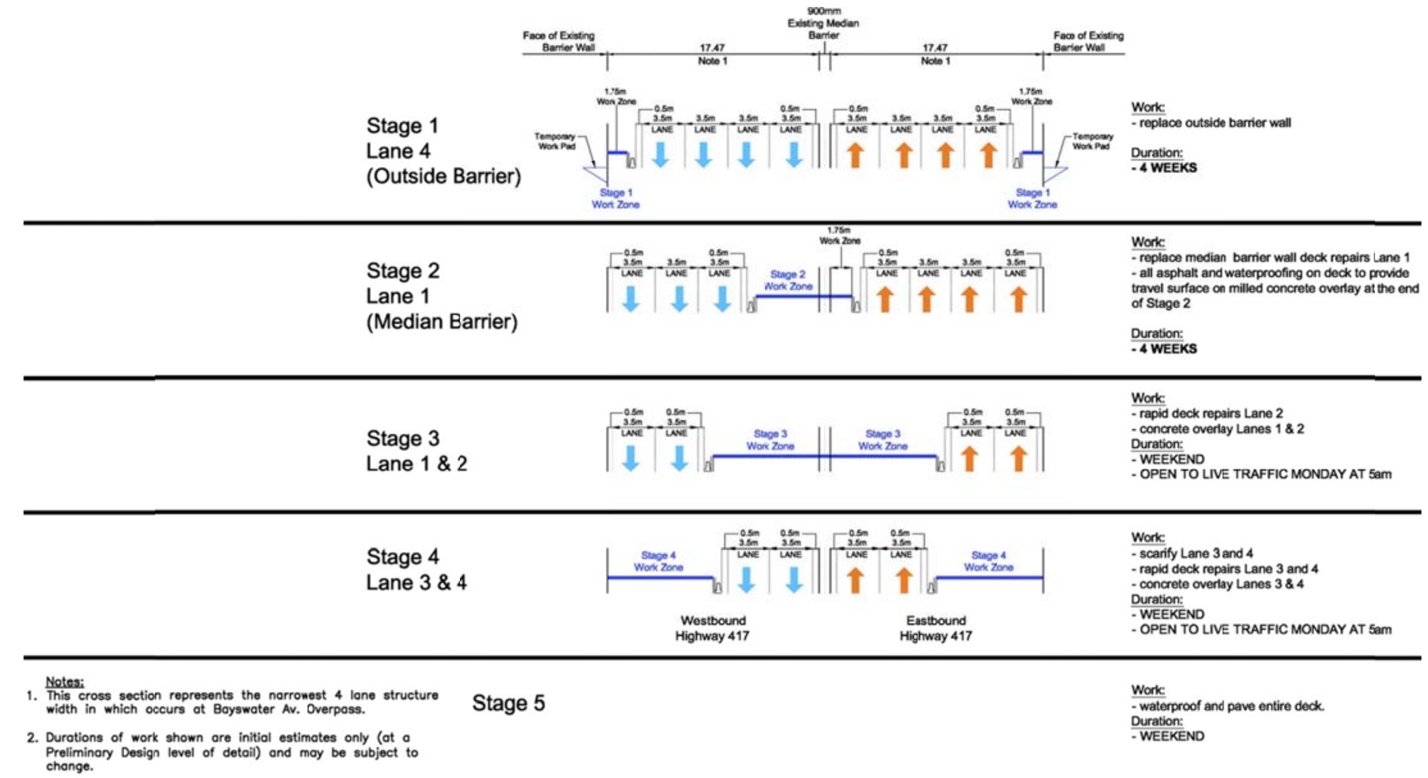


Figure 6.2: Traffic Staging Short Listed Alternative 2

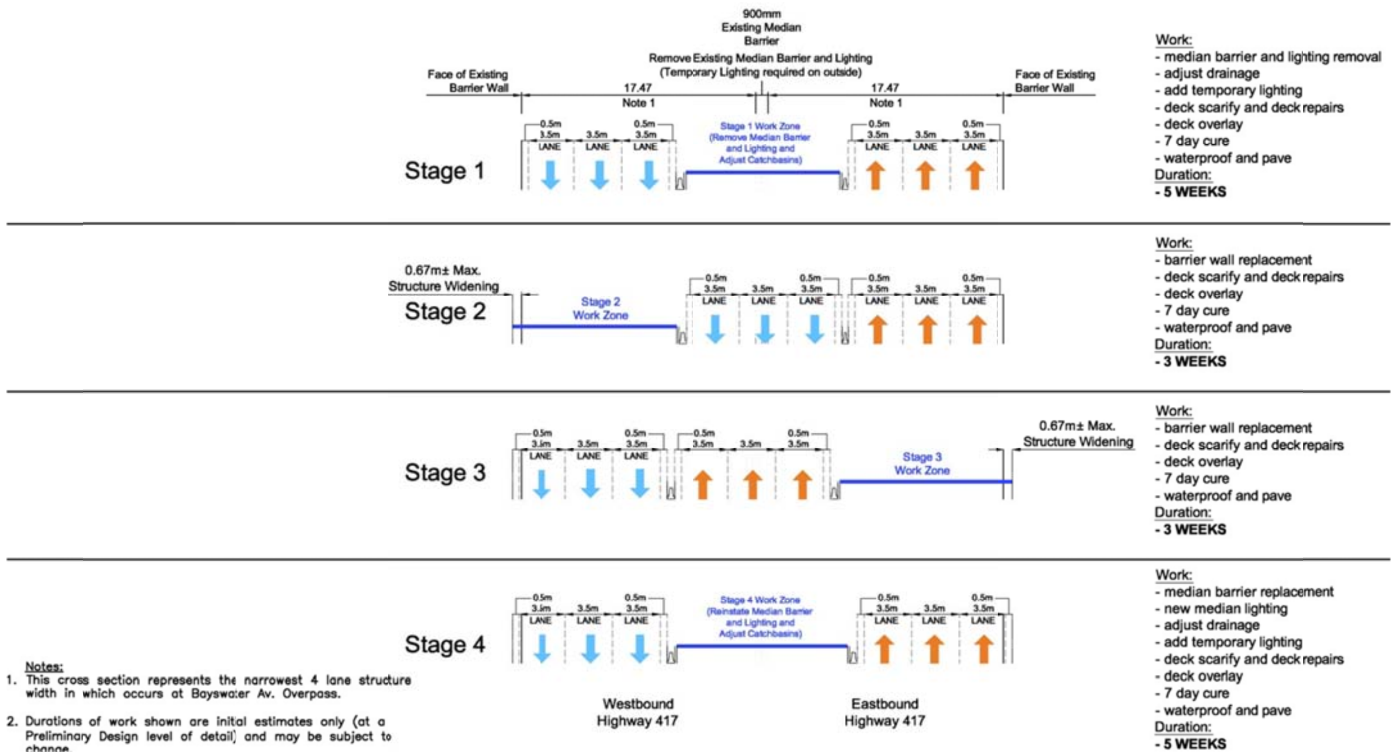


Figure 6.3: Traffic Staging Short Listed Alternative 5

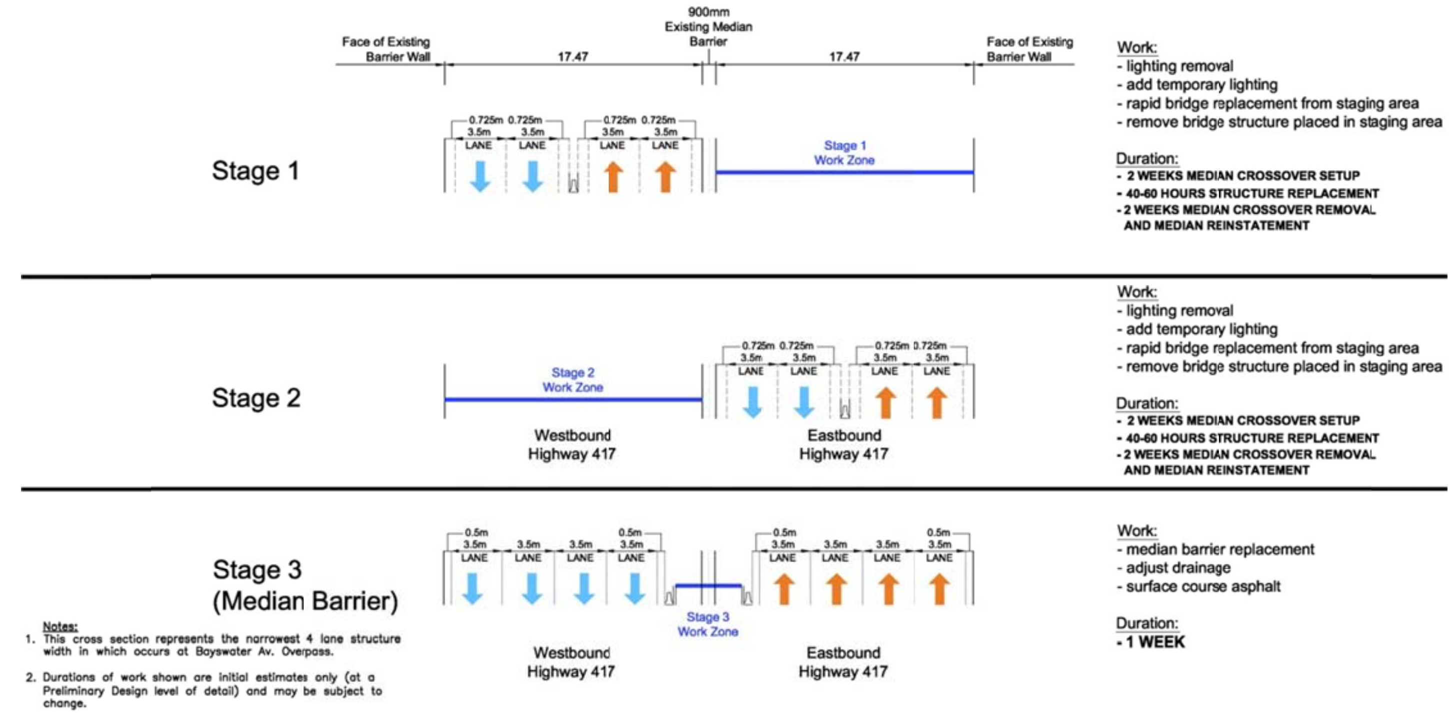


Figure 6.4: Traffic Staging Short Listed Alternative 7

Traffic staging short listed **Alternative 6** included the following:

- Complete Closure of Queensway, and detour of traffic
- Assumption: 1300 veh and 0.2 h delay per vehicle for weekend
- 3-day weekend for twin replacement of bridge structures

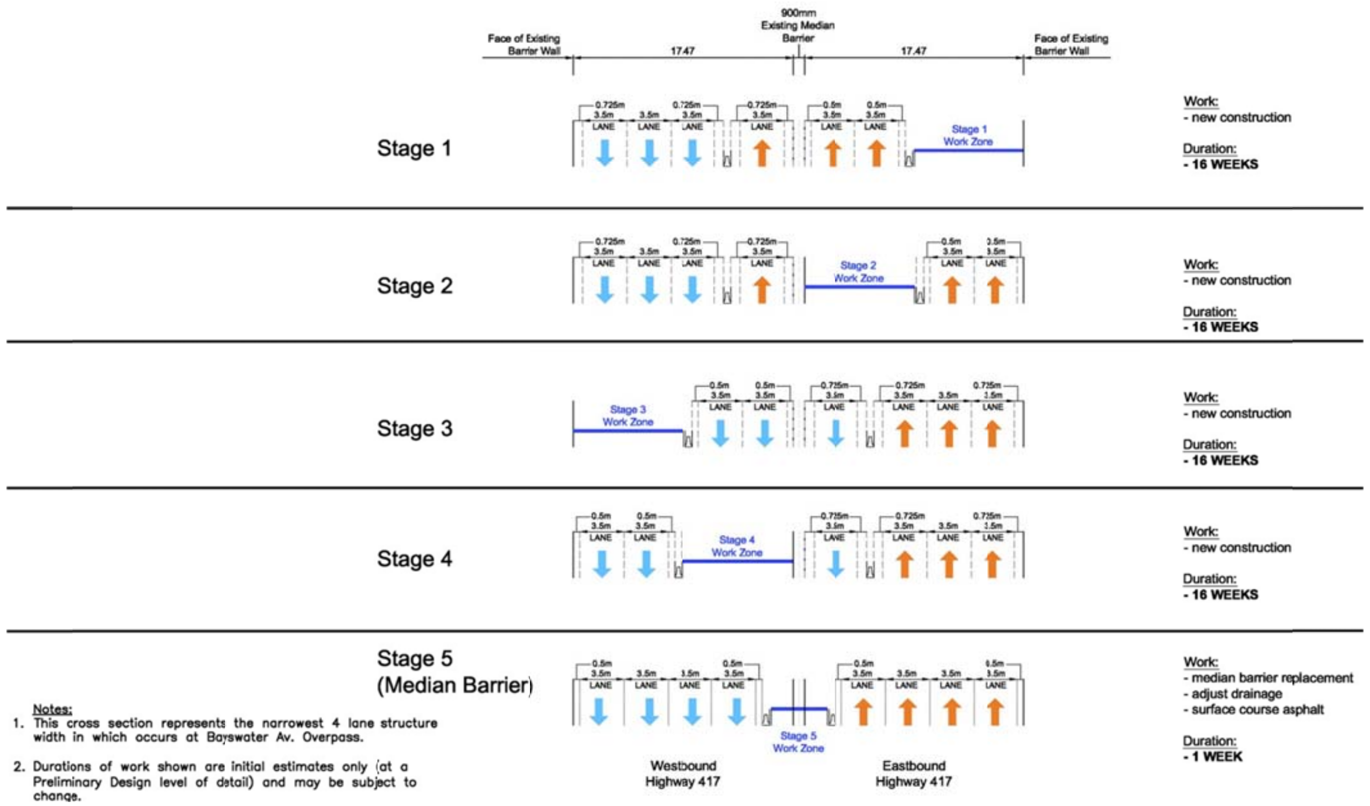


Figure 6.5: Traffic Staging Short Listed Alternative 9

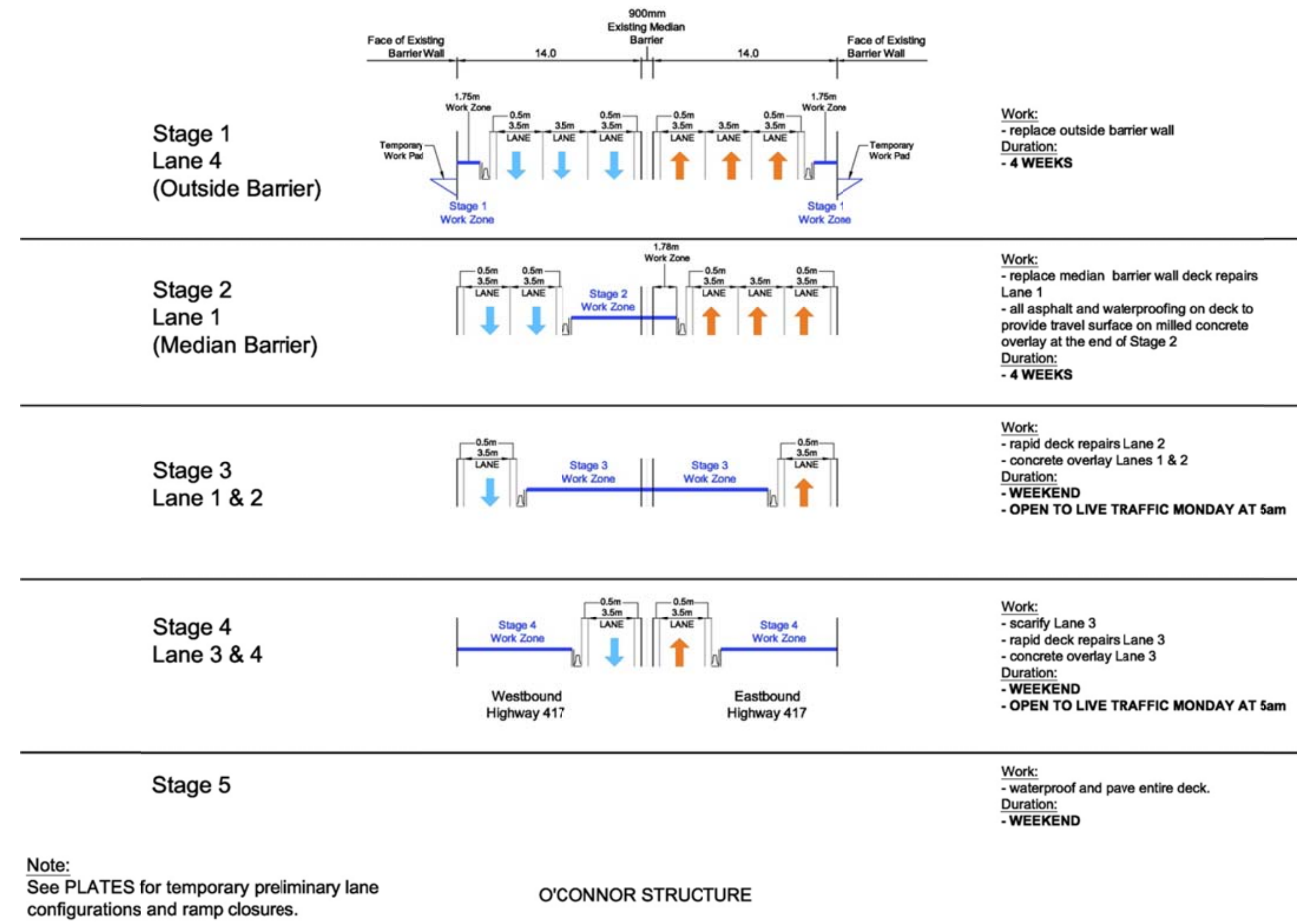


Figure 6.6: Traffic Staging Short Listed Alternative 2 for O'Connor Street

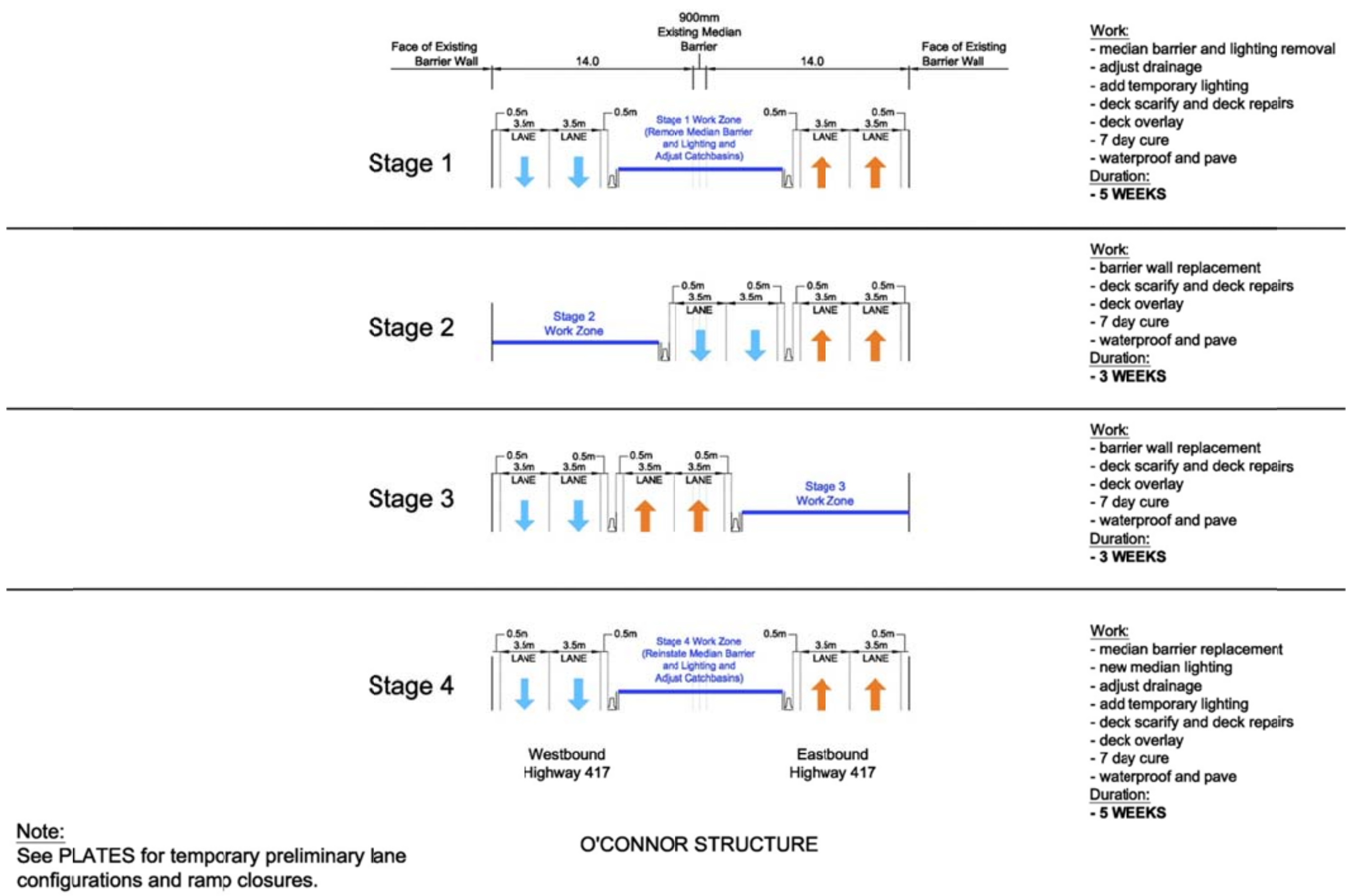


Figure 6.7: Traffic Staging Short Listed Alternative 5 for O'Connor Street

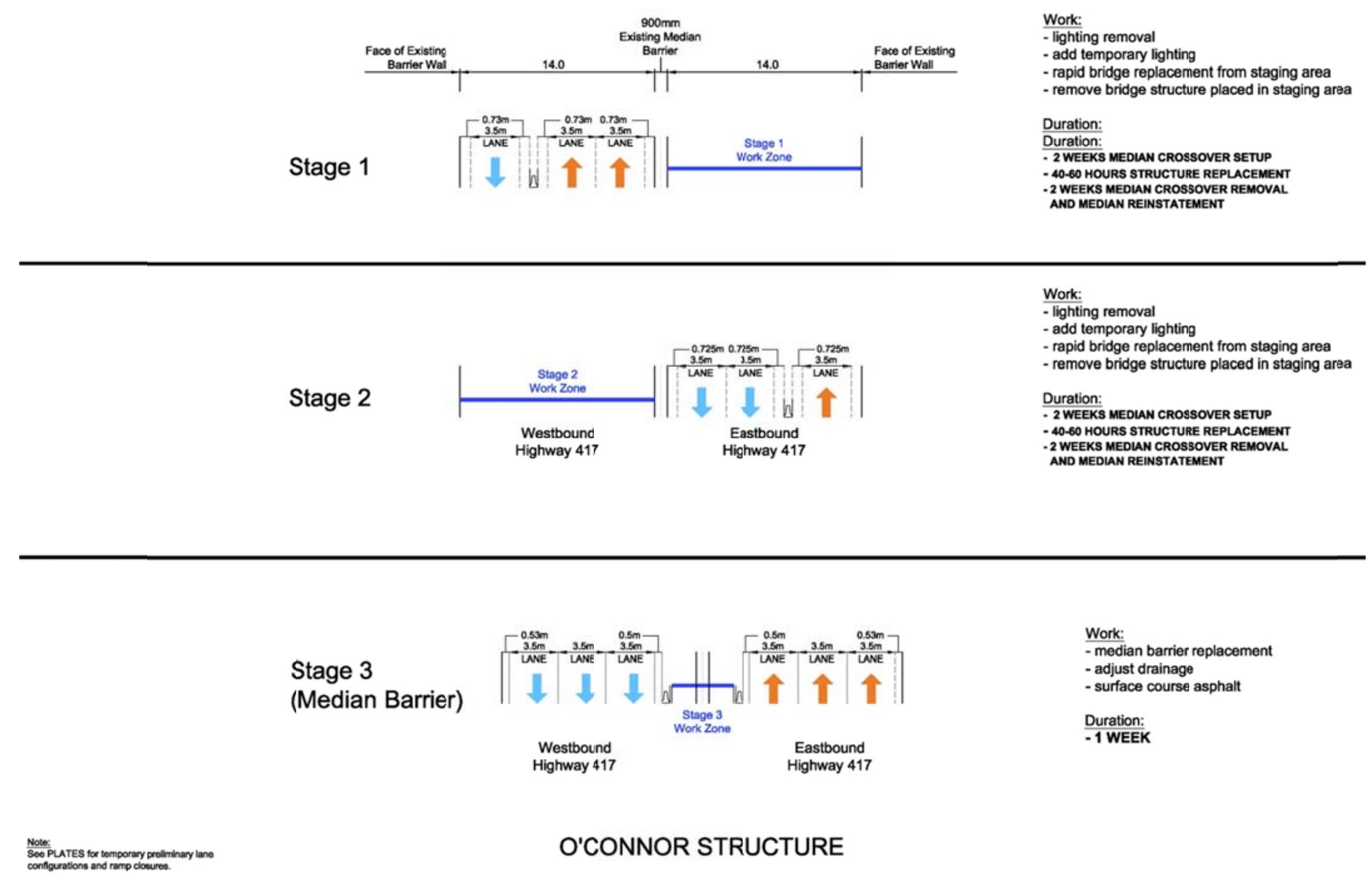


Figure 6.8: Traffic Staging Short Listed Alternative 7 for O'Connor Street

The traffic staging short listed **Alternative 6** for O'Connor Street involves the following stages:

- Complete Closure of Queensway, and detour of traffic
- Assume 1300 veh and 0.2 h delay per vehicle for weekend

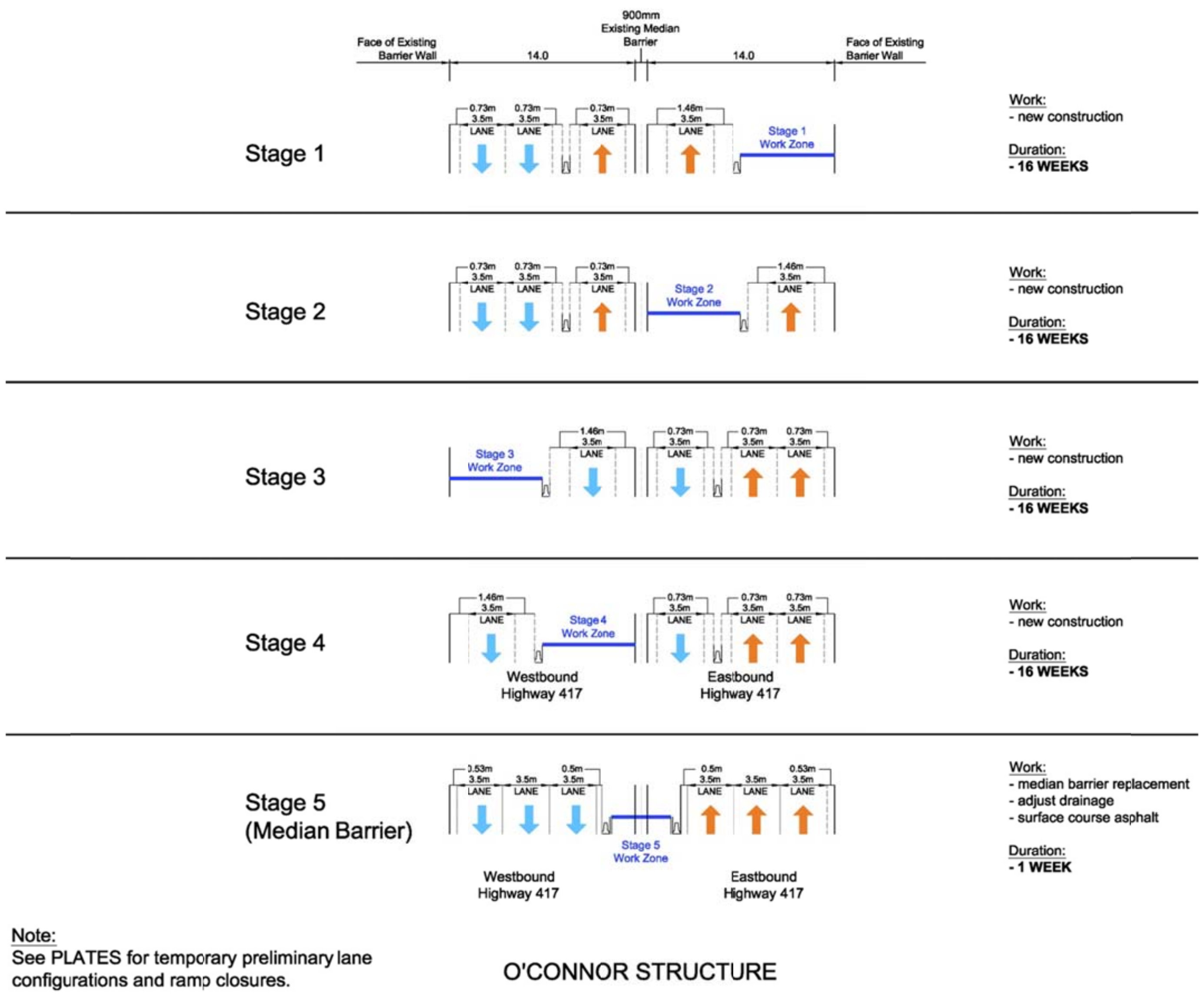


Figure 6.9: Traffic Staging Short Listed Alternative 9 for O'Connor Street

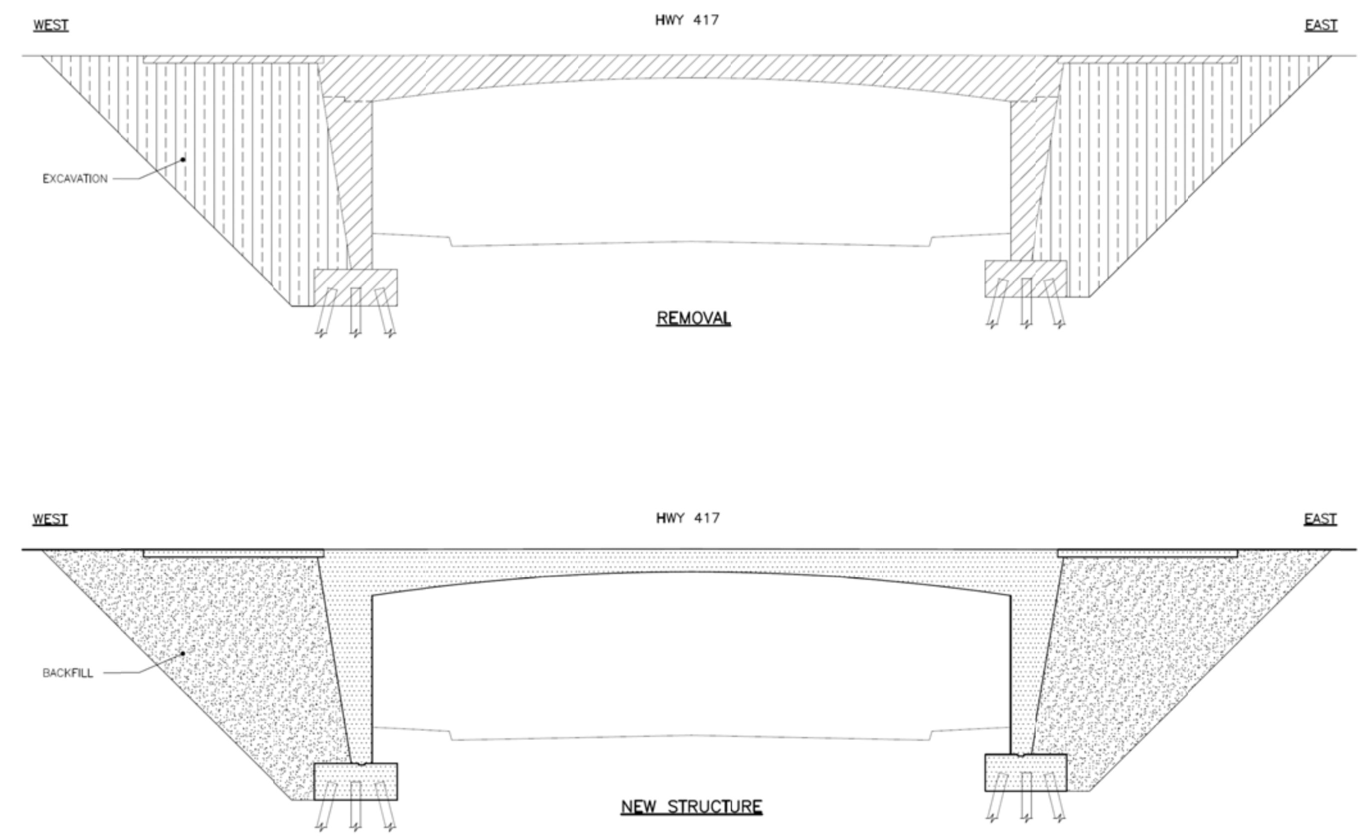


Figure 6.10: Alternative Be – Conventional Replacement for Same Span

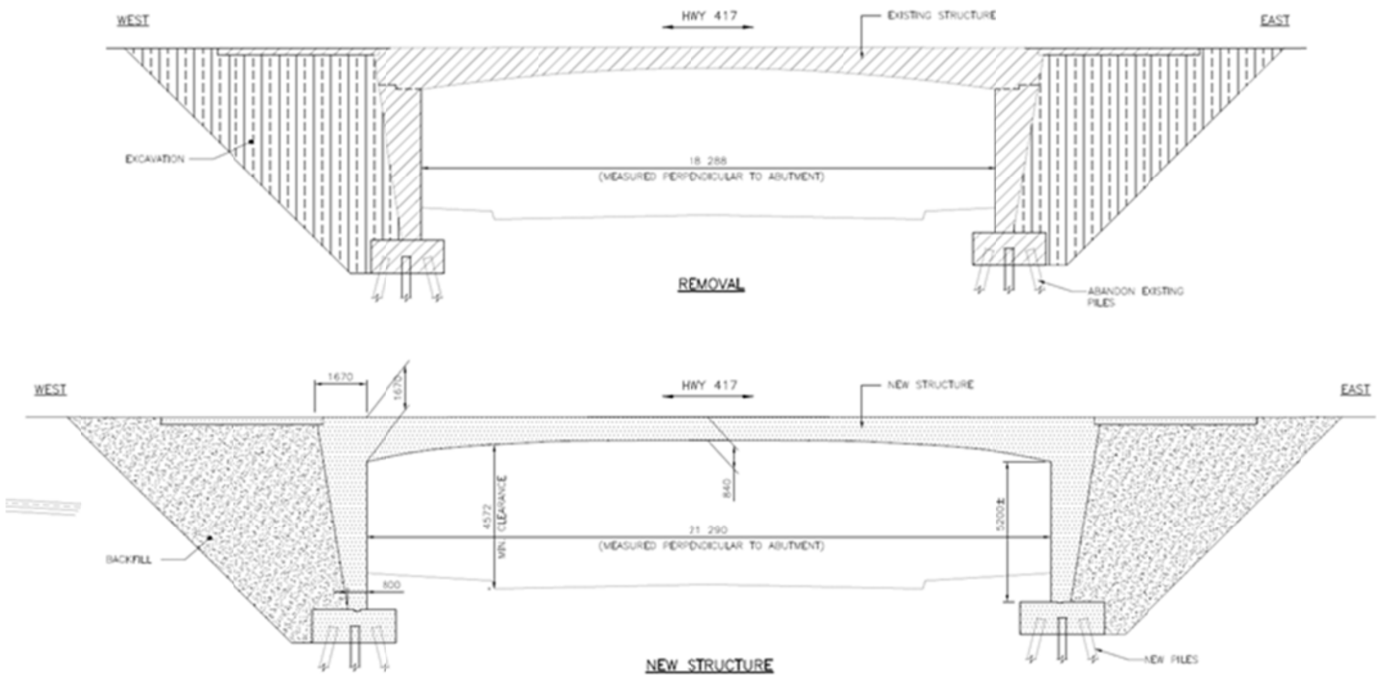


Figure 6.11: Alternative BI – Conventional Replacement for Longer Span

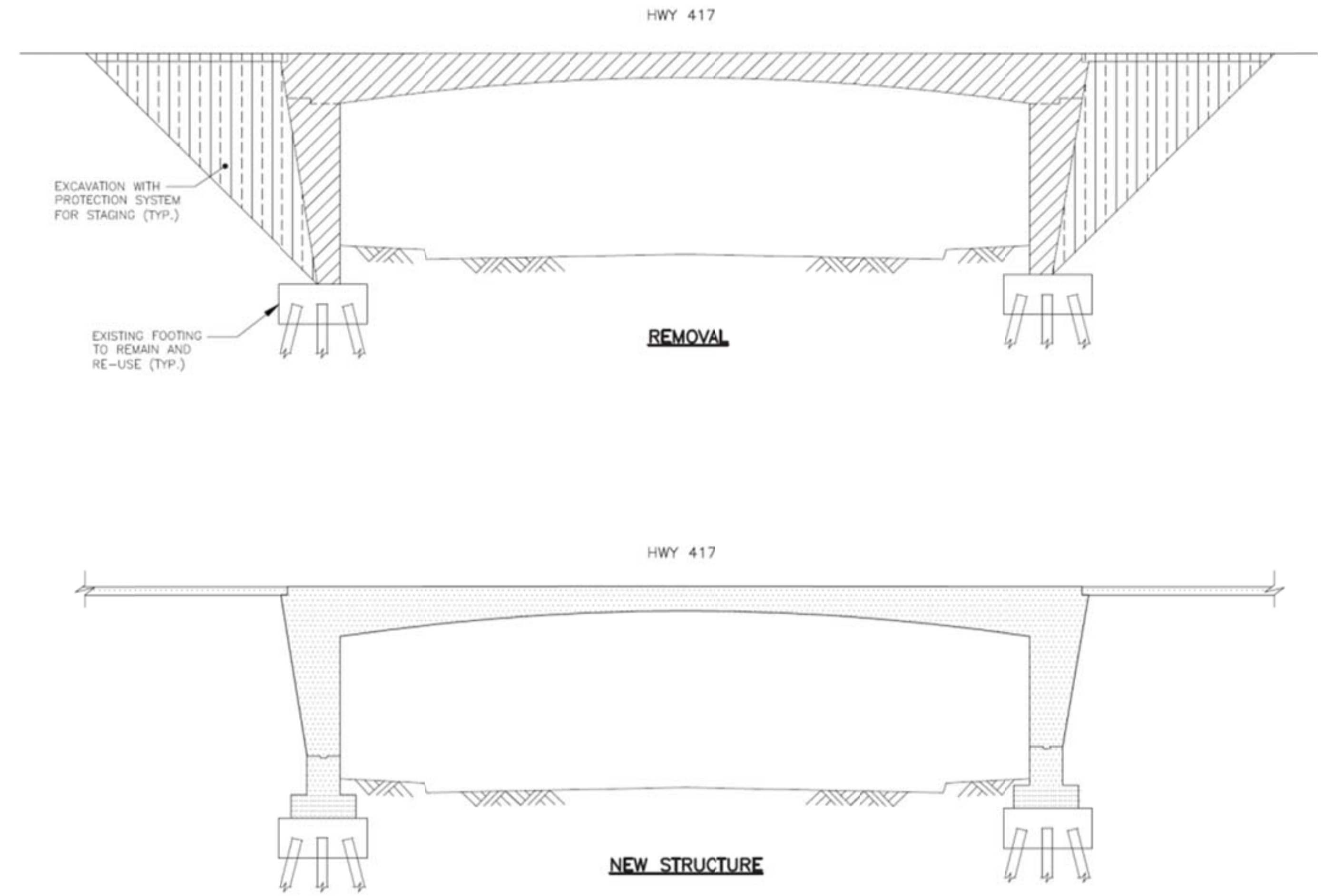


Figure 6.12: Alternative Ce – Rapid Bridge Replacement for Same Span

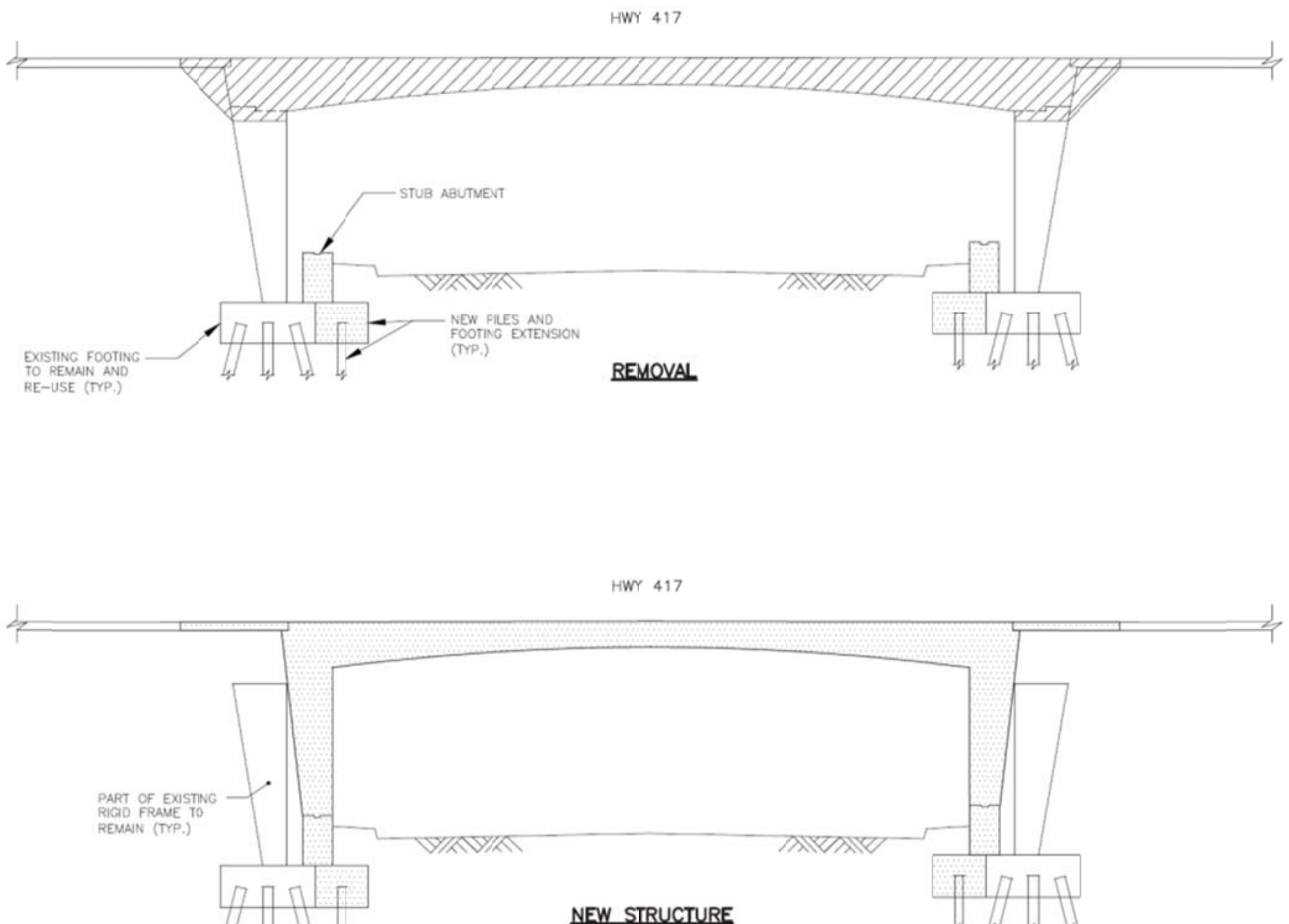


Figure 6.13: Alternative Cs – Rapid Bridge Replacement for Shorter Span

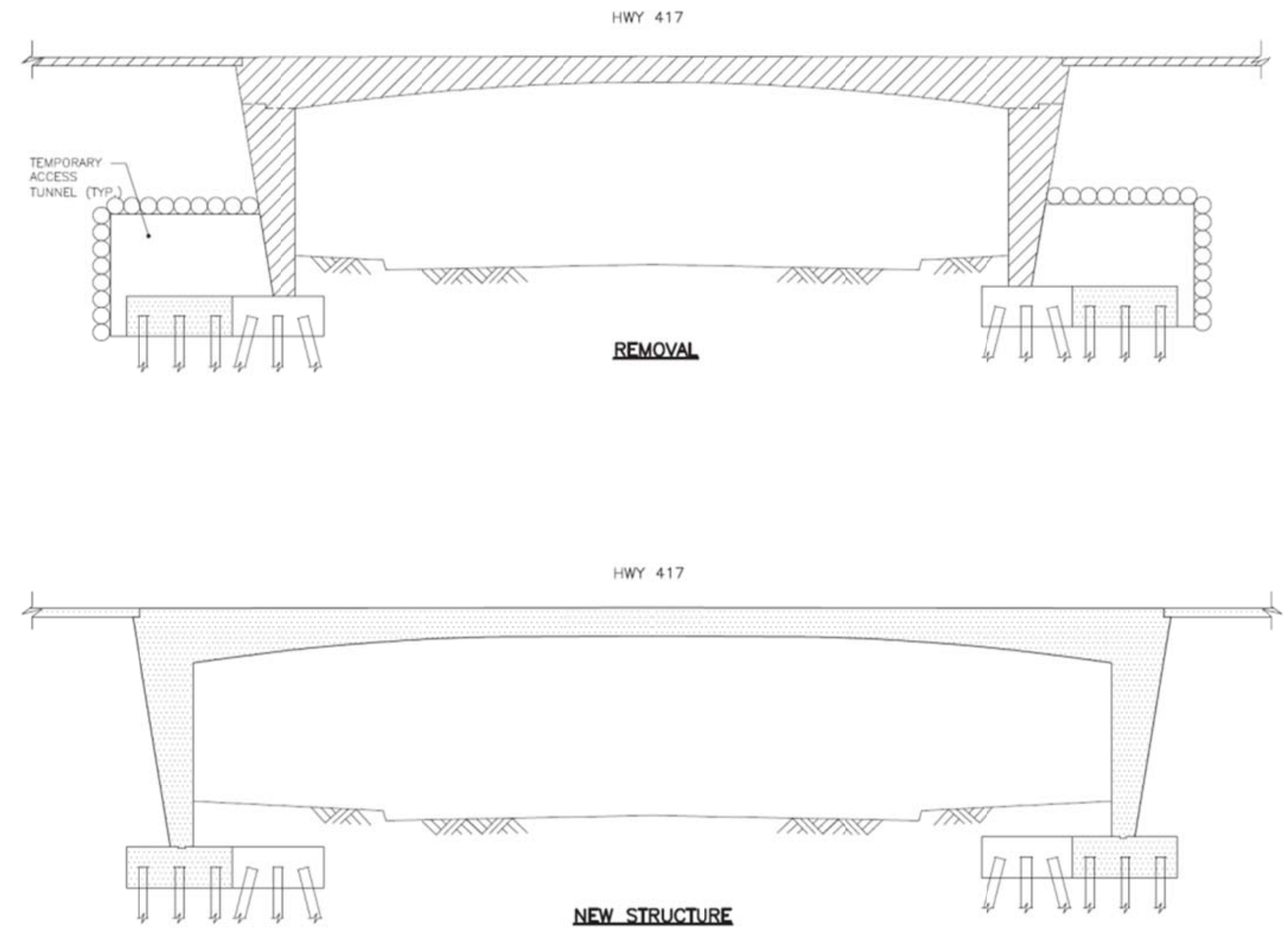


Figure 6.14: Alternative Cl – Rapid Bridge Replacement Longer Span

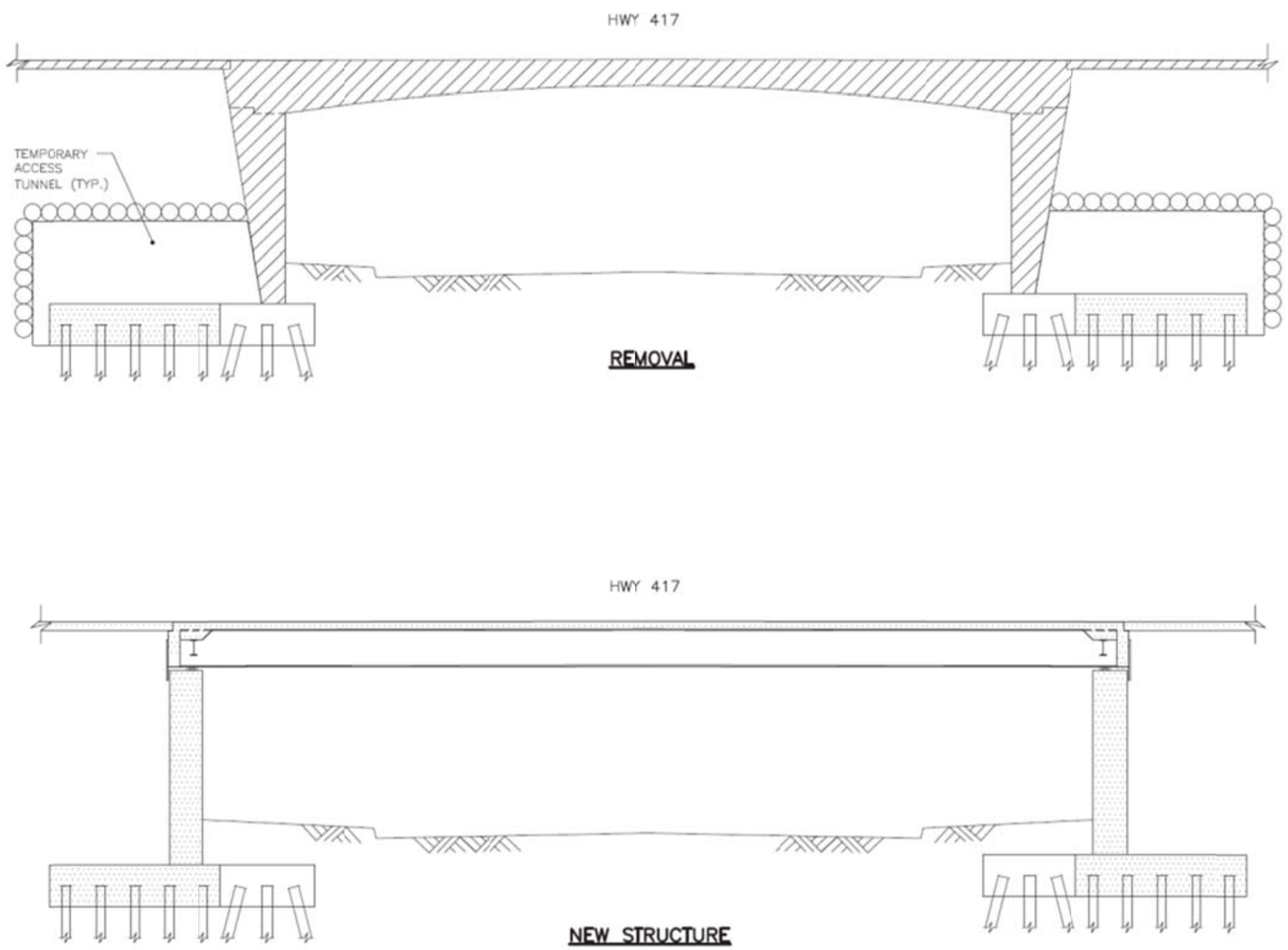
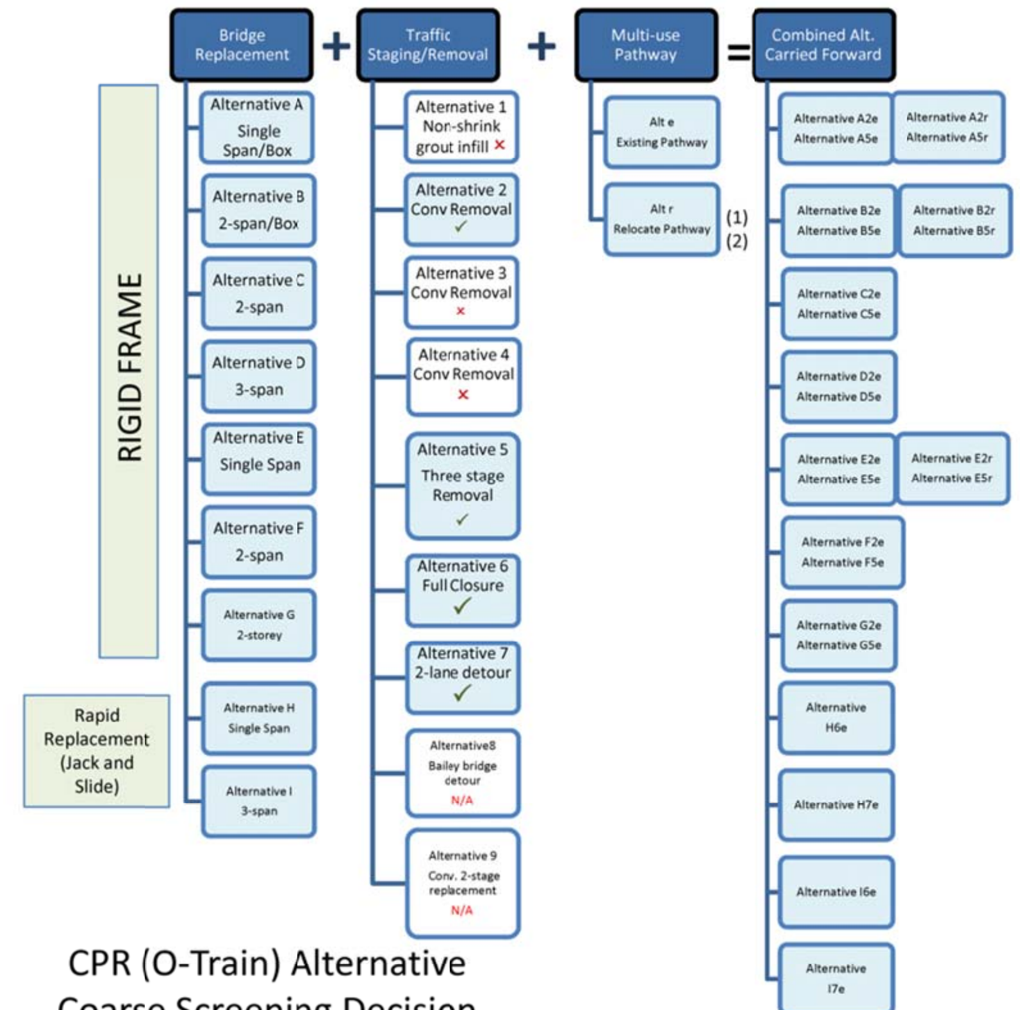


Figure 6.15: Alternative DI – Rapid Bridge Replacement for Longer Span with Semi-integral Abutment

6.2.2 *CPR/O-Train Bridge Sites*

The combined short list of alternatives for the CPR/O-Train sites involves a combination of a structural alternative + traffic staging alternative + a multi-use pathway alignment (relocated to Preston Street or kept along existing O-Train corridor), as outlined in **Table 6.3.** The combination of all available alternatives is shown in **Figure 6.16**. The traffic staging short listed alternatives the CPR/O-Train bridge site can be seen in **Figure 6.17** to **Figure 6.19**. The alternatives for each bridge can be seen in **Figures 6.20** to **6.28**.

Figure 6.16: CPR/O-Train Bridge Site Alternative Coarse Screening Decision Flowchart



CPR (O-Train) Alternative Coarse Screening Decision Flowchart

i.e. "A" + "3" + "e" = Alt A3e

Notes:

(1) Relocation of multi-use pathway considered for alternatives with stand-alone pedestrian structure (box, additional span)

(2) No relocation of multi-use pathway sub-alternative considered for Alternative G because it is identical to Alternative A with a relocated multi-use pathway

LEGEND

× - not carried forward to evaluation

✓ - carried forward to evaluation

A - bridge management approach

3 - traffic staging/removal alternative

e – multi-use pathway

Summary:

There are 24 CPR (O-Train) alternatives carried forward to the detailed evaluation.

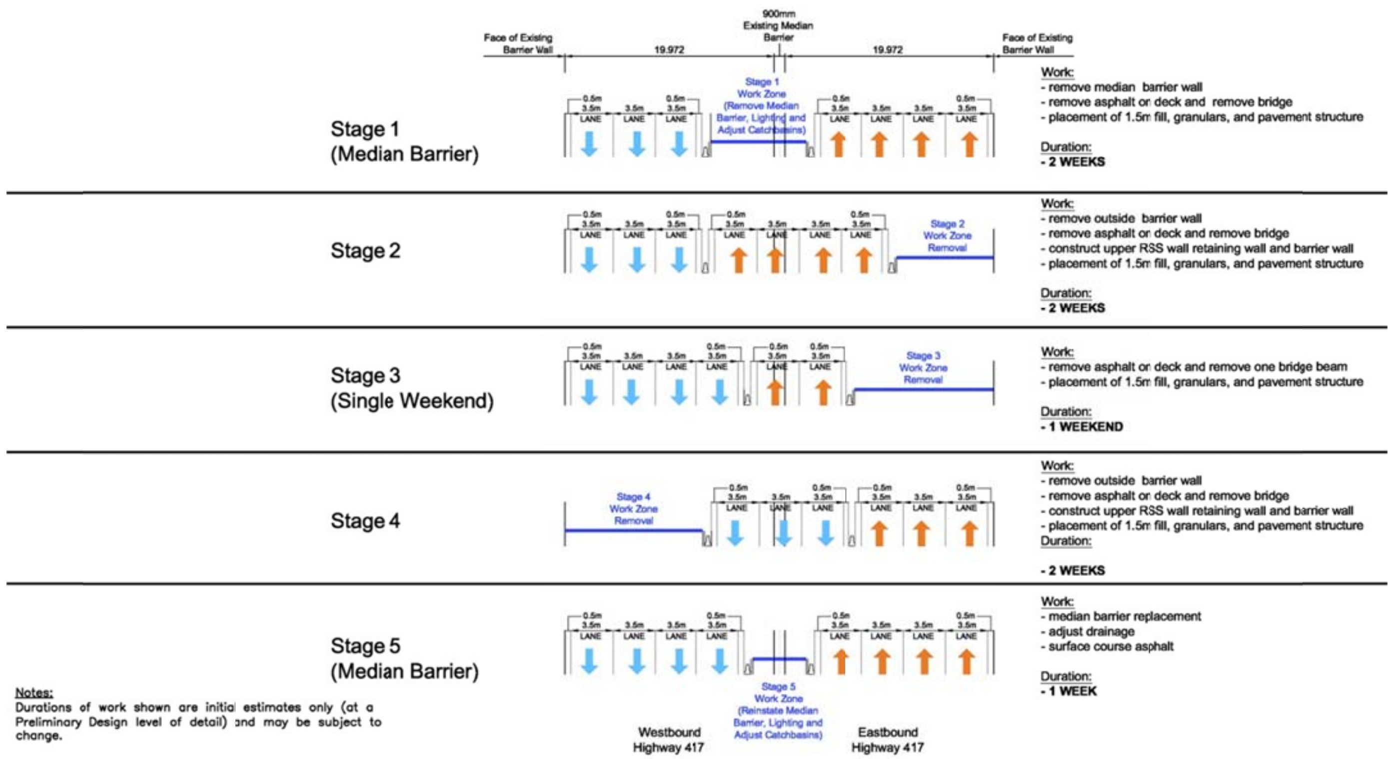


Figure 6.17: Traffic Staging Short Listed Alternative 2 for CPR/O-Train Bridge Site

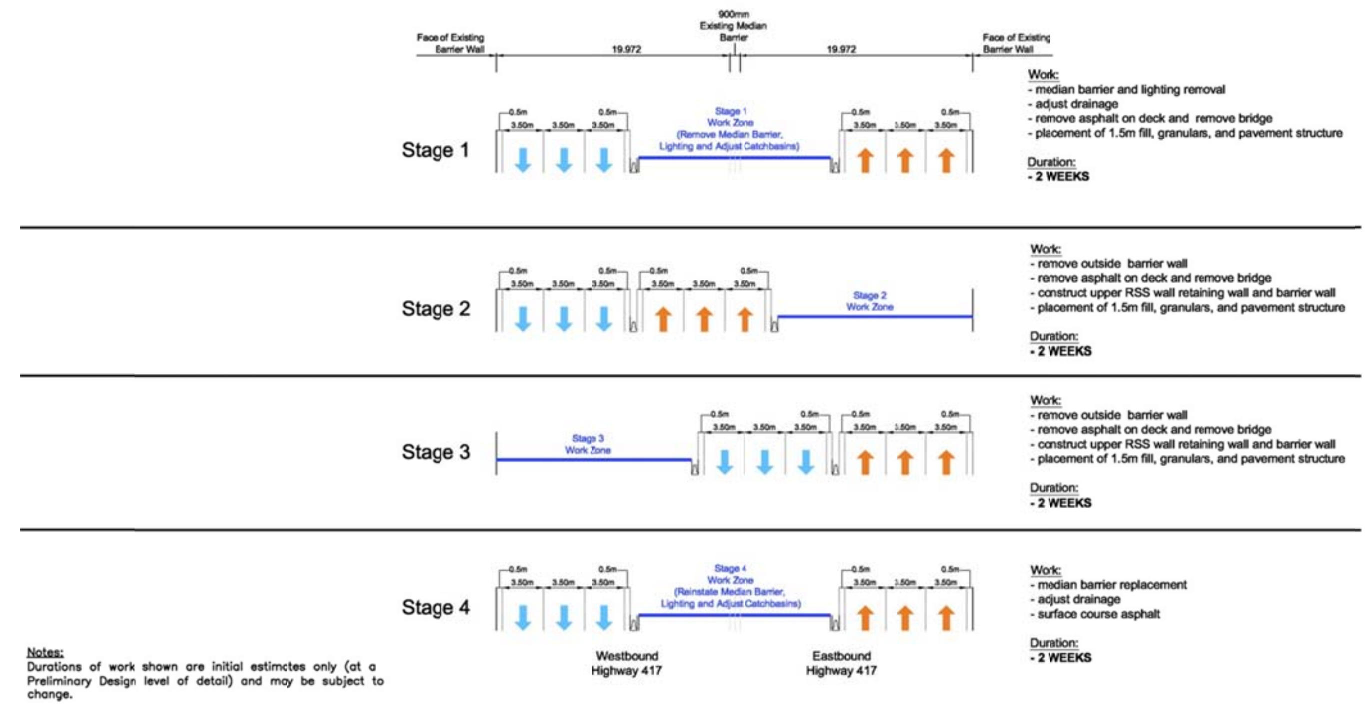


Figure 6.18: Traffic Staging Short Listed Alternative 5 for CPR/O-Train Bridge Site

The traffic staging short listed **Alternative 6 (1-span)** for CPR/O-Train bridge site involves the following stages:

- Stage 1: full lane closures for one weekend
- Remaining removals occur similar to Alternative 2

The traffic staging short listed **Alternative 6 (3-span)** for CPR/O-Train bridge site involves the following stages:

- Complete Closure of Queensway, and detour of traffic
- Assume 1300 veh and 0.2 h delay per vehicle for weekend
- 3-day weekend for twin replacement of bridge structures

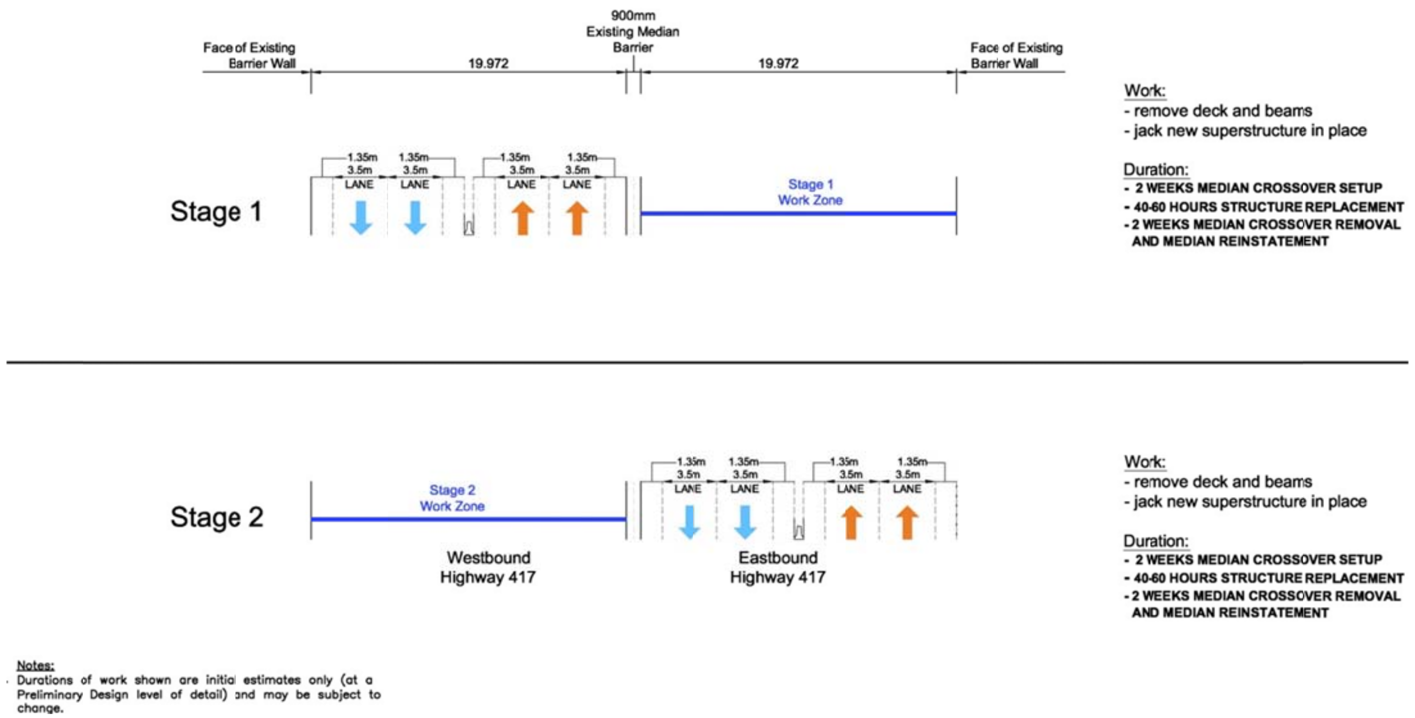


Figure 6.19: Traffic Staging Short Listed Alternative 7 for CPR/O-Train Bridge Site

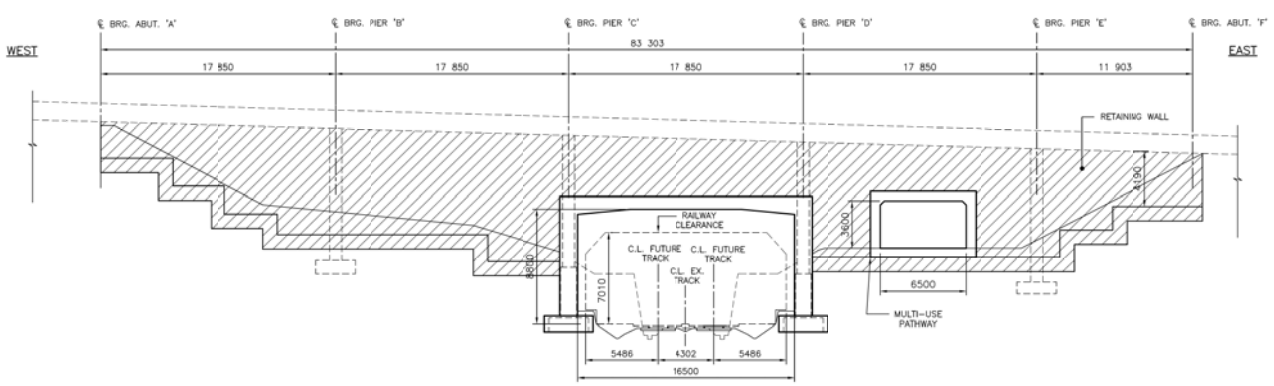


Figure 6.20: Alternative A – Single Span Rigid Frame with Separate Multi-use Pathway

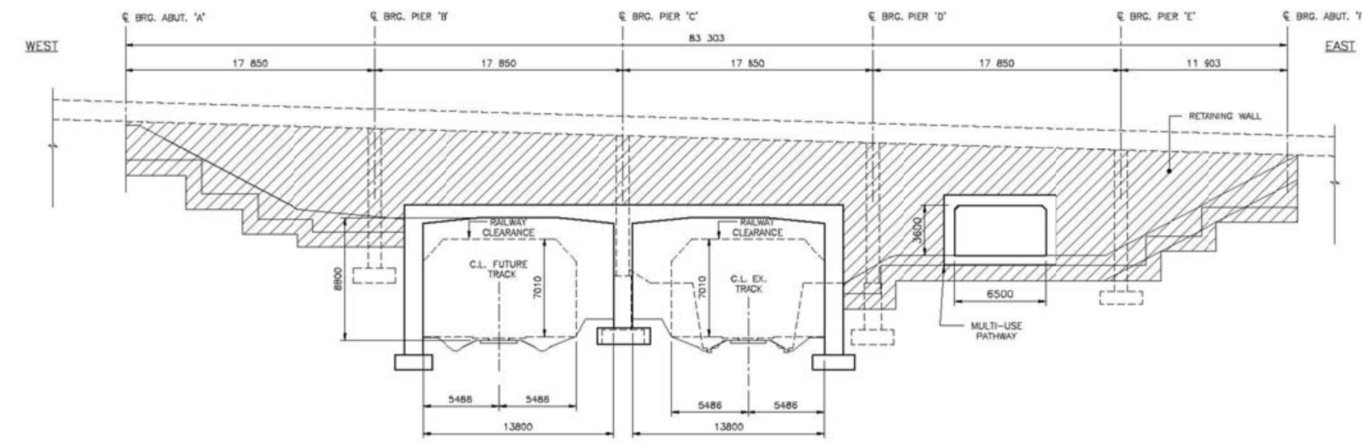


Figure 6.21: Alternative B – Two-Span Rigid Frame with Separate Multi-use Pathway

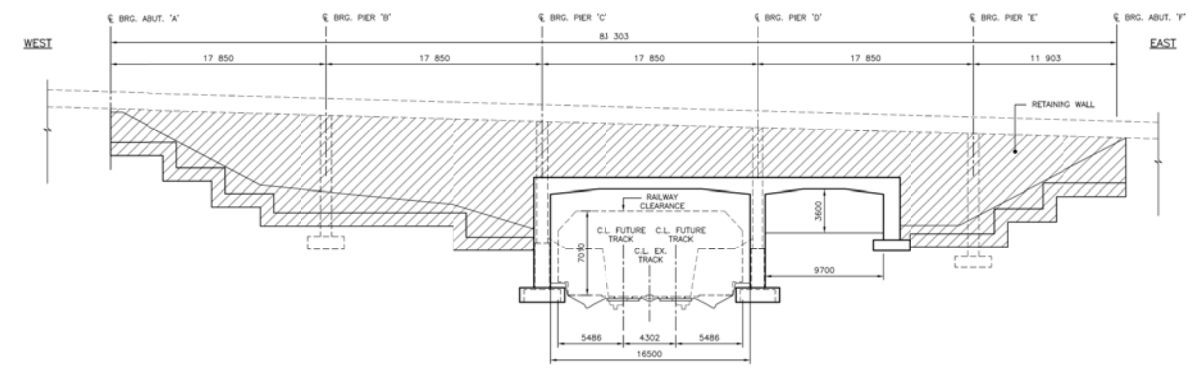


Figure 6.22: Alternative C – Two-Span Rigid Frame Incorporating Multi-use Pathway

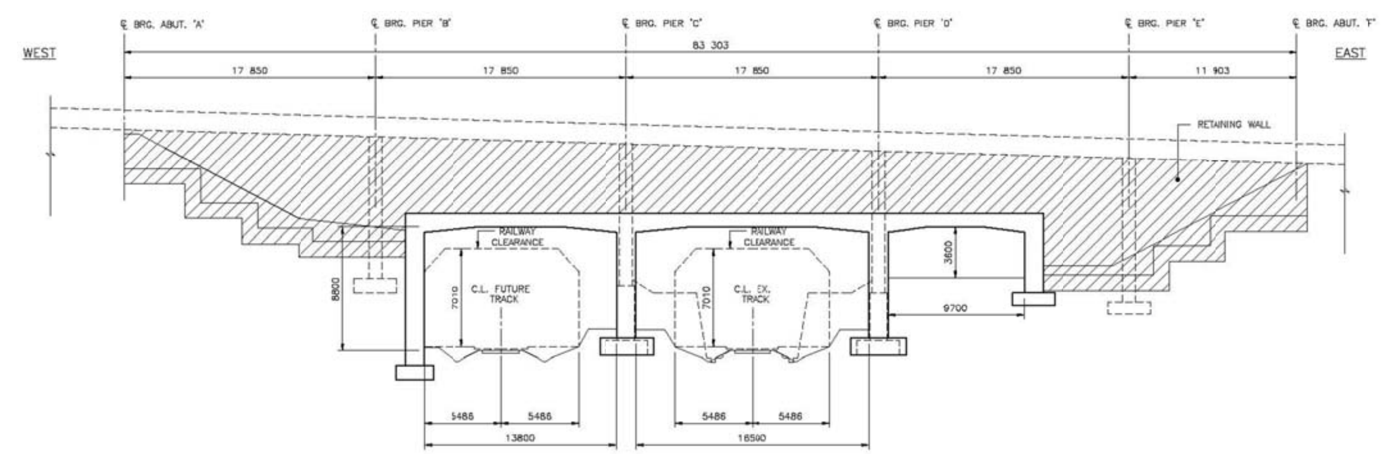


Figure 6.23: Alternative D – Three-Span-Rigid Frame Incorporating Multi-use Pathway

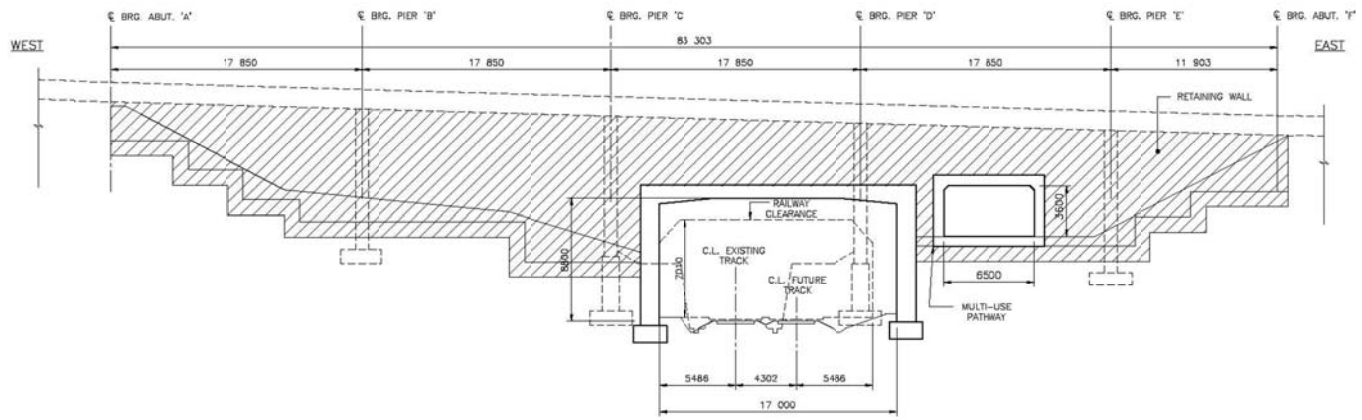


Figure 6.24: Alternative E – Single-Span Rigid Frame with Separate Multi-use Pathway

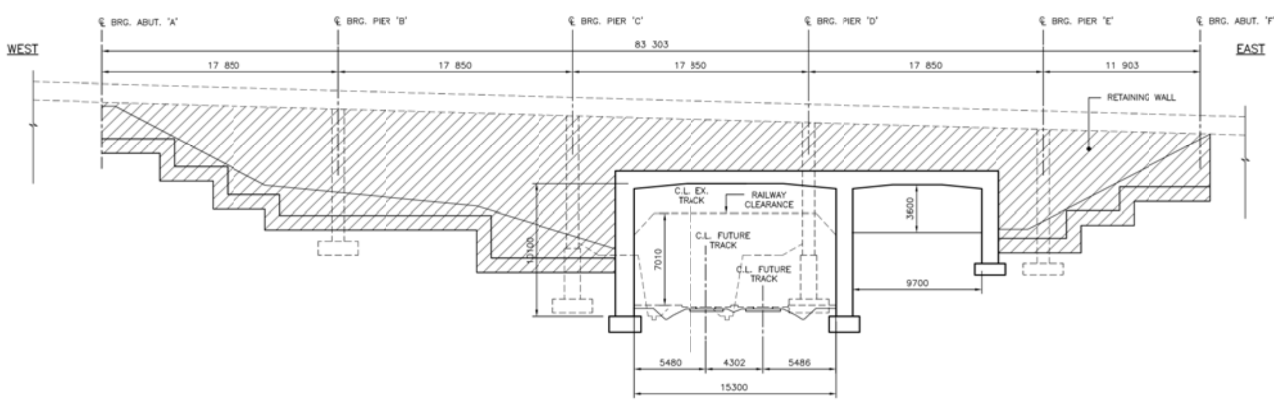


Figure 6.25: Alternative F – Two-Span Rigid Frame Incorporating Multi-use Pathway

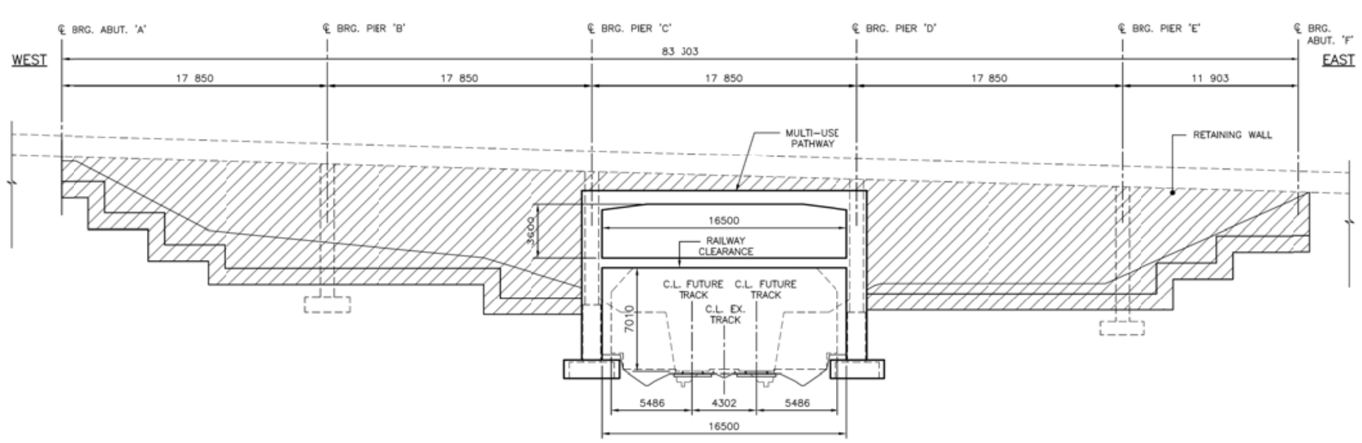


Figure 6.26: Alternative G – Single-Span Rigid Frame with Separate Multi-use Pathway

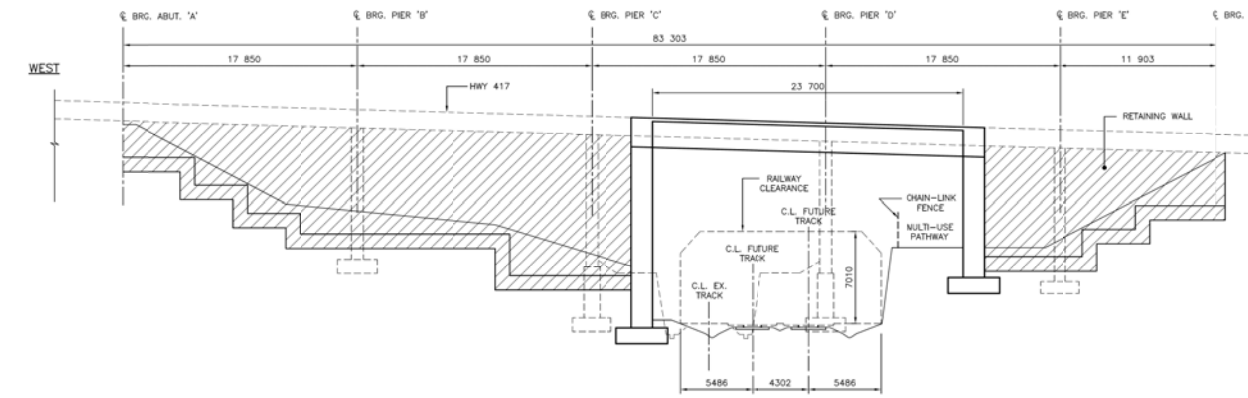


Figure 6.27: Alternative H – Single Span Deck Structure Installed by Jack-And-Slide

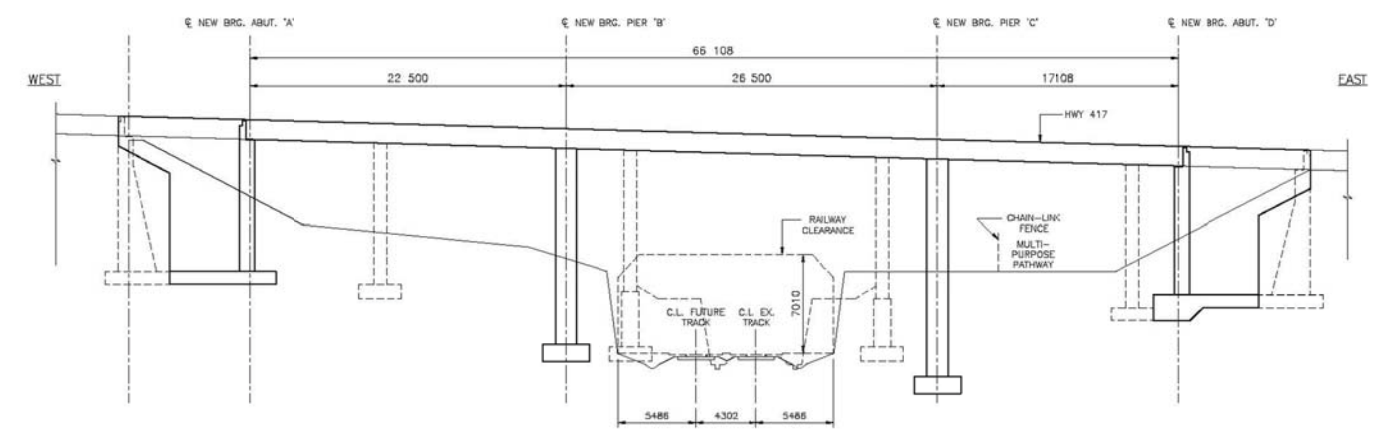


Figure 6.28: Alternative I – Three-Span Deck Structure Installed by Jack-And-Slide

6.2.3 *Multi-Use Pathway Location for Bridge Sites*

The multi-use pathway is located in a different alignment for each bridge site. Each location is illustrated in **Figures 6.29** to **6.37**.

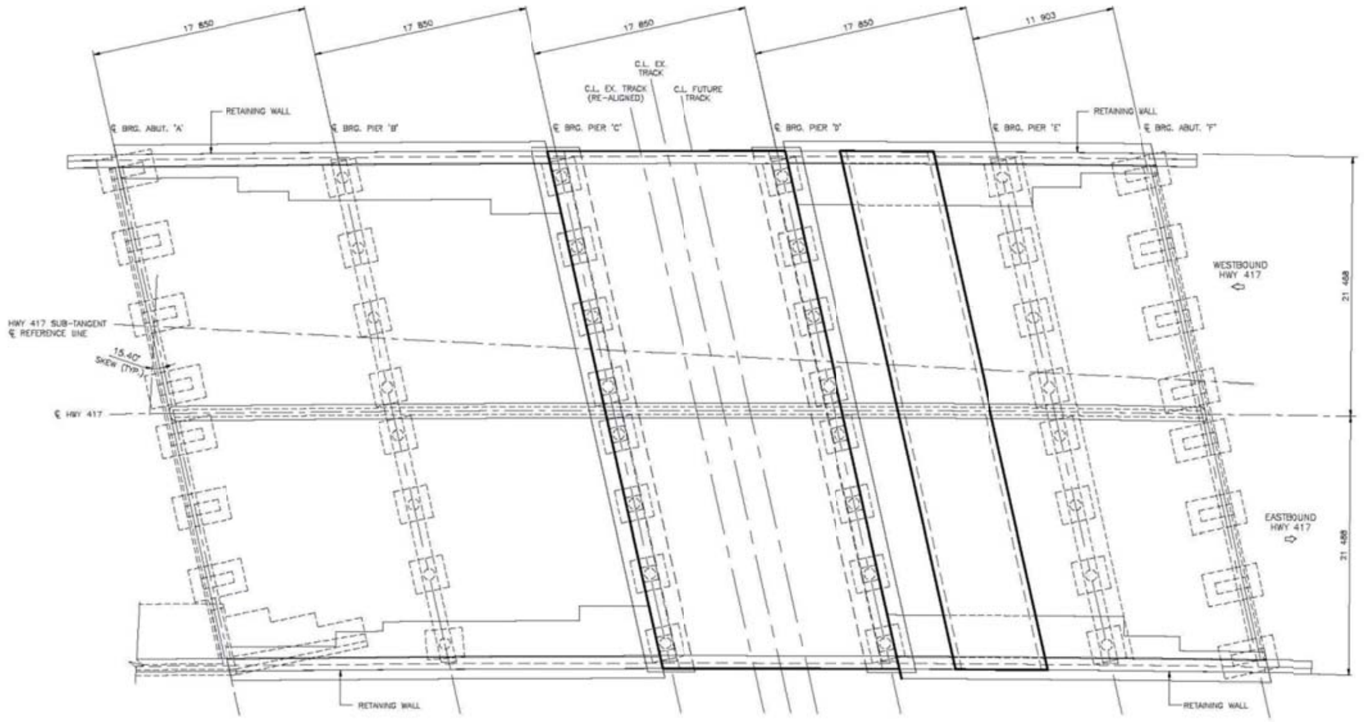


Figure 6.29: Alternative A - Single Span Rigid Frame with Separate Multi-use Pathway

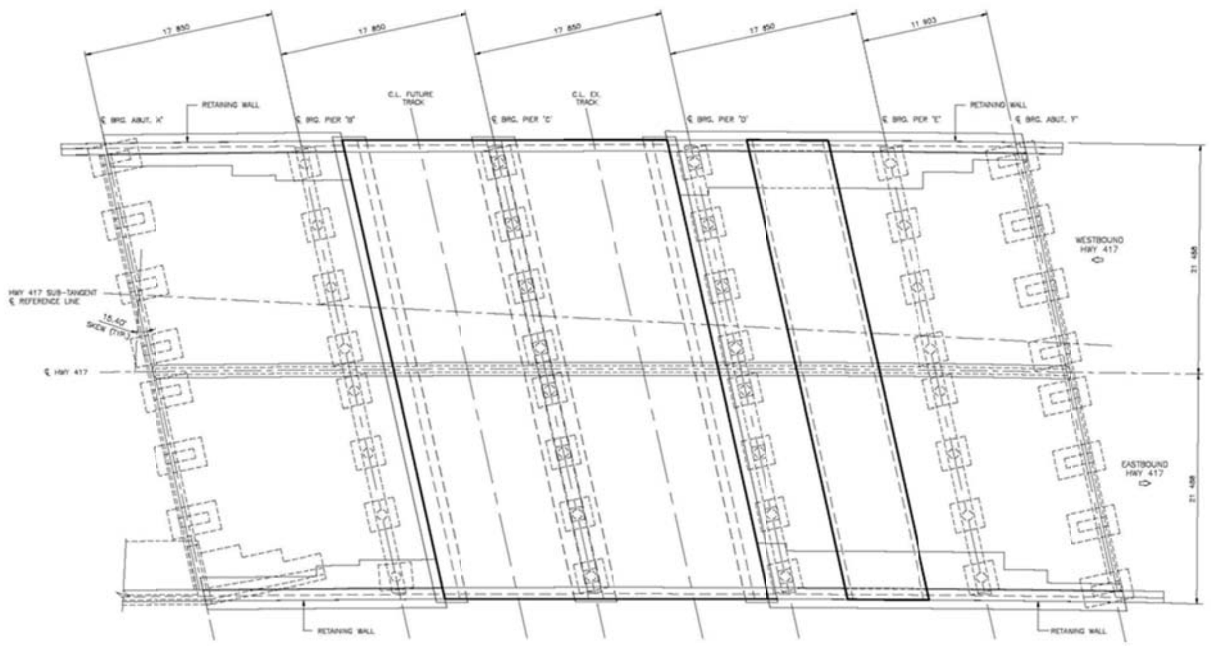


Figure 6.30: Alternative B – Two-Span Rigid Frame with Separate Multi-use Pathway

Figure 6.31: Alternative C – Two-Span Rigid Frame Incorporating Multi-use Pathway

Figure 6.32: Alternative D – Three-Span-Rigid Frame Incorporating Multi-use Pathway

Figure 6.33: Alternative E – Single-Span Rigid Frame with Separate Multi-use Pathway

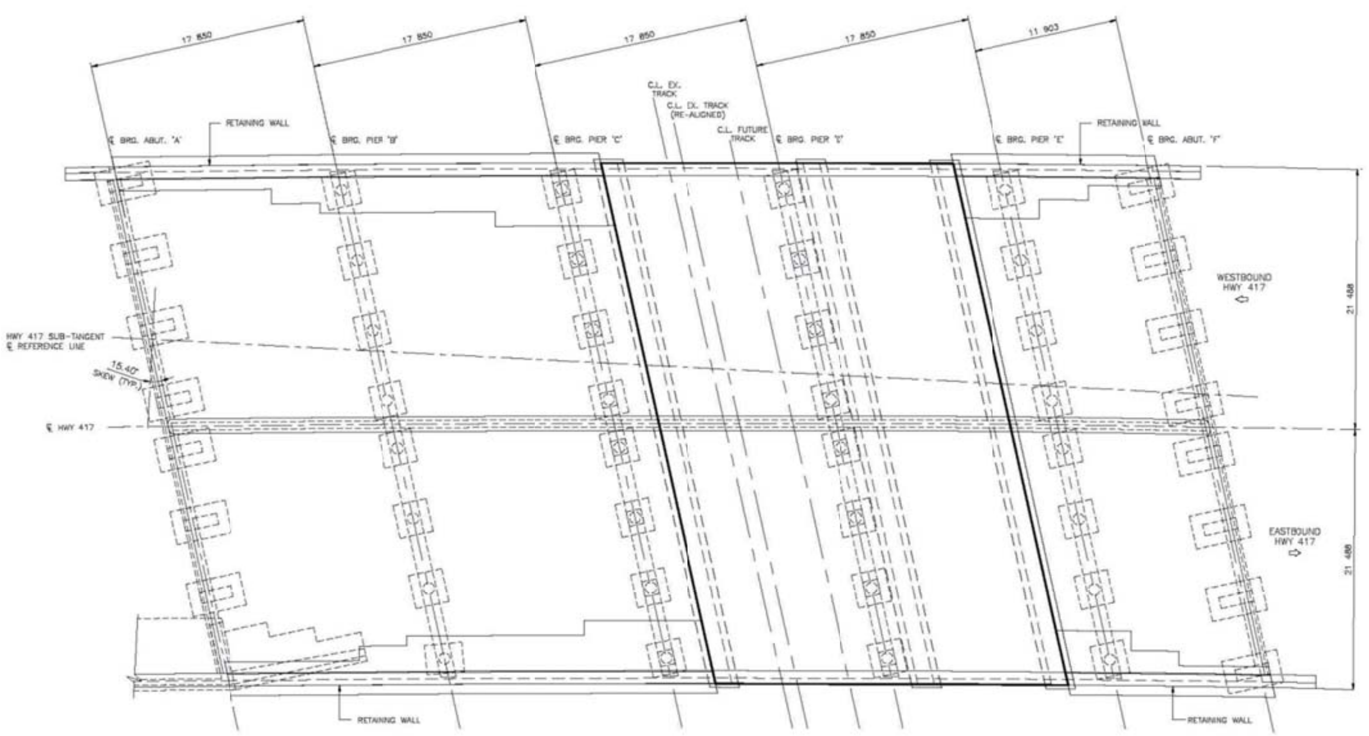


Figure 6.34: Alternative F – Two-Span Rigid Frame Incorporating Multi-use Pathway

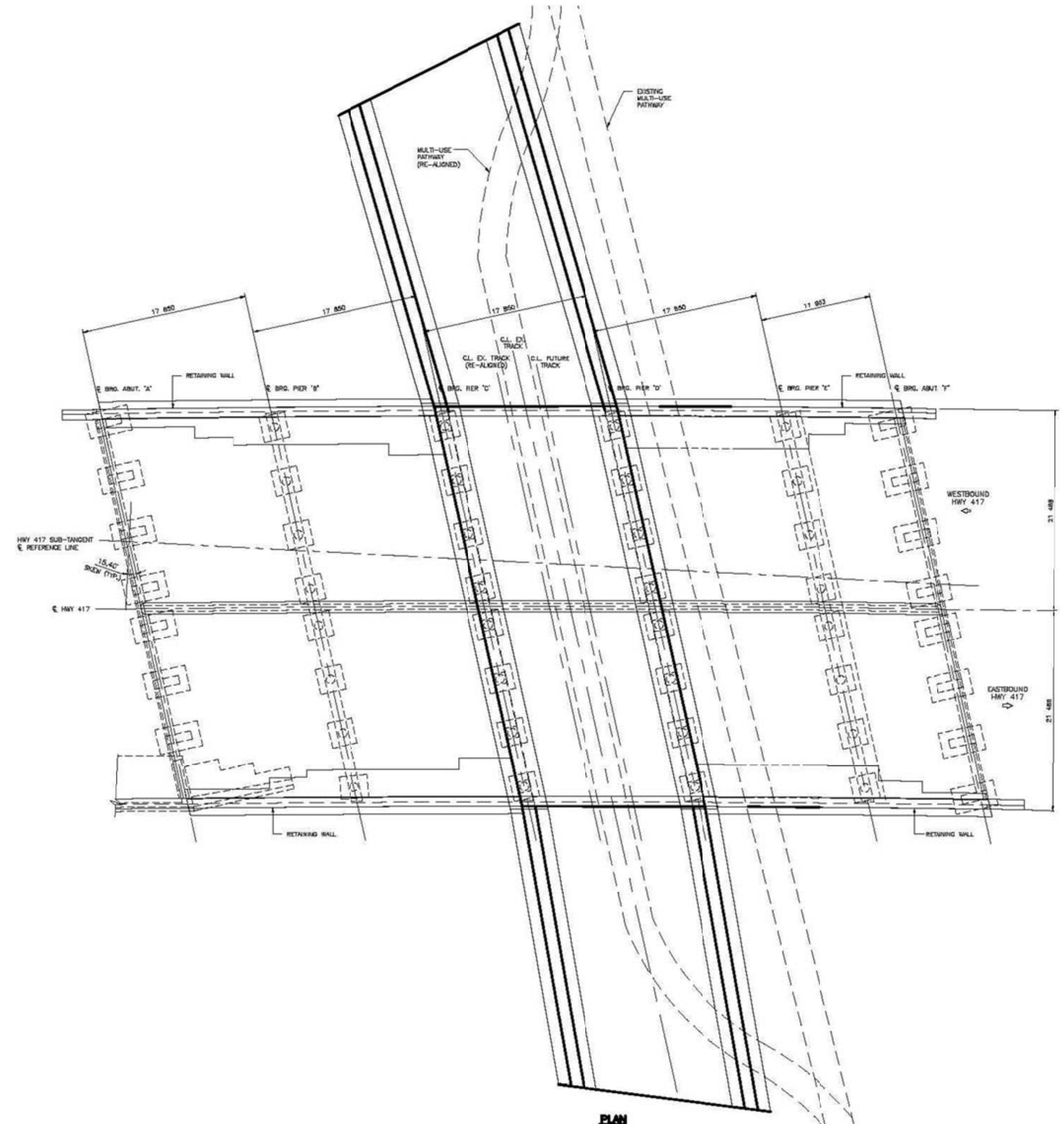


Figure 6.35: Alternative G – Single-Span Rigid Frame with Separate Multi-use Pathway

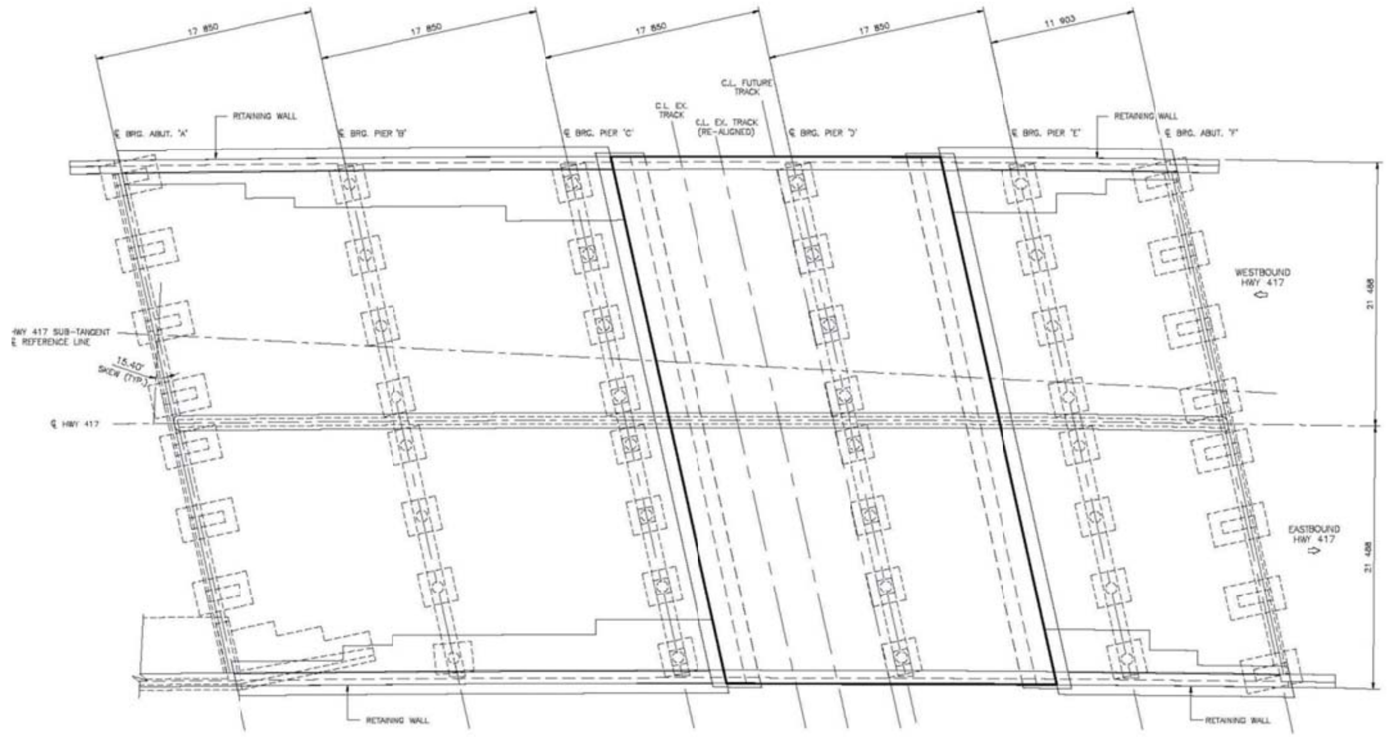


Figure 6.36: Alternative H – Single Span Deck Structure Installed by Jack-And-Slide

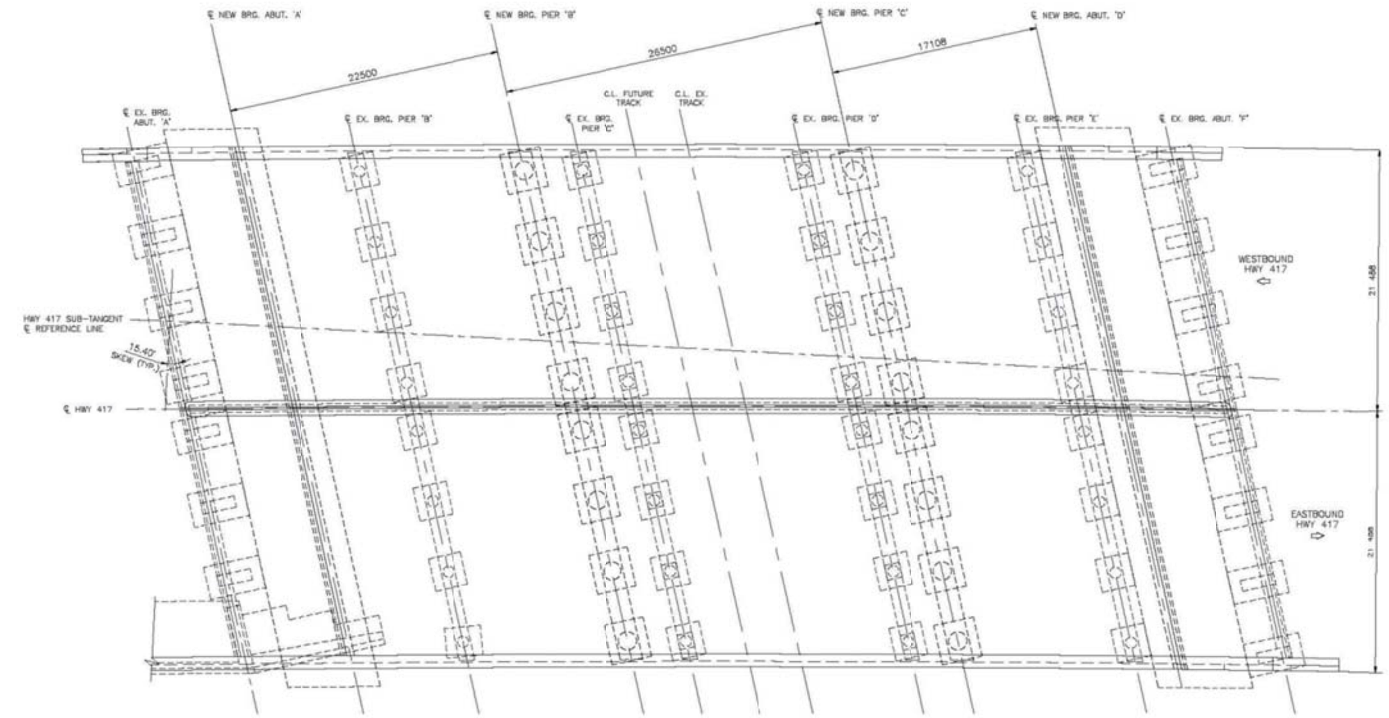


Figure 6.37: Alternative I – Three-Span Deck Structure Installed by Jack-And-Slide

7 ANALYSIS AND EVALUATION PROCESS

This section describes the formal evaluation approach used in this study for selecting a Technically Preferred Alternative (TPA) for each bridge site.

The analysis and evaluation process is a central requirement of the EA process and has been the subject of review by the Ministry of the Environment (MOE). MOE's review of *Evaluation Methods in Environmental Assessment* provided the framework for the detailed evaluation processes to be followed for this study.

7.1 Qualitative Assessment

Where there are a limited number of alternatives or a limited number of evaluation criteria when comparing options, a qualitative method/approach is typically chosen as the evaluation methodology. This can be documented as a narrative assessment or using a tabular qualitative assessment. The qualitative methodology is an accepted approach for the evaluation of alternatives where there are few alternatives, criteria and trade-offs and there is substantial agreement for the recommendations. The qualitative assessment method was applied to the analysis of Alternatives to the Undertaking and the coarse screening phase of the evaluation of Alternative Methods / Preliminary Design Alternatives.

7.2 Quantitative Assessment

This evaluation approach is based on the "Weighted Additive Method" which focuses on the differences between the alternatives, addressing the complexity of the base data collected, and providing a traceable decision-making process. In addition, the method allows quick sensitivity tests to be performed because of the matrix configuration of the assessment and the use of numerical scores to measure the impact of the alternatives. The sensitivity tests are also documented in this report. This approach is consistent with the MTO and MOE practices for the evaluation of numerous and complex alternatives. Using the "Weighted Additive Method", overall scores are assigned to each alternative and the option with the highest score is selected as the preferred alternative to complete the evaluation.

The steps shown below, as described in the Evaluation Methodology report included in **Appendix B**, are being followed by the Technical Advisory Committee (TAC) to arrive at an overall score for each alternative.

- Development of Evaluation Criteria (Coarse screening a long list of criteria to develop a short list of criteria to carry forward for evaluation). These factors and sub-factors are used to measure the differences between the alternatives.
- Public review (PIC No. 1)
- Development of definitions and utility functions for each sub-factor carried forward. (Data must be collected for each alternative under each sub-factor. Measurements for each alternative, under each sub-factor, are conducted using topographic plans, field surveys, numerical modelling etc.)
- Weighting of Criteria (assigning weights to each Factor and Sub-factor based on their importance to each team member's discipline or area of expertise)
- Rating Alternatives (based on Average TAC Weights)
- Selection of TPA – Highest Ranked Alternative
- Sensitivity testing
- Public review (PIC No. 2), and
- Recommendations and presentation of a Recommended Plan.

This systematic approach is consistent with MOE practices for the evaluation of numerous and complex alternatives. It avoids many of the pitfalls associated with qualitative assessments by using an analytical approach that measures scores based on a mathematical relationship, i.e. the degree of subjectivity by the TAC is minimized. This traceable process allows the TAC and the public an opportunity to assess trade-offs involved in the evaluation and use of this information in the decision making process. These steps are briefly described in the following sections.

7.3 Evaluation Criteria

The initial task in the evaluation is to develop evaluation criteria from which alternatives will be assessed. This process includes the identification of "global" groups of factors followed by the selection of a number of "local" sub-factors under the global groups.

7.3.1 *Global Evaluation Factors*

As an initial step, the evaluation criteria were grouped into broad categories, or factors, established to describe the study specific engineering and environmental concerns. Six factors were selected which were used for each evaluation.

These global factors included:

- Traffic and Transportation
- Natural Environment
- Social and Cultural Environment
- Economic Environment
- Land Use and Property, and
- Cost

7.3.2 *Evaluation Sub-Factors*

Under each of the six general global factors listed above there were a number of sub-factors selected under which measurements could be made. These sub-factors, under one of the applicable global factors, were the individual descriptors for the evaluation. The selection of the sub-factors is very important to the decision-making process because they must adequately describe the issue or aspect of the environment to be evaluated and the unique features of each alternative. Any information regarding an alternative, where there are differences among alternatives, is incorporated into the decision making process by including it as a sub-factor. Generally, the process begins by establishing a long list of potential sub-factors through discussions with the TAC, Stakeholders and the Public. Then, for each group of alternatives being evaluated the sub-factors are reviewed and screened by eliminating those that were considered equal or not applicable among the alternatives. **Appendix D** documents this long and short list screening. This will be presented at the initial PIC for public review and comment.

Table 7.1, **Table 7.2** and **Table 7.3** provide the Short List of Factors and Sub-factors carried forward to the analysis for each bridge site – broken down by the three (3) Study Area Sub-sections (**Figure 5.1**) for both the Queensway EB and WB lanes.

Table 7.1: Short Listed Evaluation Sub-factors (Holland/Parkdale/Fairmont/Bayswater – Section 1)

Factors and Sub-Factors	Unit of Measure	Sub-factors Carried Forward								Remarks
		Holland Avenue		Parkdale Avenue		Fairmount Avenue		Bayswater Avenue		
		EB Structures	WB Structures	EB Structures	WB Structures	EB Structures	WB Structures	EB Structures	WB Structures	
Transportation										
Maximum Peak Queue Length on Queensway	Km*days (peak hour)	✓	✓	✓	✓	✓	✓	✓	✓	
Delays	Veh h	✓	✓	✓	✓	✓	✓	✓	✓	
Ramp Closures	Veh (peak hour)	✓	✓							
Highway Safety - Collision Potential	Days	✓	✓	✓	✓	✓	✓	✓	✓	
Highway Safety – Design Consistency of Traffic Staging Design	Yes/No	✓	✓	✓	✓	✓	✓	✓	✓	
Pedestrian – Delay and Out-of-way Travel	High/ Medium/ Low	✓	✓	✓	✓	✓	✓	✓	✓	
Bicycle – Delay and Out-of-way Travel	High/ Medium/ Low	✓	✓	✓	✓	✓	✓	✓	✓	
Pedestrian/Bicycle Safety	High/ Low	✓	✓	✓	✓					
Transit Operations Delay	High/ Medium/Low	✓	✓	✓	✓					
General Traffic Municipal Street Delay	High/ Medium/Low	✓	✓	✓	✓	✓	✓	✓	✓	
Municipal Street – Traffic Signal Operations	Yes/No			✓	✓					
Social and Cultural Environment										
Community Green Spaces Impacted	Yes/No	✓	✓							Potential temporary impacts to Fisher Park Playground; Reid Park; and Fairmont Park.
Impact to Emergency Response	Days	✓	✓	✓	✓	✓	✓	✓	✓	
Potentially Contaminated Property	Yes/No			✓	✓	✓	✓	✓	✓	
Land Use and Property										
Temporary Property Impacts – Commercial, Industrial, Tourism Operations, Federal (NCC) (as applicable to each site)	Yes/No	✓	✓							
Permanent Property Impacts	Yes/No	✓	✓							
Cost										
Capital Cost	$	✓	✓	✓	✓	✓	✓	✓	✓	
Future Life Cycle Cost	$	✓	✓	✓	✓	✓	✓	✓	✓	

Legend: ✓ Carried Forward   Not Carried Forward

Table 7.2: Short Listed Evaluation Sub-factors (CPR/O-Train, Preston, Rochester and Booth – Section 2)

Factors and Sub-Factors	Unit of Measure	Sub-factors Carried Forward: CPR/O-Train EB Structures	CPR/O-Train WB Structures	Preston Street EB Structures	Preston Street WB Structures	Rochester Street EB Structures	Rochester Street WB Structures	Booth Street EB Structures	Booth Street WB Structures	Remarks
Transportation										
Maximum Peak Queue Length on Queensway	Km*days (peak hour)	✓	✓	✓	✓	✓	✓	✓	✓	
Delays	Veh h	✓	✓	✓	✓	✓	✓	✓	✓	
Ramp Closures	Veh (peak hour)	✓	✓	✓	✓	✓	✓	✓	✓	
Highway Safety - Collision Potential	Days	✓	✓	✓	✓	✓	✓	✓	✓	
Highway Safety – Design Consistency of Traffic Staging Design	Yes/No			✓	✓	✓	✓	✓	✓	
Pedestrian – Delay and Out-of-way Travel	High/ Medium/ Low			✓	✓	✓	✓	✓	✓	
Bicycle – Delay and Out of Way Travel	High/ Medium/ Low			✓	✓	✓	✓	✓	✓	
Pedestrian/Bicycle safety	High/ Low			✓	✓	✓	✓	✓	✓	
Multi-use Pathway - Safety and Security of All Users	m	✓	✓							
Multi-use Pathway Users – Out-of-way Travel	m	✓	✓							
Multi-use Pathway - Safety	High/ Medium/Low									
Transit (O-Train) Closure	Days	✓	✓							
Transit Operations Delay	High/ Medium/ Low			✓	✓	✓	✓	✓	✓	
General Traffic Municipal Street Delay	High/ Medium/ Low			✓	✓	✓	✓	✓	✓	
Social and Cultural Environment										
Impact to Emergency Response	Days	✓	✓	✓	✓	✓	✓	✓	✓	
Green Spaces Impacted	Yes/No	✓	✓							
Potentially Contaminated Property	Yes/No	✓	✓	✓	✓	✓	✓	✓	✓	
Economic Environment										
Loss of Parking - Permanent	No.	✓	✓							
Loss of Parking - Temporary	No.	✓	✓							Removing driveways for temporary impact; potential temporary loss of parking

Table 7.2: Short Listed Evaluation Sub-factors (CPR/O-Train, Preston, Rochester and Booth – Section 2)

Factors and Sub-Factors	Unit of Measure	Sub-factors Carried Forward								Remarks
		CPR/O-Train		Preston Street		Rochester Street		Booth Street		
		EB Structures	WB Structures	EB Structures	WB Structures	EB Structures	WB Structures	EB Structures	WB Structures	
										areas.
Preston Street Business Effects	Yes/No	✓	✓							Potential loss of business.
Land Use and Property										
Temporary Property Impacts – Commercial, Industrial, Tourism Operations, Federal (NCC) (as applicable to each site)	Yes/No	✓	✓							Potential impacts to commercial building south west of CPR/O-Train; and to various commercial and federal buildings parking areas.
Environmental Impacts along the CPR/O-Train Corridor	Good/Poor	✓	✓							
Temporary Property Impacts	m²			✓	✓	✓	✓	✓	✓	Potential temporary impacts to St. Anthony's Soccer Club parking; and Adult High School playfield and parking; Potential temporary impacts to Public Works parking / storage.
Cost										
Capital Cost	$	✓	✓	✓	✓	✓	✓	✓	✓	
Life Cycle Cost	$	✓	✓	✓	✓	✓	✓	✓	✓	

Legend: ✓ Carried Forward

Table 7.3: Short Listed Evaluation Sub-factors (Bronson, Percy, Bank and O'Connor – Section- 3)

Factors and Sub-Factors	Unit of Measure	Sub-factors Carried Forward							Remarks
		Bronson Avenue		Percy Street		Bank Street		O'Connor Street	
		EB Structures	WB Structures	EB Structures	WB Structures	EB Structures	WB Structures	EB/ WB Continuous Structure	
Transportation									
Maximum Peak Queue Length on Queensway	Km*days (peak hour)	✓	✓	✓	✓	✓	✓	✓	
Delays	Veh h	✓	✓	✓	✓	✓	✓	✓	
Ramp Closures	Veh (peak hour)	✓	✓	✓	✓	✓	✓	✓	
Highway Safety - Collision Potential	Days	✓	✓	✓	✓	✓	✓	✓	
Highway Safety – Design Consistency of Traffic Staging Design	Yes/No	✓	✓	✓	✓	✓	✓	✓	
Pedestrian – Delay and Out-of-way Travel	High/ Medium/ Low	✓	✓	✓	✓	✓	✓	✓	
Bicycle – Delay and Out of Way Travel	High/ Medium/ Low	✓	✓	✓	✓	✓	✓	✓	
Pedestrian/Bicycle safety	High/ Low	✓	✓	✓	✓	✓	✓	✓	
Transit Operations Delay	Km-days	✓	✓		✓	✓	✓	✓	
General Traffic Municipal Street Delay	High/ Medium/ Low	✓	✓	✓	✓	✓	✓	✓	
Provision of Ramp Terminal LT	Yes/No	✓	✓						
Social and Cultural Environment									
Impact to Emergency Response	Days	✓	✓	✓	✓	✓	✓	✓	
Potentially Contaminated Property	Yes/No	✓	✓	✓	✓	✓	✓	✓	
Land Use and Property									
Temporary Property Impacts– Commercial, Industrial, Tourism Operations, Federal (NCC) (as applicable to each site)	Yes/No	✓	✓	✓	✓	✓	✓	✓	
Permanent Property Impacts	Yes/No	✓	✓	✓	✓				
Cost									
Capital Cost	$	✓	✓	✓	✓	✓	✓	✓	
Future Life Cycle Cost	$	✓	✓	✓	✓	✓	✓	✓	
Schedule Certainty									
Potential									

Legend: ✓ Carried Forward

7.4 Social Utility Function

The evaluation method (Weighted Additive Method) used to evaluate alternatives related the performance or attractiveness of alternatives using a mathematical relationship. This included two variables. The first was the raw, measured or modelled data, and the second was the utility score. The utility score is the measure of the attractiveness of the alternative under the particular sub-factor. For this study, the relationship between these two variables was described by either a linear, stepped or a dichotomous social utility function. These utility functions assigned a dimensionless score between 0 and 1 to an alternative for each sub-factor.

Examples of dichotomous, stepped and linear functions used in this study are explained in the following sections.

7.4.1 *Dichotomous Utility Function*

The dichotomous utility function, shown in **Figure 7.1**, permits the decision-makers to establish criteria that present an "either-or" situation (desirable or undesirable, negative or positive, present or absent, etc.). If a "no" answer is desirable then a utility score of 'one' would be assigned to this criterion, otherwise a value of 'zero' would be assigned; no other utility score being available.

7.4.2 *Stepped Utility Function*

The stepped utility function, shown in **Figure 7.1**, permits the decision-makers to assess criteria when the sub-factor presents more than one level of impact. An example of this situation is where the sub-factor can be categorized into "high, medium or low" degrees of impact. If a "high" answer is undesirable then a utility score or zero is assigned to this criterion, a "medium" answer would be 0.5 and "low" would have a value of 1.0 assigned to it. The stepped function may have more than three categories, with each category assigned a value between one and zero.

The value for each step is determined by the subject area specialist (expert). The maximum value found within the group is either the highest or lowest step. If the maximum value is undesirable it is given a value of zero and conversely the lowest value is desirable and is assigned a value of one.

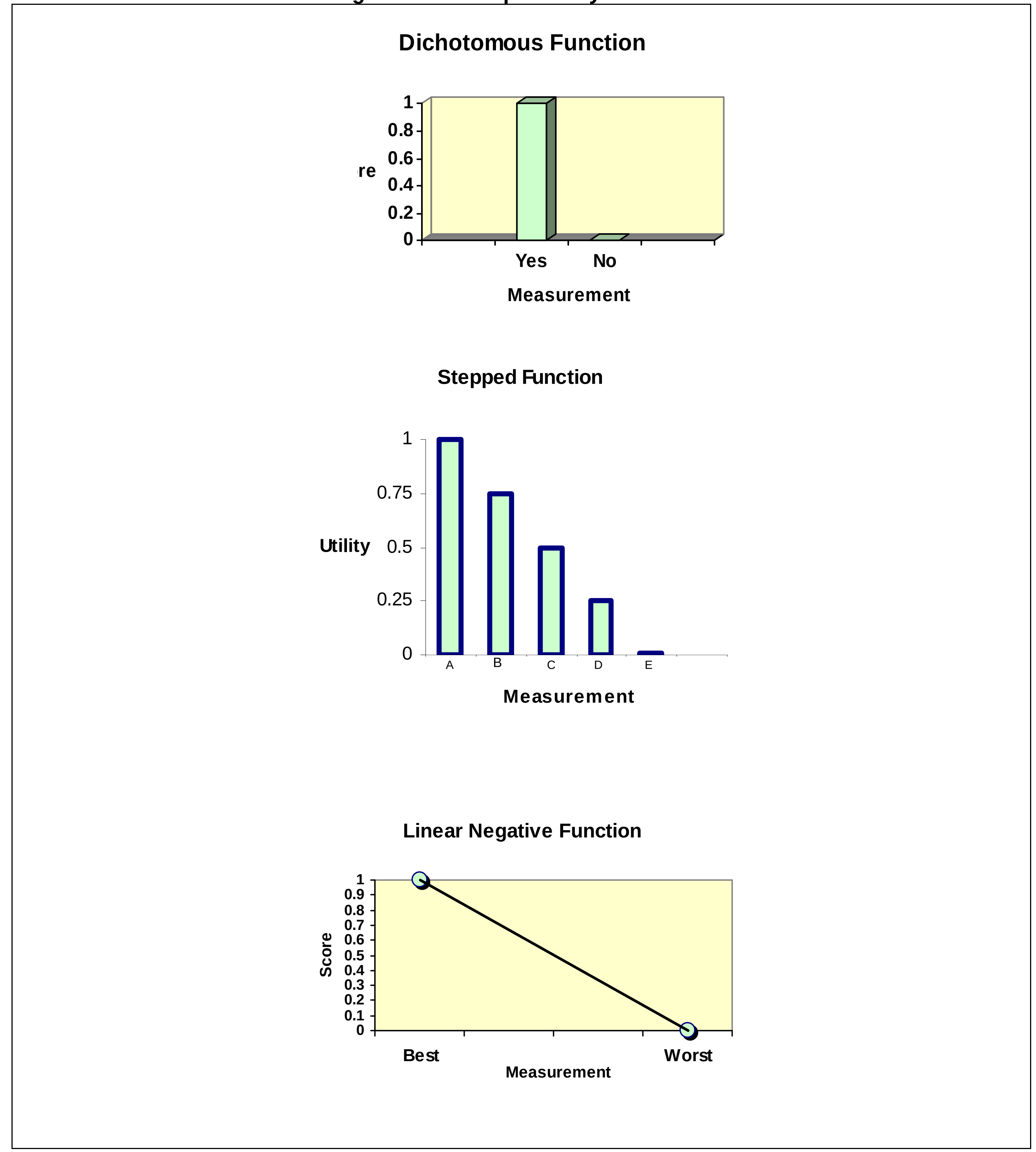
7.4.3 *Linear Utility Function*

The linear function, shown in **Figure 7.1**, was used to convert scores for sub-factors that had varying measurements. Given a measurement, a unique score between zero and one could be assigned to a sub-factor.

The slope of the linear utility function is either negative or positive depending on the desirability of the impact. In the example below, the slope of the function is negative.

The short listed criteria, including definitions and their respective social utility functions are included as **Appendix E**.

Figure 7.1: Sample Utility Functions



7.5 Weighted Factors and Sub-Factors

Factors were eliminated where they were not applicable (because there was no difference between alternatives or they were considered equal). The selection of weights for the factors and sub-factors were based on assessments by the Technical Advisory Committee (TAC). Within a group of factors, inevitably there was an ordering with some sub-factors having more importance than others. This is accounted for by each individual assigning weights to each factor and sub-factor, which is reflected in the "Factor Weight" and "Sub-factor Weight" columns in **Table 7.4, Sample Factor / Sub-factor Weights**.

Table 7.4: Sample Factor / Sub-Factor Weights (Sample)

Factors/Sub-factors	TAC	
	Factor Weight	Sub-factor Weight
Transportation	41.7%	
• LOS of cross road		75%
• Ease of construction		10.5%
• Number of entrances		7.8%
• Potential school bus conflicts		6.7%
TOTAL		100%

The percentage weight for all global factors totalled, (considered as global weights), is 100%. As well, the percentage weight for the sub-factors under each factor, described as local weights, must total 100%. There is a degree of subjectivity in deciding which is the most important global factor and which is the least important factor. Every person assigning weights has a personal bias and understanding of the scope of the project and life experience. Hence, there is an advantage to having a diversified team of professionals with varied backgrounds performing the evaluation. The members of the TAC consisted of a diverse group of transportation planners, environmental planners plus structural and transportation engineers and technicians.

Each member assigns percentage weights to each global factor and sub-factor based on their opinion of the relative importance of each after a presentation by each specialist to TAC members. Their individual weights were then averaged to determine the TAC weight for each global factor and sub-factor.

The results of the weighting exercise for each structure site under review are provided in the following sections.

7.5.1 *Weighting Results*

The weighting exercises were carried out by the TAC. The results of the weighting exercises and the sensitivity tests have been included in the following summary tables. The sensitivity tests provided the Project Team with an indication of possible trade-offs between indicators.

The Multi Attribute Trade-off System (MATS) evaluation method is a numerical quantitative evaluation methodology based on the weighted additive method. For the purpose of this report, they can be treated as identical terms.

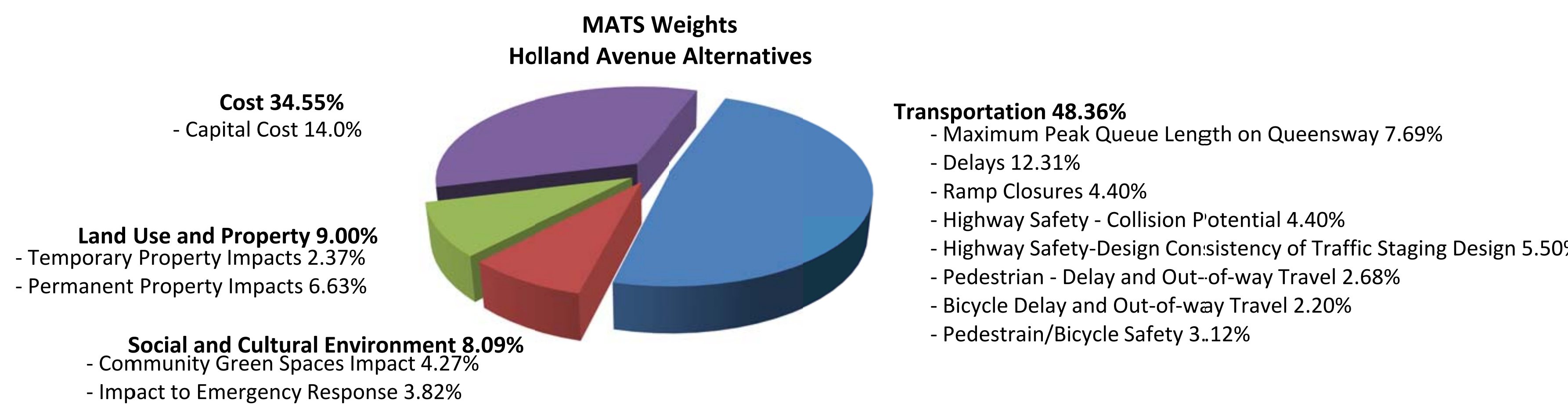
7.5.1.1 Holland Avenue

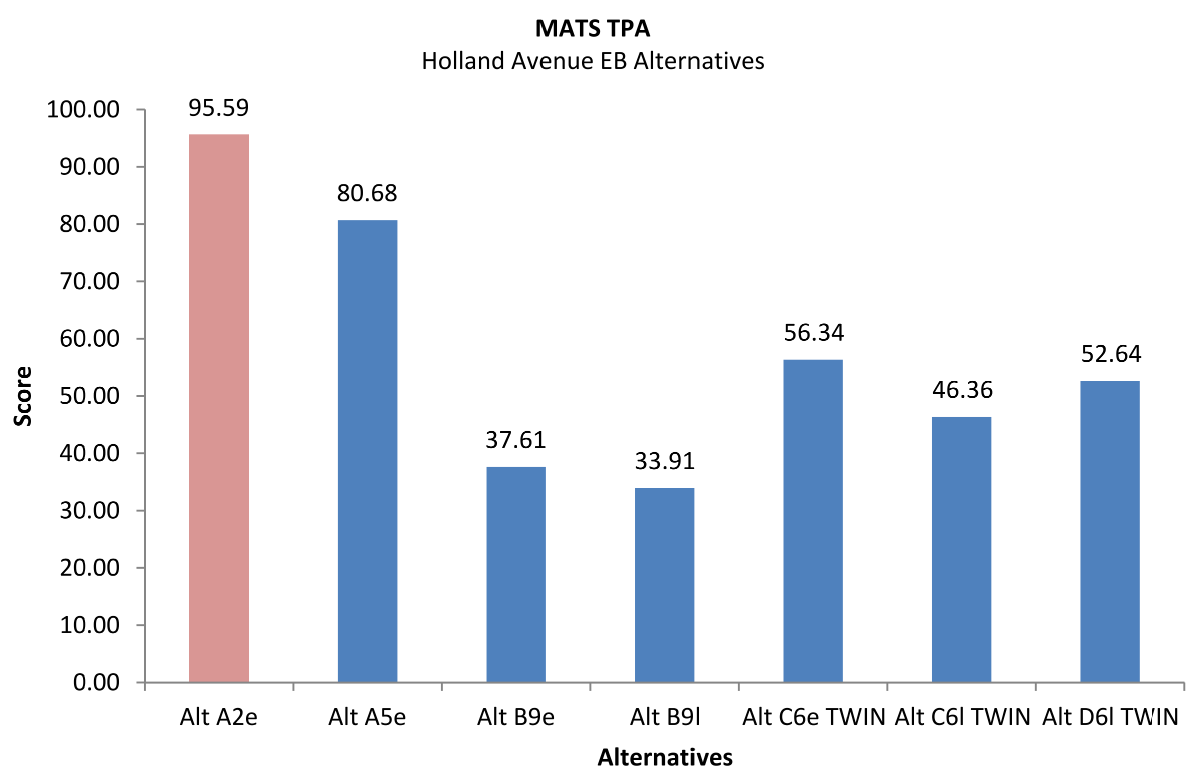
The results of the weights and rankings for Holland Avenue are illustrated on **Figure 7.2**, with the results of the weights for each sub-factor shown in **Table 7.5** and **Table 7.6** for Holland Avenue eastbound and westbound, respectively.

For the eastbound and westbound alternatives, the MATS ranked Alternative A2e, Rapid Bridge Rehabilitation, as the Technically Preferred Alternative (TPA) for both directions. Taking into consideration the implementation of each alternative, the TPA for Holland Avenue eastbound and westbound is Alternative A2e.

The Evaluation Committee recommended that the TESR, which will describe the project to be carried forward, be refined to allow flexibility in the project to be delivered. Although the project to be implemented is a rapid rehabilitation, the MTO should retain the flexibility to advance the replacement of the bridge, (Alternative C6e), should the structural condition of the bridge show additional significant deterioration as the project is delivered/ postponed or there are changes to Provincial priorities. This will be noted as a Statement of Flexibility in the TESR.

Figure 7.2: Holland Avenue MATS Weights and Rankings





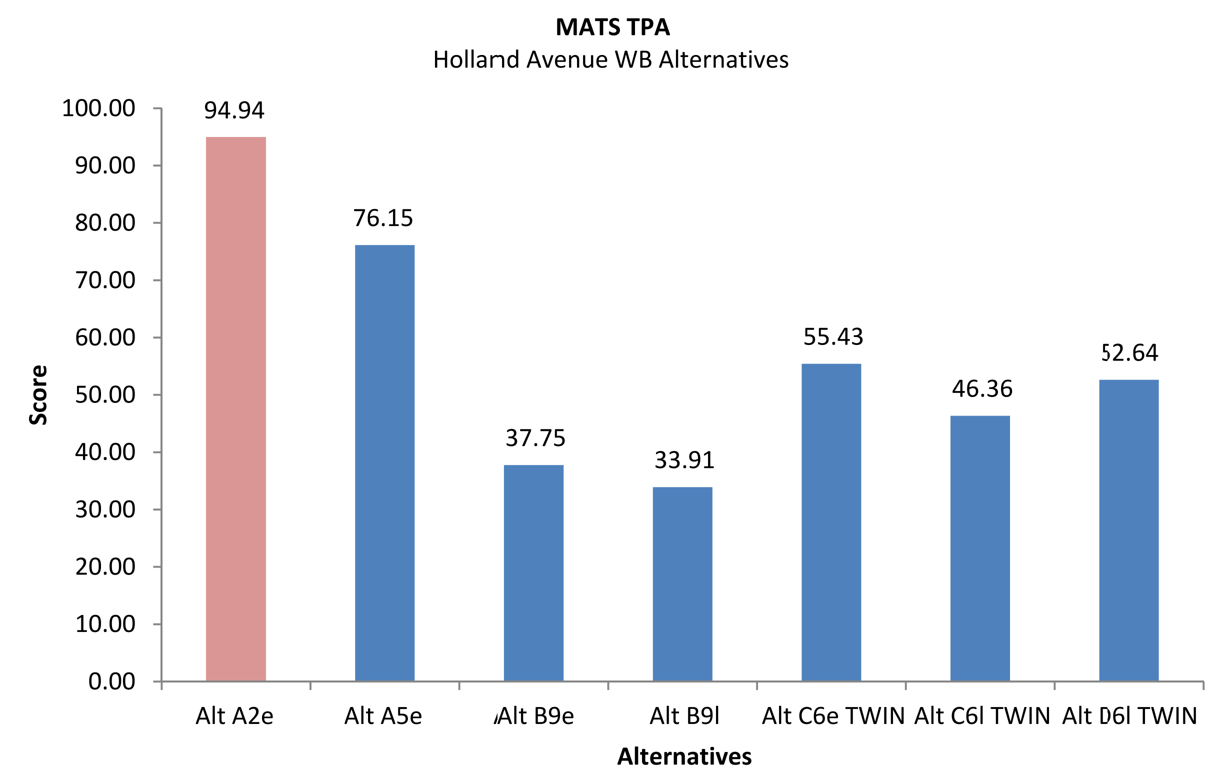


Table 7.5: Summary of Holland Avenue EB MATS Weighted Scores

Holland Avenue EB	**Alternative[1]**						
	Alt A2e	**Alt A5e**	**Alt B9e**	**Alt B9l**	**Alt C6e TWIN[2]**	**Alt C6l TWIN**	**Alt D6l TWIN**
Transportation							
Maximum Peak Queue Length on Queensway	7.54	4.54	0.00	0.00	7.69	7.69	7.69
Delays	12.31	7.39	0.00	0.00	12.31	12.31	12.31
Ramp Closures	4.09	4.40	0.00	0.00	4.04	4.04	4.04
Highway Safety - Collision Potential	3.96	2.64	0.00	0.00	4.40	4.40	4.40
Highway Safety - Design Consistency of Traffic Staging Design	5.50	5.50	0.00	0.00	5.50	5.50	5.50
Pedestrian - Delay and Out-of-way Travel	2.68	2.68	0.00	0.00	1.34	1.34	1.34
Bicycle - Delay and Out-of-way Travel	2.20	2.20	0.00	0.00	1.10	1.10	1.10
Pedestrian/Bicycle Safety	0.00	0.00	0.00	3.12	0.00	3.12	3.12
Transit Operations Delay	2.90	2.90	0.00	0.00	1.45	1.45	1.45
General Traffic Municipal Street Delay	3.17	3.17	0.00	0.00	1.58	1.58	1.58
TOTAL	44.34	35.40	0.00	3.12	39.42	42.54	42.54
Social and Cultural Environment							
Community Green Spaces Impacts	4.27	4.27	4.27	4.27	0.00	0.00	0.00
Impact to Emergency Response	3.44	2.29	0.00	0.00	3.82	3.82	3.82
TOTAL	7.71	6.56	4.27	4.27	3.82	3.82	3.82
Land Use and Property							
Temporary Property Impacts	2.37	2.37	2.37	2.37	0.00	0.00	0.00
Permanent Property Impacts	6.63	6.63	6.63	6.63	0.00	0.00	0.00
TOTAL	9.00	9.00	9.00	9.00	0.00	0.00	0.00
Cost							
Capital Cost	13.98	12.44	7.69	5.59	4.05	0.00	1.96
Life Cycle Cost	20.57	17.28	16.66	11.93	9.05	0.00	4.32
TOTAL	34.55	29.72	24.35	17.52	13.10	0.00	6.28
Score	**95.59**	**80.68**	**37.61**	**33.91**	**56.34**	**46.36**	**52.64**

Table 7.6: Summary of Holland Avenue WB MATS Weighted Scores

Holland Avenue WB	**Alternative[3]**						
	Alt A2e	**Alt A5e**	**Alt B9e**	**Alt B9l**	**Alt C6e TWIN[4]**	**Alt C6l TWIN**	**Alt D6l TWIN**
Transportation							
Maximum Peak Queue Length on Queensway	7.54	4.54	0.00	0.00	7.69	7.69	7.69
Delays	12.31	7.39	0.00	0.00	12.31	12.31	12.31
Ramp Closures	3.43	0.00	0.00	0.00	2.99	4.04	4.04
Highway Safety - Collision Potential	3.96	2.64	0.00	0.00	4.40	4.40	4.40
Highway Safety - Design Consistency of Traffic Staging Design	5.50	5.50	0.00	0.00	5.50	5.50	5.50
Pedestrian - Delay and Out-of-way Travel	2.68	2.68	0.00	0.00	1.34	1.34	1.34
Bicycle - Delay and Out-of-way Travel	2.20	2.20	0.00	0.00	1.10	1.10	1.10
Pedestrian/Bicycle Safety	0.00	0.00	0.00	3.12	0.00	3.12	3.12
Transit Operations Delay	2.90	2.90	0.00	0.00	1.45	1.45	1.45
General Traffic Municipal Street Delay	3.17	3.17	0.00	0.00	1.58	1.58	1.58
TOTAL	43.68	31.01	0.00	3.12	38.36	42.54	42.54
Social and Cultural Environment							
Community Green Spaces Impacts	4.27	4.27	4.27	4.27	0.00	0.00	0.00
Impact to Emergency Response	3.44	2.29	0.00	0.00	3.82	3.82	3.82
TOTAL	7.71	6.56	4.27	4.27	3.82	3.82	3.82
Land Use and Property							
Temporary Property Impacts	2.37	2.37	2.37	2.37	0.00	0.00	0.00
Permanent Property Impacts	6.63	6.63	6.63	6.63	0.00	0.00	0.00
TOTAL	9.00	9.00	9.00	9.00	0.00	0.00	0.00
Cost							
Capital Cost	13.98	12.30	7.83	5.59	4.19	0.00	1.96
Life Cycle Cost	20.57	17.28	16.66	11.93	9.05	0.00	4.32
TOTAL	34.55	29.58	24.49	17.52	13.24	0.00	6.28
Score	**94.94**	**76.15**	**37.75**	**33.91**	**55.43**	**46.36**	**52.64**

[1] All alternative descriptors/abbreviations are defined in the last column of Figure 6.1.
[2] "TWIN" references that a common staging area on the north side of the Queensway is to be used for both eastbound and westbound structure replacements. Therefore, both eastbound and westbound structures must be completed on the same weekend.

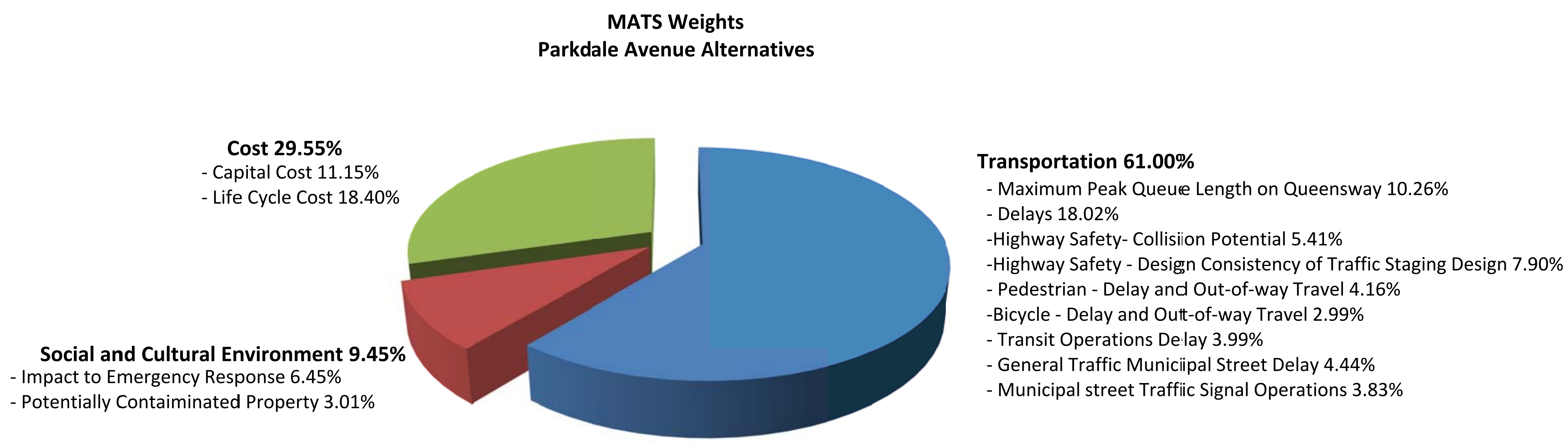
[3] All alternative descriptors/abbreviations are defined in the last column of Figure 6.1.
[4] "TWIN" references that a common staging area on the north side of the Queensway is to be used for both eastbound and westbound structure replacements. Therefore, both eastbound and westbound structures must be completed on the same weekend.

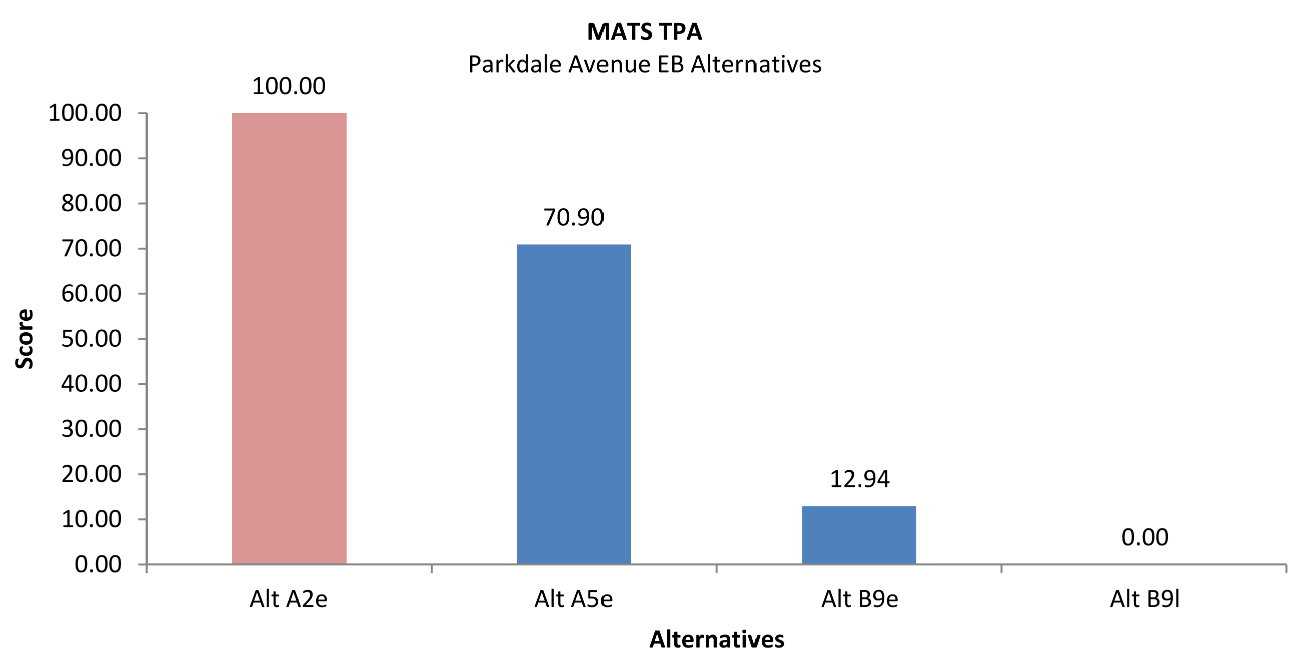
7.5.1.2 Parkdale Avenue

The results of the weights and rankings for Parkdale Avenue are illustrated on **Figure 7.3**, with the results of the weights for each sub-factor shown in **Table 7.7** and **Table 7.8** for Parkdale Avenue eastbound and westbound, respectively.

For the eastbound and westbound alternatives, the MATS ranked Alternative A2e, Rapid Bridge Rehabilitation, as the Technically Preferred Alternative for both directions. Taking into consideration the implementation of each alternative, the TPA for Parkdale Avenue eastbound and westbound remains Alternative A2e.

Figure 7.3: Parkdale Avenue MATS Weights and Rankings





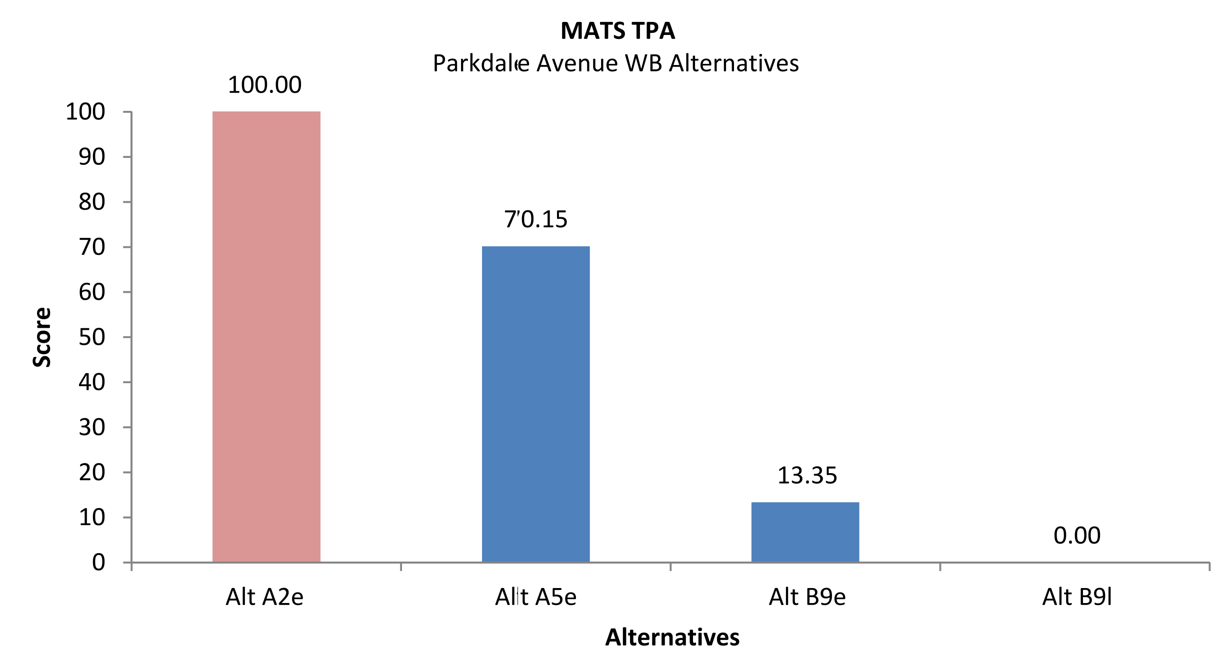


Table 7.7: Summary of Parkdale Avenue EB MATS Weighted Scores

Parkdale Avenue EB	Alternative[5]			
	Alt A2e	**Alt A5e**	**Alt B9e**	**Alt B9l**
Transportation				
Maximum Peak Queue Length on Queensway	10.26	6.05	0.00	0.00
Delays	18.02	10.81	0.00	0.00
Highway Safety - Collision Potential	5.41	3.24	0.00	0.00
Highway Safety - Design Consistency of Traffic Staging Design	7.90	7.90	0.00	0.00
Pedestrian - Delay and Out-of-way Travel	4.16	4.16	0.00	0.00
Bicycle - Delay and Out-of-way Travel	2.99	2.99	0.00	0.00
Transit Operations Delay	0.00	0.00	0.00	0.00
General Traffic Municipal Street Delay	3.99	3.99	0.00	0.00
Municipal Street Traffic Signal Operations	4.44	4.44	0.00	0.00
TOTAL	3.83	3.83	0.00	0.00
Social and Cultural Environment	61.00	47.42	0.00	0.00
Impact to Emergency Response	6.45	3.87	0.00	0.00
Potentially Contaminated Property	3.01	3.01	0.00	0.00
TOTAL	9.45	6.88	0.00	0.00
Cost				
Capital Cost	11.15	8.14	3.01	0.00
Life Cycle Cost	18.40	8.46	9.94	0.00
TOTAL	29.55	16.60	12.94	0.00
Score	**100.00**	**70.90**	**12.94**	**0.00**

Table 7.8: Summary of Parkdale Avenue WB MATS Weighted Scores

Parkdale Avenue WB	Alternative[6]			
	Alt A2e	**Alt A5e**	**Alt B9e**	**Alt B9l**
Transportation				
Maximum Peak Queue Length on Queensway	10.26	6.26	0.00	0.00
Delays	18.02	10.81	0.00	0.00
Highway Safety - Collision Potential	5.41	3.24	0.00	0.00
Highway Safety - Design Consistency of Traffic Staging Design	7.90	7.90	0.00	0.00
Pedestrian - Delay and Out-of-way Travel	4.16	4.16	0.00	0.00
Bicycle - Delay and Out-of-way Travel	2.99	2.99	0.00	0.00
Transit Operations Delay	3.99	3.99	0.00	0.00
General Traffic Municipal Street Delay	4.44	4.44	0.00	0.00
Municipal Street Traffic Signal Operations	3.83	3.83	0.00	0.00
TOTAL	61.00	47.63	0.00	0.00
Social and Cultural Environment				
Impact to Emergency Response	6.45	3.87	0.00	0.00
Potentially Contaminated Property	3.01	3.01	0.00	0.00
TOTAL	9.45	6.88	0.00	0.00
Cost				
Capital Cost	11.15	8.03	3.79	0.00
Life Cycle Cost	18.40	7.73	10.67	0.00
TOTAL	29.55	15.75	13.35	0.00
Score	**100.00**	**70.15**	**13.35**	**0.00**

[5] All alternative descriptors/abbreviations are defined in the last column of Figure 6.1.

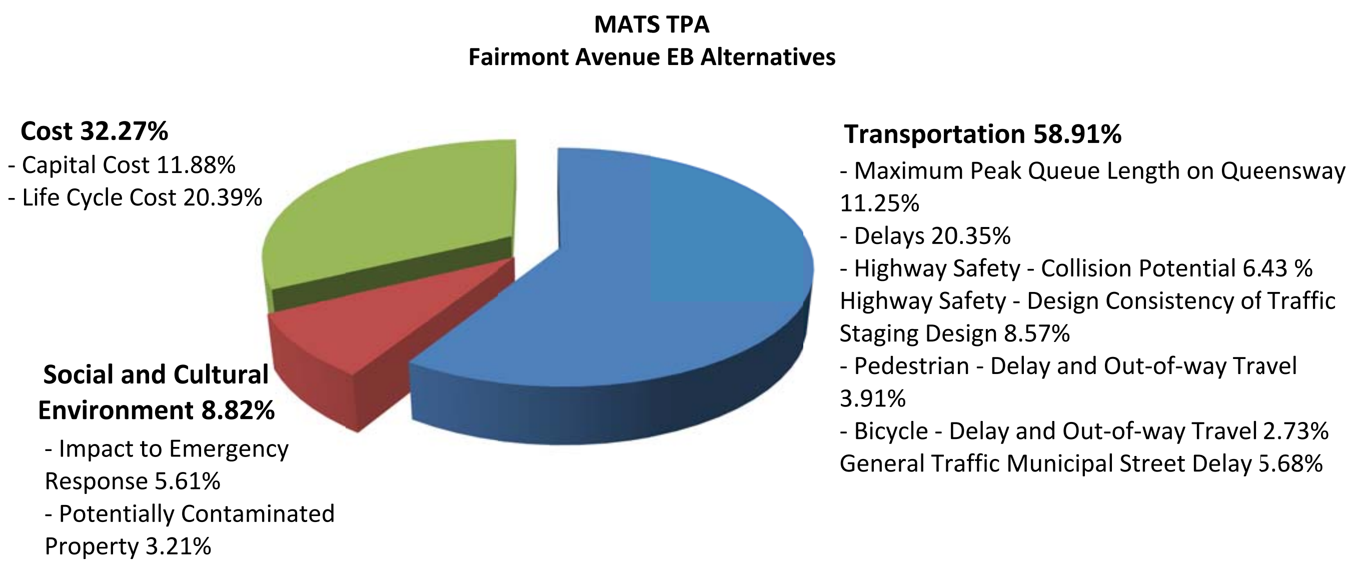
[6] All alternative descriptors/abbreviations are defined in the last column of Figure 6.1.

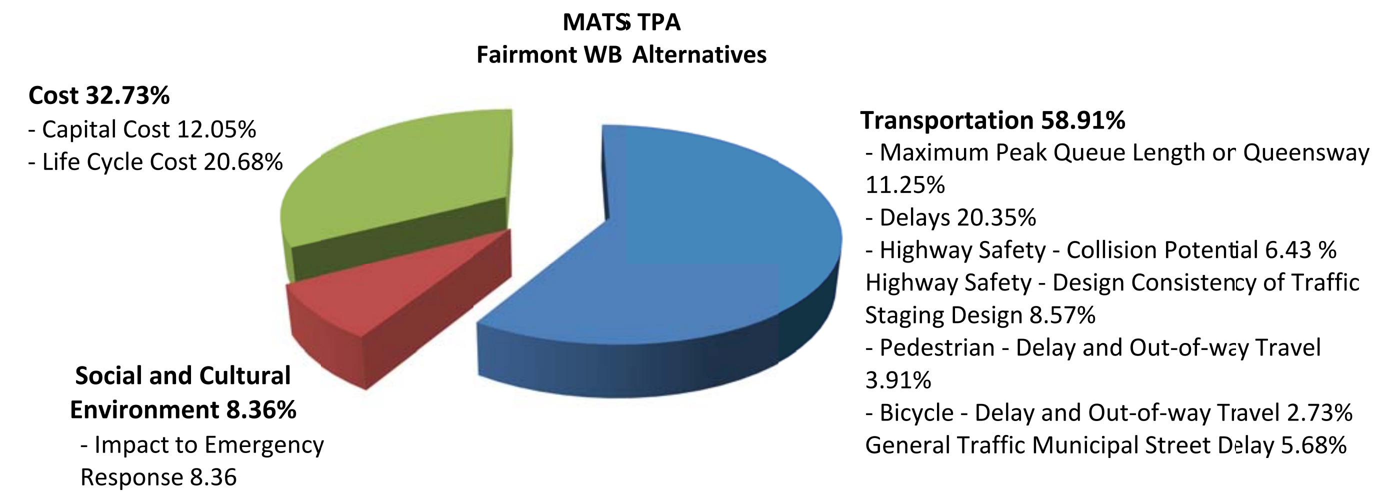
7.5.1.3 Fairmont Avenue

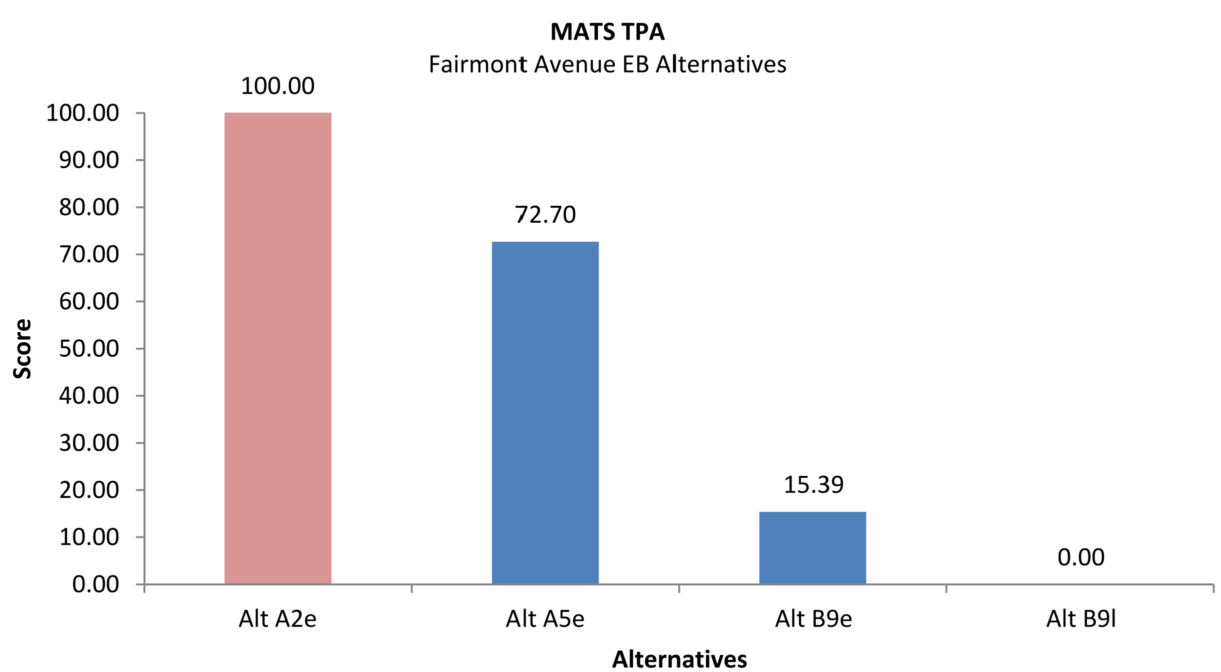
The results of the weights and rankings for Fairmont Avenue are illustrated on **Figure 7.4**, with the results of the weights for each sub-factor shown in **Table 7.9** and **Table 7.10** for Fairmont Avenue eastbound and westbound, respectively.

For the eastbound and westbound alternatives, the MATS ranked Alternative A2e, Rapid Bridge Rehabilitation, as the Technically Preferred Alternative for both directions. Taking into consideration the implementation of each alternative, the TPA for Fairmont Avenue eastbound and westbound remains Alternative A2e.

Figure 7.4 Fairmont Avenue MATS Weights and Rankings







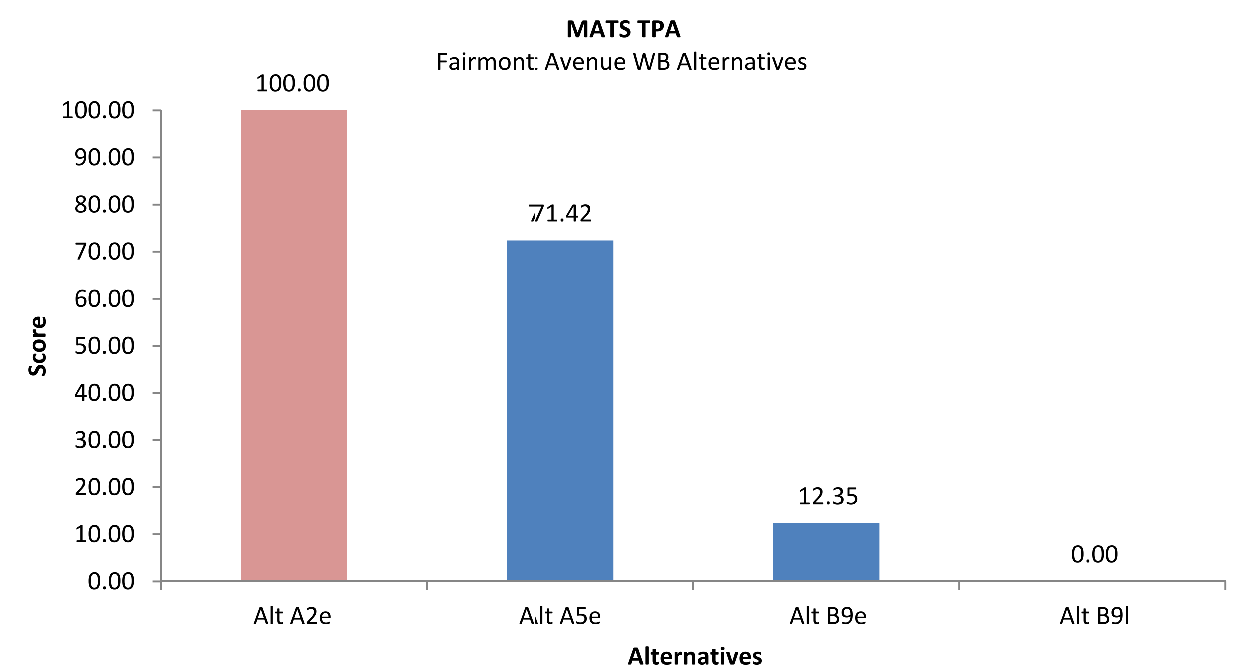


Table 7.9: Summary of Fairmont Avenue EB MATS Weighted Scores

Fairmont Avenue EB	Alternative[7]			
	Alt A2e	Alt A5e	Alt B9e	Alt B9l
Transportation				
Maximum Peak Queue Length on Queensway	11.25	6.64	0.00	0.00
Delays	20.35	14.65	0.00	0.00
Highway Safety - Collision Potential	6.43	3.86	0.00	0.00
Highway Safety - Design Consistency of Traffic Staging Design	8.57	8.57	0.00	0.00
Pedestrian - Delay and Out-of-way Travel	3.91	3.91	0.00	0.00
Bicycle - Delay and Out-of-way Travel	2.73	2.73	0.00	0.00
General Traffic Municipal Street Delay	5.68	5.68	0.00	0.00
TOTAL	58.91	46.03	0.00	0.00
Social and Cultural Environment				
Impact to Emergency Response	5.61	3.37	0.00	0.00
Potentially Contaminated Property	3.21	3.21	3.21	0.00
TOTAL	8.82	6.57	3.21	0.00
Cost				
Capital Cost	11.88	8.67	3.21	0.00
Life Cycle Cost	20.39	11.42	8.97	0.00
TOTAL	32.27	20.09	12.18	0.00
Score	**100.00**	**72.70**	**15.39**	**0.00**

Table 7.10: Summary of Fairmont Avenue WB MATS Weighted Scores

Fairmont Avenue WB	Alternative[8]			
	Alt A2e	Alt A5e	Alt B9e	Alt B9l
Transportation				
Maximum Peak Queue Length on Queensway	20.35	14.65	0.00	0.00
Delays	6.43	3.86	0.00	0.00
Highway Safety - Collision Potential	8.57	8.57	0.00	0.00
Highway Safety - Design Consistency of Traffic Staging Design	3.91	3.91	0.00	0.00
Pedestrian - Delay and Out-of-way Travel	2.73	2.73	0.00	0.00
Bicycle - Delay and Out-of-way Travel	5.68	5.68	0.00	0.00
General Traffic Municipal Street Delay	58.91	46.03	0.00	0.00
TOTAL	58.91	46.99	0.00	0.00
Social and Cultural Environment				
Impact to Emergency Response	8.36	5.02	0.00	0.00
TOTAL	8.36	5.02	0.00	0.00
Cost				
Capital Cost	12.05	8.80	3.25	0.00
Life Cycle Cost	20.68	11.58	9.10	0.00
TOTAL	32.73	20.38	12.35	0.00
Score	**100.00**	**71.42**	**12.35**	**0.00**

[7] All alternative descriptors/abbreviations are defined in the last column of Figure 6.1.

[8] All alternative descriptors/abbreviations are defined in the last column of Figure 6.1.

7.5.1.4 Bayswater Avenue

The results of the weights and rankings for Bayswater Avenue are illustrated on **Figure 7.5**, with the results of the weights for each sub-factor shown in **Table 7.11** and **Table 7.12** for Bayswater Avenue eastbound and westbound, respectively.

For the eastbound and westbound alternatives, the MATS ranked Alternative A2e, Rapid Bridge Rehabilitation, as the Technically Preferred Alternative for both directions. Taking into consideration the implementation of each alternative, the TPA for Bayswater Avenue eastbound and westbound remains Alternative A2e.

Figure 7.5: Bayswater Avenue MATS Weights and Rankings

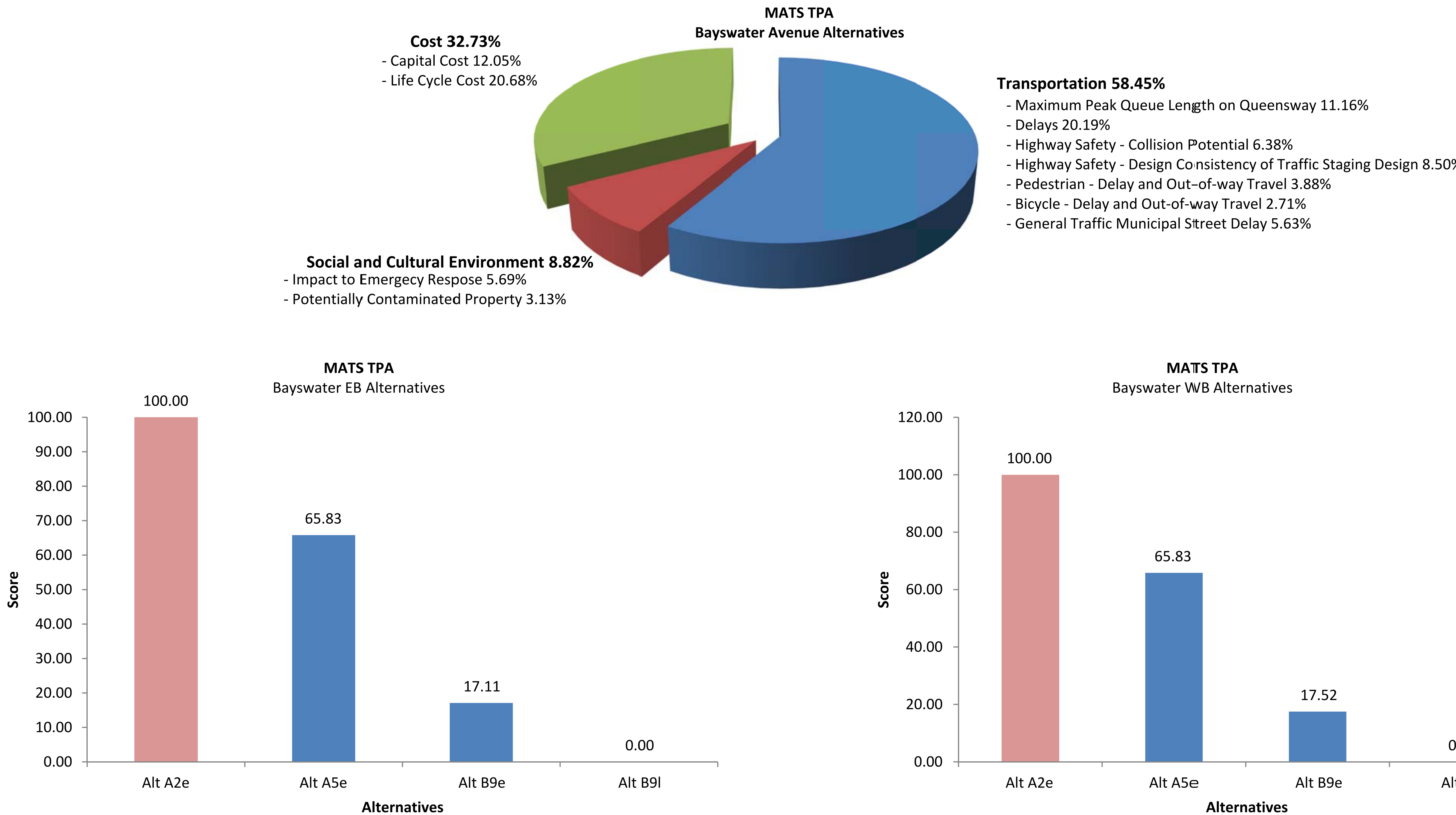


Table 7.11: Summary of Bayswater Avenue EB MATS Weighted Scores

Bayswater EB	Alternative[9]			
	Alt A2e	Alt A5e	Alt B9e	Alt B9l
Transportation				
Maximum Peak Queue Length on Queensway	11.16	6.58	0.00	0.00
Delays	20.19	12.12	0.00	0.00
Highway Safety - Collision Potential	6.38	3.83	0.00	0.00
Highway Safety - Design Consistency of Traffic Staging Design	8.50	8.50	0.00	0.00
Pedestrian - Delay and Out-of-way Travel	3.88	3.88	0.00	0.00
Bicycle - Delay and Out-of-way Travel	2.71	2.71	0.00	0.00
General Traffic Municipal Street Delay	5.63	5.63	0.00	0.00
TOTAL	58.45	43.25	0.00	0.00
Social and Cultural Environment				
Impact to Emergency Response	5.69	3.42	0.00	0.00
Potentially Contaminated Property	3.13	3.13	0.00	0.00
TOTAL	8.82	6.54	0.00	0.00
Cost				
Capital Cost	12.05	8.80	3.25	0.00
Life Cycle Cost	20.68	7.24	13.85	0.00
TOTAL	32.73	16.03	17.11	0.00
Score	**100.00**	**65.83**	**17.11**	**0.00**

Table 7.12: Summary of Bayswater Avenue WB MATS Weighted Scores

Bayswater WB	Alternative[10]			
	Alt A2e	Alt A5e	Alt B9e	Alt B9l
Transportation				
Maximum Peak Queue Length on Queensway	11.16	6.58	0.00	0.00
Delays	20.19	12.12	0.00	0.00
Highway Safety - Collision Potential	6.38	3.83	0.00	0.00
Highway Safety - Design Consistency of Traffic Staging Design	8.50	8.50	0.00	0.00
Pedestrian - Delay and Out-of-way Travel	3.88	3.88	0.00	0.00
Bicycle - Delay and Out-of-way Travel	2.71	2.71	0.00	0.00
General Traffic Municipal Street Delay	5.63	5.63	0.00	0.00
TOTAL	58.45	43.25	0.00	0.00
Social and Cultural Environment				
Impact to Emergency Response	5.69	3.42	0.00	0.00
Potentially Contaminated Property	3.13	3.13	0.00	0.00
TOTAL	8.82	6.54	0.00	0.00
Cost				
Capital Cost	12.05	8.80	3.25	0.00
Life Cycle Cost	20.68	7.24	14.27	0.00
TOTAL	32.73	16.03	17.52	0.00
Score	**100.00**	**65.83**	**17.52**	**0.00**

[9] All alternative descriptors/abbreviations are defined in the last column of Figure 6.1.

[10] All alternative descriptors/abbreviations are defined in the last column of Figure 6.1.

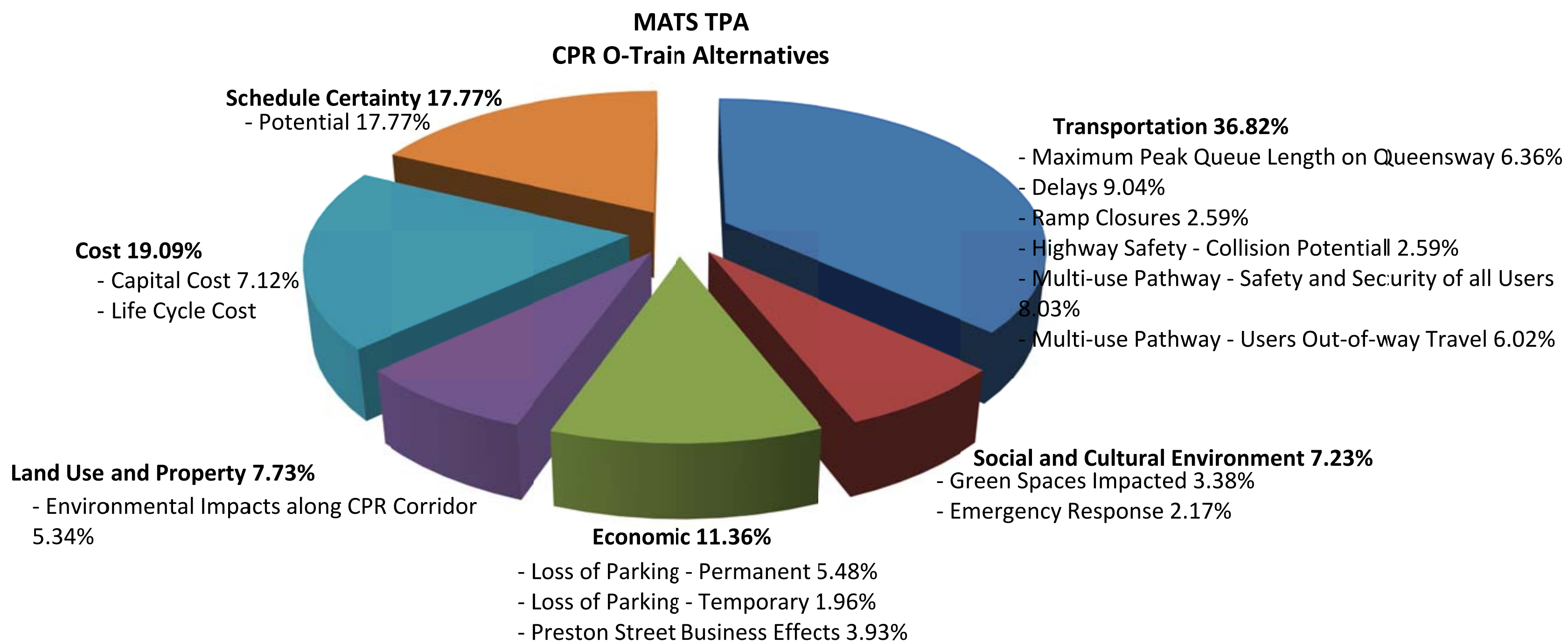
7.5.1.5 CPR/O-Train

The results of the weights and rankings for CPR/O-Train are illustrated on **Figure 7.6**, with the results of the weights for each sub-factor shown in **Table 7.13**.

For the eastbound and westbound alternative bridge sites, the MATS evaluation ranked Alternative H6e, Single Span Jack and Slide Replacement, as the Technically Preferred Alternative. Taking into consideration the implementation of each alternative, the TPA for CPR/O-Train remains Alternative H6e.

The preferred alternative was 5% higher in score above the two next rated options (both two-span rigid frame Alternatives C or F). The value of the score is considered significant, and the range of variation of scores between alternatives reflects the perspective of the evaluation team which prioritized personal safety and security of users high. The high weight placed on this criterion resulted in this alternative being carried forward. The trade-off among these closely ranked options is that the TPA (single span jack and slide) has a marginally higher capital cost but provides meaningful improved safety for users of the multi-use path (MUP). The Evaluation Team recognized this trade-off but endorsed the preferred alternative. For a new high volume MUP where there will be a 50 m length of enclosure for vulnerable users, the more open design is preferred and considered good value.

Figure 7.6: CPR/O-Train MATS Weights and Ranking



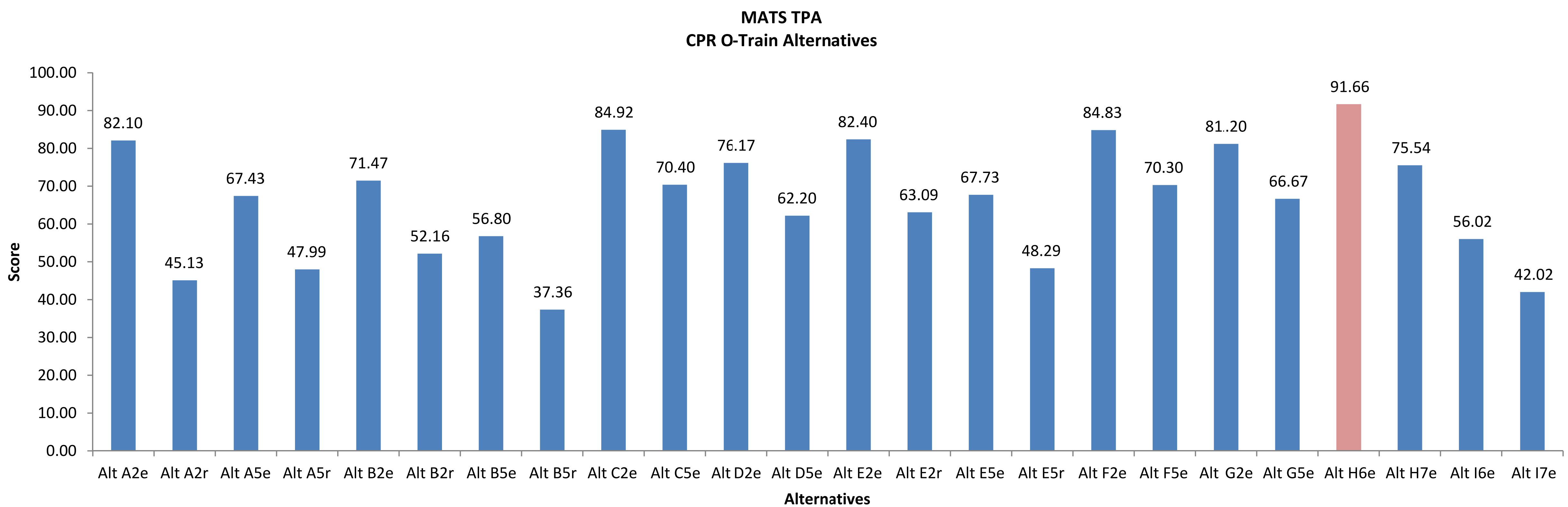


Table 7.13: Summary of CPR O-Train MATS Weighted Scores

CPR O-Train	Alternative[11]																							
	Alt A2e	Alt A2r	Alt A5e	Alt A5r	Alt B2e	Alt B2r	Alt B5e	Alt B5r	Alt C2e	Alt C5e	Alt D2e	Alt D5e	Alt E2e	Alt E2r	Alt E5e	Alt E5r	Alt F2e	Alt F5e	Alt G2e	Alt G5e	Alt H6e	Alt H7e	Alt I6e	Alt I7e
Transportation																								
Maximum Peak Queue Length on Queensway	3.88	3.88	0.00	0.00	3.88	3.88	0.00	0.00	3.88	0.00	3.88	0.00	3.88	3.88	0.00	0.00	3.88	0.00	3.88	0.00	6.36	3.18	6.36	3.18
Delays	7.41	7.41	0.00	0.00	7.41	7.41	0.00	0.00	7.41	0.00	7.41	0.00	7.41	7.41	0.00	0.00	7.41	0.00	7.41	0.00	9.04	2.98	9.04	2.98
Ramp Closures	1.37	1.37	0.00	0.00	1.37	1.37	0.00	0.00	1.37	0.00	1.37	0.00	1.37	1.37	0.00	0.00	1.37	0.00	1.37	0.00	2.59	0.05	2.59	0.05
Highway Safety - Collision Potential	0.80	0.93	0.00	0.00	0.80	0.93	0.00	0.00	0.80	0.00	0.80	0.00	0.80	0.93	0.00	0.00	0.80	0.00	0.80	0.00	2.59	0.80	2.59	0.80
Multi-use Pathway - Safety and Security of all Users	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.02	4.02	4.02	4.02	0.00	0.00	0.00	0.00	4.02	4.02	8.03	8.03	8.03	8.03	8.03	8.03
Multi-use Pathway - Users Out-of-way Travel	6.02	0.00	6.02	0.00	6.02	0.00	6.02	0.00	6.02	6.02	6.02	6.02	6.02	0.00	6.02	0.00	6.02	6.02	6.02	6.02	6.02	6.02	6.02	6.02
Transit / O-Train Closure	2.18	2.18	2.18	2.18	2.18	2.18	2.18	2.18	2.18	2.18	2.18	2.18	2.18	2.18	2.18	2.18	2.18	2.18	2.18	2.18	0.00	0.00	0.00	0.00
TOTAL	21.67	15.77	8.20	2.18	21.67	15.77	8.20	2.18	25.69	12.22	25.69	12.22	21.67	15.77	8.20	2.18	25.69	12.22	29.70	16.23	34.64	21.08	34.64	21.08
Social and Cultural Environment																								
Green Spaces Impacted	3.38	0.00	3.38	0.00	3.38	0.00	3.38	0.00	3.38	3.38	3.38	3.38	3.38	0.00	3.38	0.00	3.38	3.38	3.38	3.38	3.38	3.38	3.38	3.38
Emergency Response	0.65	0.65	0.00	0.00	0.65	0.65	0.00	0.00	0.65	0.00	0.65	0.00	0.65	0.65	0.00	0.00	0.65	0.00	0.65	0.00	2.17	0.43	2.17	0.43
Potentially Contaminated Property	0.74	0.74	0.74	0.74	0.42	0.42	0.42	0.42	1.02	1.02	0.72	0.72	0.74	0.74	0.74	0.74	1.02	1.02	0.34	0.34	1.68	1.68	0.00	0.00
TOTAL	4.77	1.39	4.12	0.74	4.45	1.07	3.80	0.42	5.06	4.41	4.75	4.10	4.77	1.39	4.12	0.74	5.06	4.41	4.37	3.72	7.23	5.49	5.55	3.82
Economic																								
Loss of Parking - Permanent	5.48	0.00	5.48	0.00	5.48	0.00	5.48	0.00	5.48	5.48	5.48	5.48	5.48	0.00	5.48	0.00	5.48	5.48	5.48	5.48	5.48	5.48	5.48	5.48
Loss of Parking - Temporary	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	0.00	0.00
Preston Street Business Effects	3.93	0.00	3.93	0.00	3.93	0.00	3.93	0.00	3.93	3.93	3.93	3.93	3.93	0.00	3.93	0.00	3.93	3.93	3.93	3.93	3.93	3.93	3.93	3.93
TOTAL	11.36	1.96	11.36	1.96	11.36	1.96	11.36	1.96	11.36	11.36	11.36	11.36	11.36	1.96	11.36	1.96	11.36	11.36	11.36	11.36	11.36	11.36	9.40	9.40
Land Use and Property																								
Environmental Impacts along CPR corridor	5.34	5.34	5.34	5.34	0.00	0.00	0.00	0.00	5.34	5.34	0.00	0.00	5.34	5.34	5.34	5.34	5.34	5.34	5.34	5.34	5.34	5.34	5.34	5.34
Temporary Property Impacts	2.39	2.39	2.39	2.39	2.39	2.39	2.39	2.39	2.39	2.39	2.39	2.39	2.39	2.39	2.39	2.39	2.39	2.39	2.39	2.39	2.39	2.39	0.00	2.39
TOTAL	7.73	7.73	7.73	7.73	2.39	2.39	2.39	2.39	7.73	7.73	2.39	2.39	7.73	7.73	7.73	7.73	7.73	7.73	7.73	7.73	7.73	7.73	5.34	7.73

[11] All alternative descriptors/abbreviations are defined in the last column of Figure 6.16.

Cost																								
Capital Cost	7.00	6.84	6.71	6.55	5.12	4.96	4.81	4.66	6.44	6.28	5.26	5.67	7.12	6.96	6.82	6.67	6.40	6.24	3.76	3.60	4.84	4.53	0.42	0.00
Life Cycle Cost	11.79	11.25	11.54	11.07	8.71	8.24	8.46	7.98	10.88	10.63	8.94	8.69	11.98	11.50	11.72	11.25	10.83	10.58	6.50	6.25	8.08	7.58	0.67	0.00
TOTAL	18.79	18.10	18.25	17.62	13.82	13.20	13.27	12.64	17.32	16.91	14.20	14.36	19.09	18.46	18.55	17.92	17.23	16.82	10.26	9.85	12.93	12.11	1.09	0.00
Schedule Certainty																								
Potential	17.77	17.77	17.77	17.77	17.77	17.77	17.77	17.77	17.77	17.77	17.77	17.77	17.77	17.77	17.77	17.77	17.77	17.77	17.77	17.77	17.77	17.77	0.00	0.00
TOTAL	17.77	17.77	17.77	17.77	17.77	17.77	17.77	17.77	17.77	17.77	17.77	17.77	17.77	17.77	17.77	17.77	17.77	17.77	17.77	17.77	17.77	17.77	0.00	0.00
Score	**82.10**	**62.72**	**67.43**	**47.99**	**71.47**	**52.16**	**56.80**	**37.36**	**84.92**	**70.40**	**76.17**	**62.20**	**82.40**	**63.09**	**67.73**	**48.29**	**84.83**	**70.30**	**81.20**	**66.67**	**91.66**	**75.54**	**56.02**	**42.02**

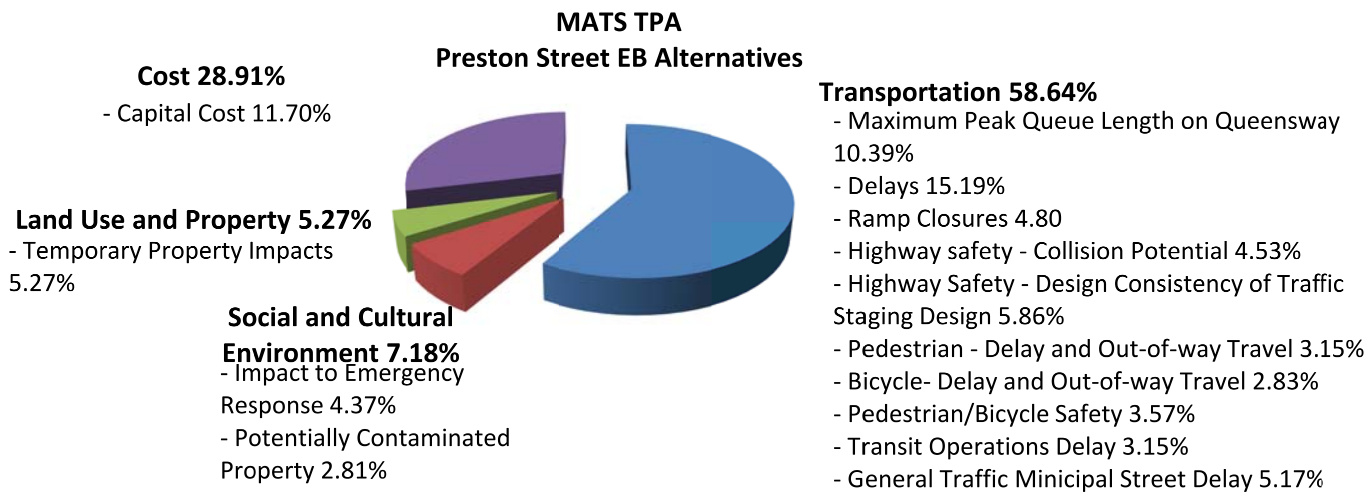
7.5.1.6 Preston Street

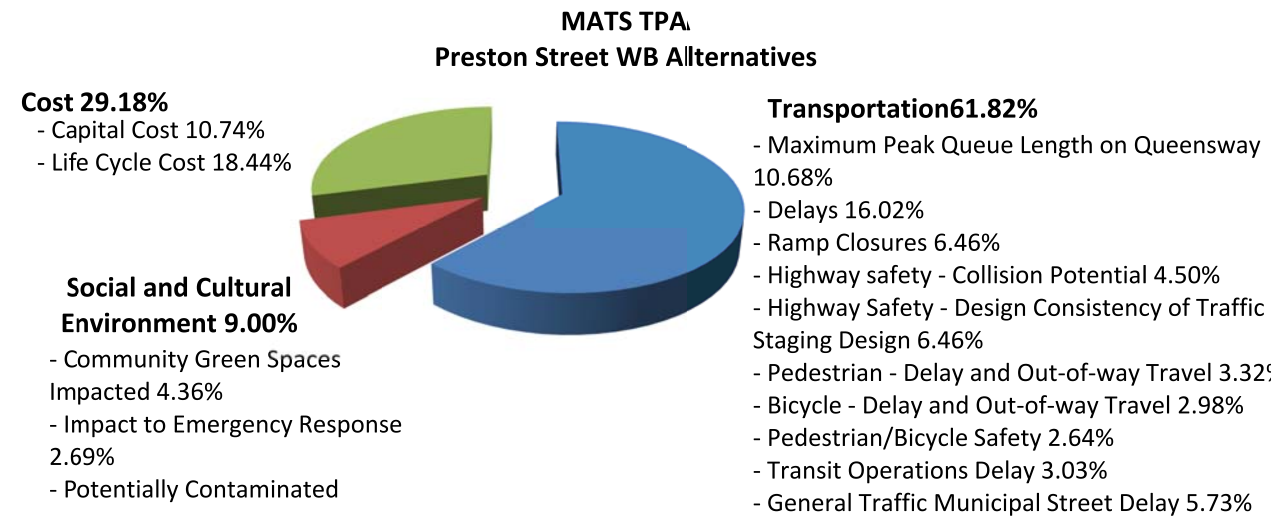
The results of the weights and rankings for Preston Street are illustrated on **Figure 7.7**, with the results of the weights for each sub-factor shown in **Table 7.14** and **Table 7.15** for Preston Street eastbound and westbound, respectively.

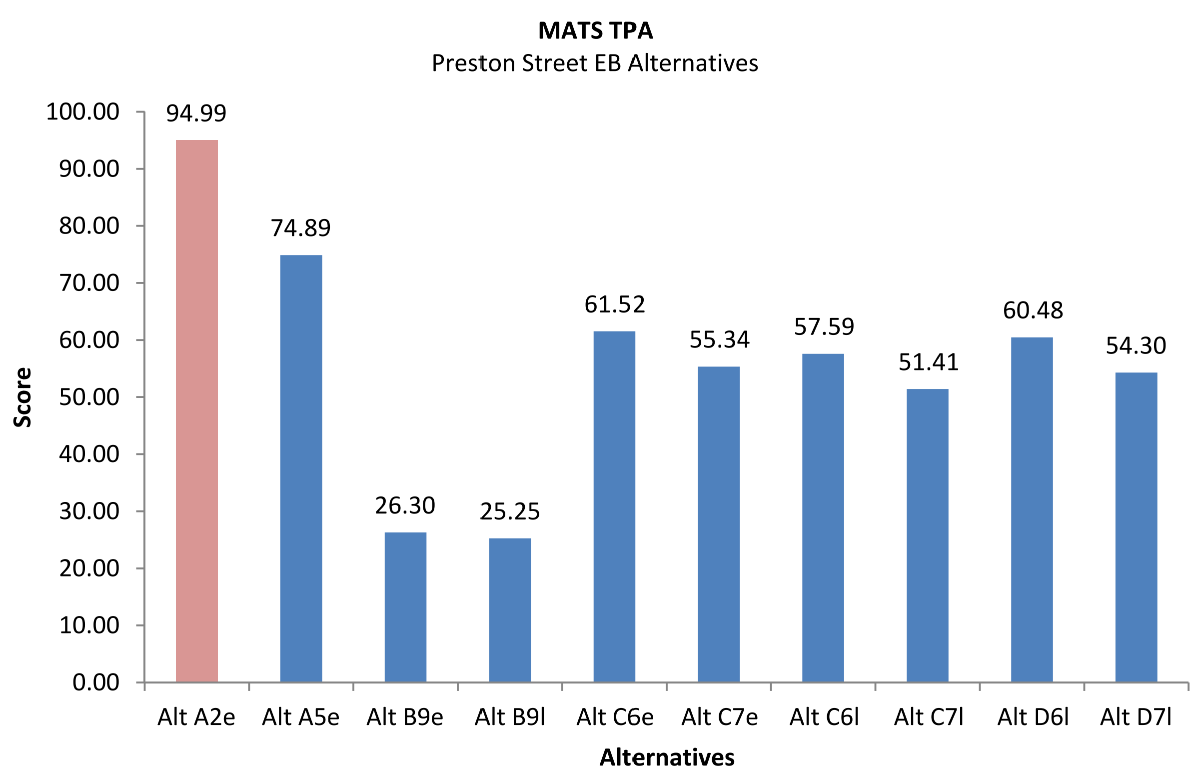
For the eastbound and westbound alternatives, the MATS ranked Alternative A2e, Rapid Bridge Rehabilitation, as the Technically Preferred Alternative for both directions. Taking into consideration the implementation of each alternative, the TPA for Preston Street eastbound and westbound is Alternative C6e.

The Evaluation Committee recommended that the TESR, which will describe the project to be carried forward, be defined to allow flexibility in the project to be delivered. Although the project to be implemented is a rapid replacement, the MTO should retain the flexibility to advance the rehabilitation of the bridge, Alternative A2e, should the structural condition of the bridge show additional significant deterioration as the project is delivered/ postponed or there are changes to Provincial priorities. This will be noted as a Statement of Flexibility in the TESR.

Figure 7.7: Preston Street MATS Weights and Rankings







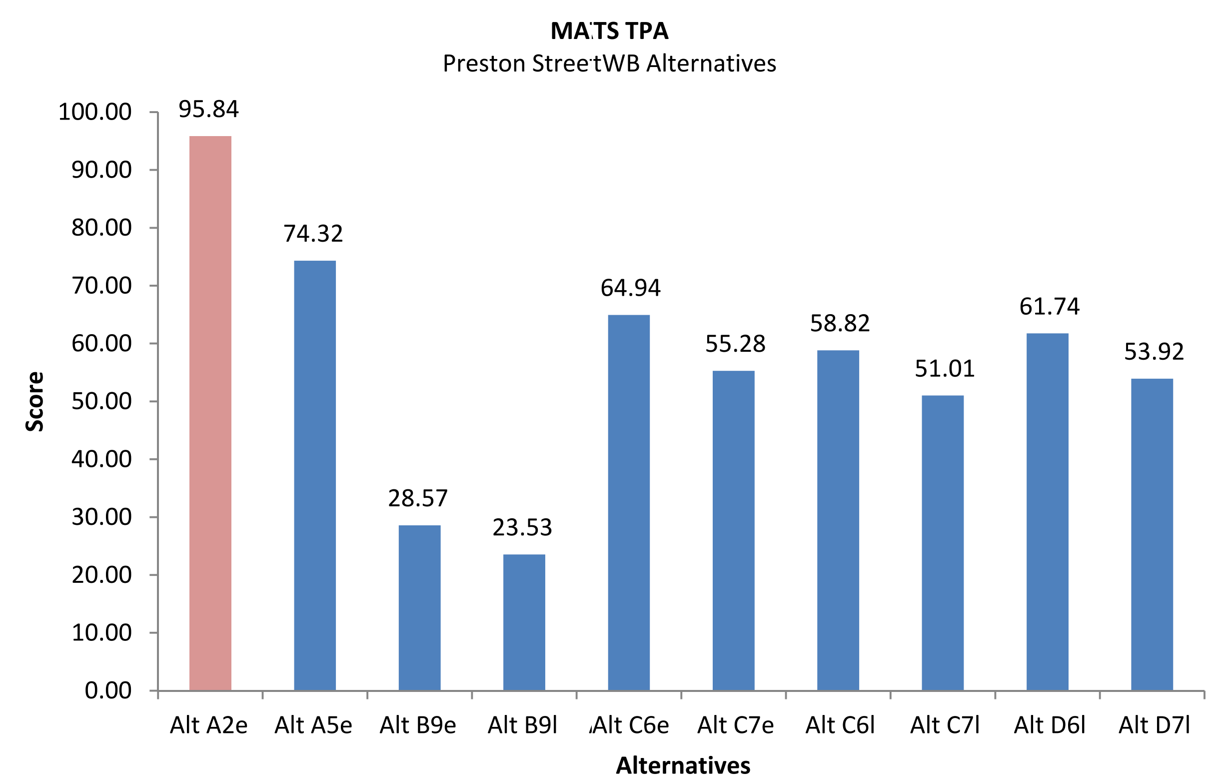


Table 7.14: Summary of Preston Street EB MATS Weighted Scores

Preston Avenue EB	Alternative[12]									
	Alt A2e	**Alt A5e**	**Alt B9e**	**Alt B9l**	**Alt C6e**	**Alt C7e**	**Alt C6l**	**Alt C7l**	**Alt D6l**	**Alt D7l**
Transportation										
Maximum Peak Queue Length on Queensway	10.19	6.13	0.00	0.00	10.39	9.36	10.39	9.36	10.39	9.36
Delays	15.19	9.12	0.00	0.00	15.19	13.67	15.19	13.67	15.19	13.67
Ramp Closures	4.46	0.05	0.00	0.00	4.80	3.79	4.80	0.00	4.80	3.79
Highway Safety - Collision Potential	4.08	2.72	0.00	0.00	4.53	4.08	4.53	4.08	4.53	4.08
Highway Safety - Design Consistency of Traffic Staging Design	5.86	5.86	0.00	0.00	5.86	5.86	5.86	5.86	5.86	5.86
Pedestrian - Delay and Out-of-way Travel	3.15	3.15	0.00	0.00	1.57	1.57	1.57	0.00	1.57	1.57
Bicycle - Delay and Out-of-way Travel	2.83	2.83	0.00	0.00	1.41	1.41	1.41	1.41	1.41	1.41
Pedestrian/Bicycle Safety	0.00	0.00	0.00	3.57	0.00	0.00	3.57	3.57	3.57	3.57
Transit Operations Delay	3.15	3.15	0.00	0.00	1.57	1.57	1.57	1.57	1.57	1.57
General Traffic Municipal Street Delay	5.17	5.17	0.00	0.00	2.59	2.59	2.59	2.59	2.59	2.59
TOTAL	54.07	38.16	0.00	3.57	47.92	43.90	51.49	42.11	51.49	47.47
Social and Cultural Environment										
Impact to Emergency Response	3.94	2.62	0.00	0.00	4.37	3.94	4.37	3.94	4.37	3.94
Potentially Contaminated Property	2.81	2.81	1.40	1.40	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	6.74	5.43	1.40	1.40	4.37	3.94	4.37	3.94	4.37	3.94
Land Use and Property										
Temporary Property Impacts	5.27	5.27	5.27	5.27	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	5.27	5.27	5.27	5.27	0.00	0.00	0.00	0.00	0.00	0.00
Cost										
Capital Cost	11.70	10.53	5.85	4.68	2.34	2.34	0.00	0.00	1.17	1.17
Life Cycle Cost	17.21	15.49	13.77	10.33	6.89	5.16	1.72	0.00	3.44	1.72
TOTAL	28.91	26.02	19.62	15.01	9.22	7.50	1.72	0.00	4.61	2.89
Score	**94.99**	**74.89**	**26.30**	**25.25**	**61.52**	**55.34**	**57.59**	**46.05**	**60.48**	**54.30**

Table 7.15: Summary of Preston Street WB MATS Weighted Scores

Preston Avenue WB	Alternative[13]									
	Alt A2e	**Alt A5e**	**Alt B9e**	**Alt B9l**	**Alt C6e**	**Alt C7e**	**Alt C6l**	**Alt C7l**	**Alt D6l**	**Alt D7l**
Transportation										
Maximum Peak Queue Length on Queensway	10.46	6.30	0.00	0.00	10.68	9.61	10.68	9.61	10.68	9.61
Delays	16.02	9.61	0.00	0.00	16.02	14.41	16.02	14.41	16.02	14.41
Ramp Closures	5.88	0.00	0.19	0.19	6.46	3.88	6.46	3.88	6.46	3.88
Highway Safety - Collision Potential	4.05	2.70	0.00	0.00	4.50	4.05	4.50	4.05	4.50	4.05
Highway Safety - Design Consistency of Traffic Staging Design	6.46	6.46	0.00	0.00	6.46	6.46	6.46	6.46	6.46	6.46
Pedestrian - Delay and Out-of-way Travel	3.32	3.32	0.00	0.00	1.66	1.66	1.66	1.66	1.66	1.66
Bicycle - Delay and Out-of-way Travel	2.98	2.98	0.00	0.00	1.49	1.49	1.49	1.49	1.49	1.49
Pedestrian/Bicycle Safety	0.00	0.00	0.00	2.64	0.00	0.00	2.64	2.64	2.64	2.64
Transit Operations Delay	3.03	3.03	0.00	0.00	1.52	1.52	1.52	1.52	1.52	1.52
General Traffic Municipal Street Delay	5.73	5.73	0.00	0.00	2.87	2.87	2.87	2.87	2.87	2.87
TOTAL	57.93	40.13	0.19	2.84	51.65	45.94	54.29	48.58	54.29	48.58
Social and Cultural Environment										
Community Green Spaces Impacted	4.36	4.36	4.36	4.36	0.00	0.00	0.00	0.00	0.00	0.00
Impact to Emergency Response	2.42	1.62	0.00	0.00	2.69	2.42	2.69	2.42	2.69	2.42
Potentially Contaminated Property	1.95	1.95	0.97	0.97	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	8.73	7.92	5.33	5.33	2.69	2.42	2.69	2.42	2.69	2.42
Cost										
Capital Cost	10.74	9.67	6.45	4.30	3.22	3.22	0.00	0.00	1.07	1.07
Life Cycle Cost	18.44	16.59	16.59	11.06	7.38	3.69	1.84	0.00	3.69	1.84
TOTAL	29.18	26.26	23.04	15.36	10.60	6.91	1.84	0.00	4.76	2.92
Score	**95.84**	**74.32**	**28.57**	**23.53**	**64.94**	**55.28**	**58.82**	**51.01**	**61.74**	**53.92**

[12] All alternative descriptors/abbreviations are defined on Figure 6.1.

[13] All alternative descriptors/abbreviations are defined in the last column of Figure 6.1.

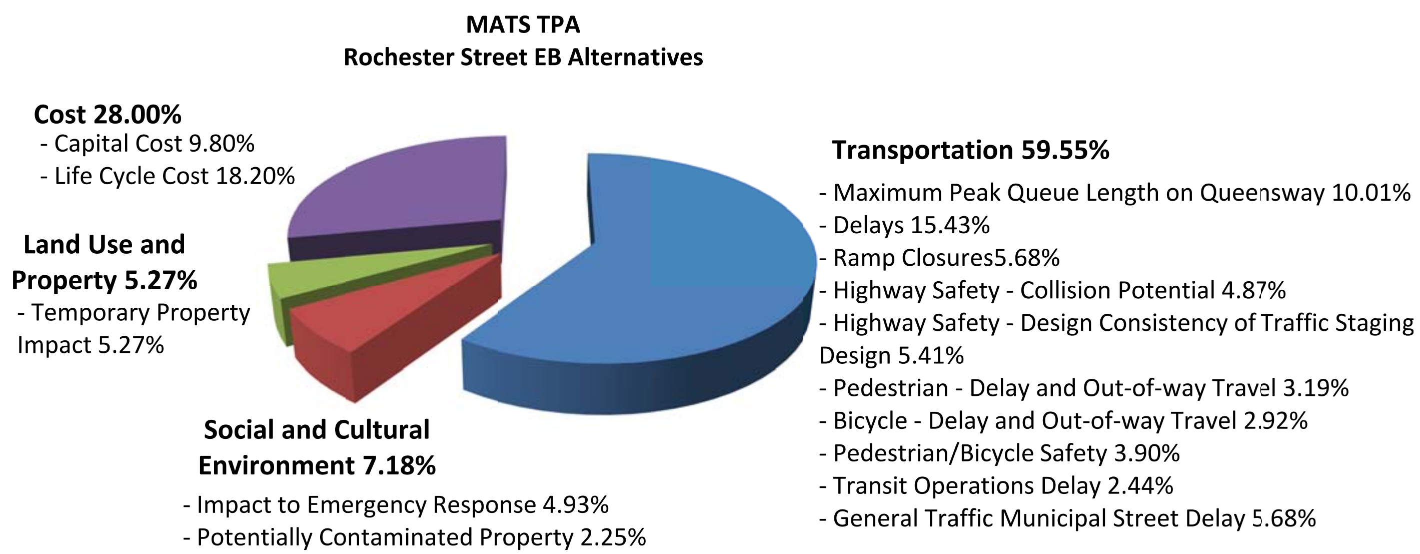
7.5.1.7 Rochester Street

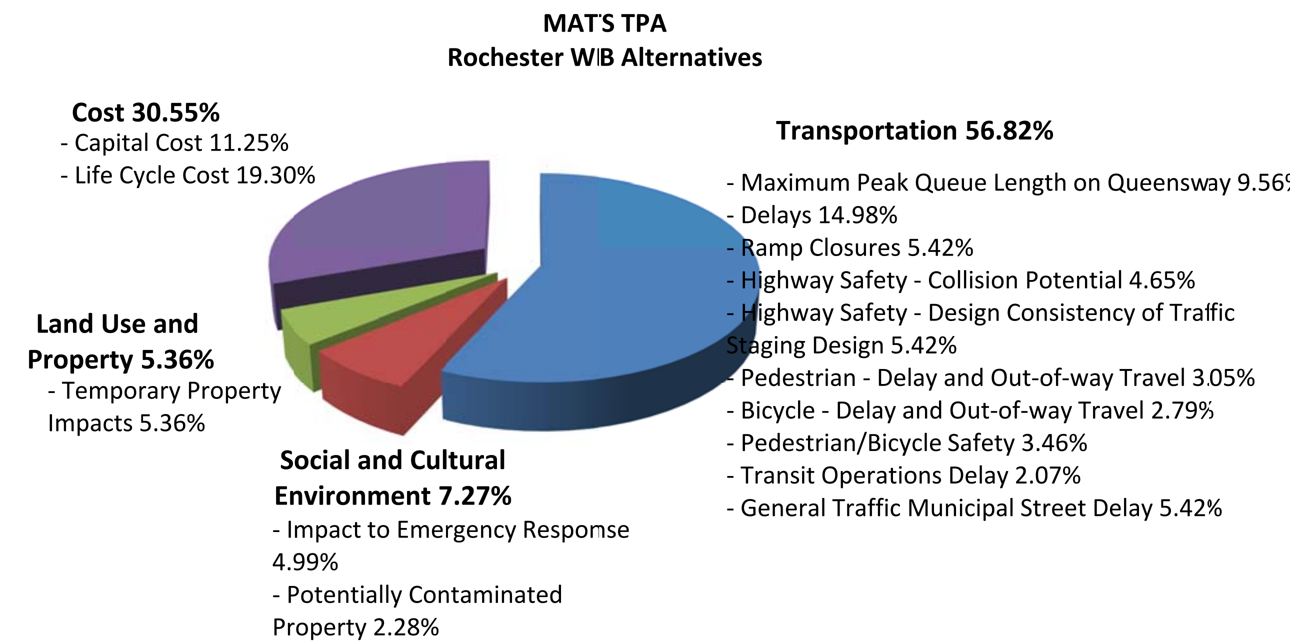
The results of the weights and rankings for Rochester Street are illustrated on **Figure 7.8**, with the results of the weights for each sub-factor shown in **Table 7.16** and **Table 7.17** for Rochester Street eastbound and westbound, respectively.

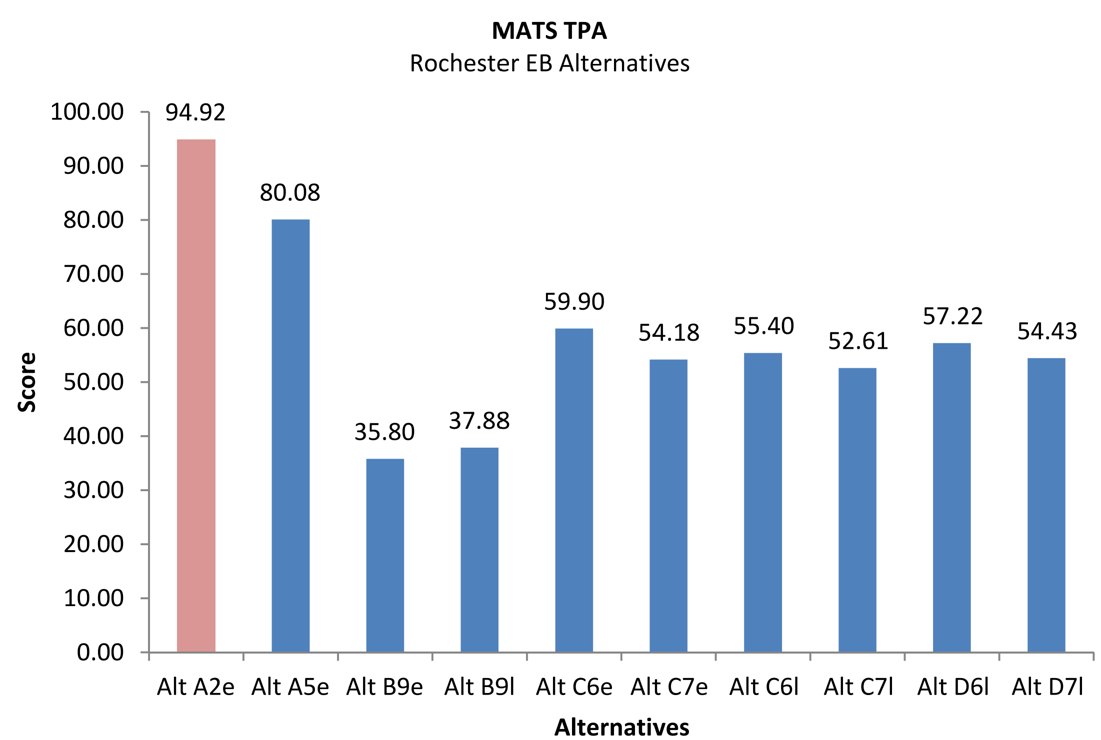
For the eastbound and westbound alternatives, the MATS ranked Alternative A2e, Rapid Bridge Rehabilitation, as the Technically Preferred Alternative for both directions. Taking into consideration the implementation of each alternative, the TPA for Rochester Street eastbound and westbound is Alternative C6e.

The Evaluation Committee recommended that the TESR, which will describe the project to be carried forward, be defined to allow flexibility in the project to be delivered. Although the project to be implemented is a rapid replacement the MTO should retain the flexibility to advance the rehabilitation of the bridge, Alternative A2e, should the structural condition of the bridge show additional significant deterioration as the project is delivered/ postponed or there are changes to Provincial priorities. This will be noted as a Statement of Flexibility in the TESR.

Figure 7.8: Rochester Street MATS Weights and Rankings







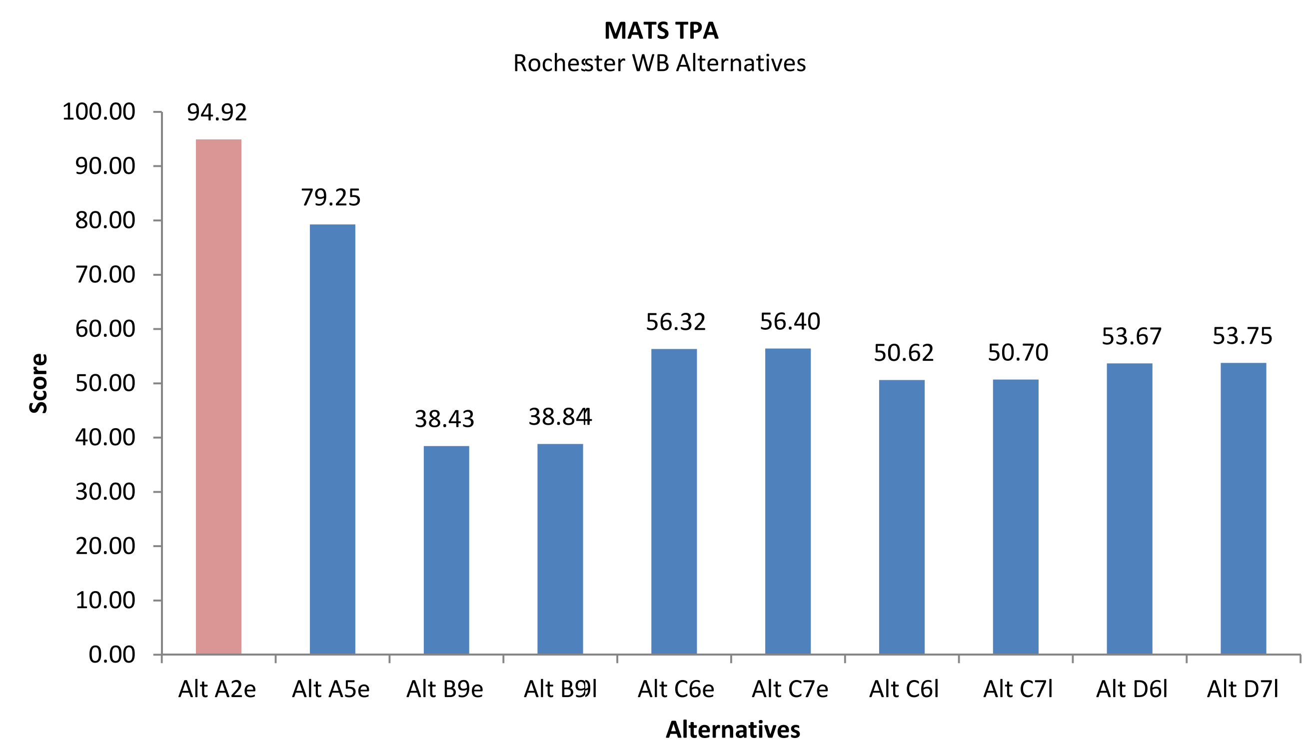


Table 7.16: Summary of Rochester Street EB MATS Weighted Scores

Rochester EB	Alternative[14]									
	Alt A2e	Alt A5e	Alt B9e	Alt B9l	Alt C6e	Alt C7e	Alt C6l	Alt C7l	Alt D6l	Alt D7l
Transportation										
Maximum Peak Queue Length on Queensway	9.81	5.91	0.00	0.00	10.01	9.01	10.01	9.01	10.01	9.01
Delays	15.43	9.26	0.00	0.00	15.43	13.88	15.43	13.88	15.43	13.88
Ramp Closures	5.68	5.68	5.68	5.68	3.13	5.68	3.13	5.68	3.13	5.68
Highway Safety - Collision Potential	4.38	2.92	0.00	0.00	4.87	4.38	4.87	4.38	4.87	4.38
Highway Safety - Design Consistency of Traffic Staging Design	5.41	5.41	0.00	0.00	5.41	5.41	5.41	5.41	5.41	5.41
Pedestrian - Delay and Out-of-way Travel	3.19	3.19	0.00	0.00	1.60	1.60	1.60	1.60	1.60	1.60
Bicycle - Delay and Out-of-way Travel	2.92	2.92	0.00	0.00	1.46	1.46	1.46	1.46	1.46	1.46
Pedestrian/Bicycle Safety	0.00	0.00	0.00	3.90	0.00	0.00	3.90	3.90	3.90	3.90
Transit Operations Delay	2.44	2.44	2.44	2.44	0.00	0.00	0.00	0.00	0.00	0.00
General Traffic Municipal Street Delay	5.68	5.68	0.00	0.00	2.84	2.84	2.84	2.84	2.84	2.84
TOTAL	54.96	43.42	8.12	12.02	44.75	44.28	48.65	48.18	48.65	48.18
Social and Cultural Environment										
Impact to Emergency Response	4.44	2.96	0.00	0.00	4.93	4.44	4.93	4.44	4.93	4.44
Potentially Contaminated Property	2.25	2.25	1.13	1.13	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	6.69	5.21	1.13	1.13	4.93	4.44	4.93	4.44	4.93	4.44
Land Use and Property										
Temporary Property Impacts	5.27	5.27	5.27	5.27	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	5.27	5.27	5.27	5.27	0.00	0.00	0.00	0.00	0.00	0.00
Cost										
Capital Cost	9.80	9.80	4.90	4.90	2.94	0.00	0.00	0.00	0.00	0.00
Life Cycle Cost	18.20	16.38	16.38	14.56	7.28	5.46	1.82	0.00	3.64	1.82
TOTAL	28.00	26.18	21.28	19.46	10.22	5.46	1.82	0.00	3.64	1.82
Score	**94.92**	**80.08**	**35.80**	**37.88**	**59.90**	**54.18**	**55.40**	**52.61**	**57.22**	**54.43**

Table 7.17: Summary of Rochester Street WB MATS Weighted Scores

Rochester WB	Alternative[15]									
	Alt A2e	Alt A5e	Alt B9e	Alt B9l	Alt C6e	Alt C7e	Alt C6l	Alt C7l	Alt D6l	Alt D7l
Transportation										
Maximum Peak Queue Length on Queensway	9.36	5.64	0.00	0.00	9.56	8.60	9.56	8.60	9.56	8.60
Delays	14.98	8.99	0.00	0.00	14.98	13.48	14.98	13.48	14.98	13.48
Ramp Closures	5.42	5.42	5.42	5.42	0.00	5.42	0.00	5.42	0.00	5.42
Highway Safety - Collision Potential	3.72	2.32	0.00	0.00	4.65	4.18	4.65	4.18	4.65	4.18
Highway Safety - Design Consistency of Traffic Staging Design	5.42	5.42	0.00	0.00	5.42	5.42	5.42	5.42	5.42	5.42
Pedestrian - Delay and Out-of-way Travel	3.05	3.05	0.00	0.00	1.52	1.52	1.52	1.52	1.52	1.52
Bicycle - Delay and Out-of-way Travel	2.79	2.79	0.00	0.00	1.39	1.39	1.39	1.39	1.39	1.39
Pedestrian/Bicycle Safety	0.00	0.00	0.00	3.46	0.00	0.00	3.46	3.46	3.46	3.46
Transit Operations Delay	2.07	2.07	2.07	2.07	0.00	0.00	0.00	0.00	0.00	0.00
General Traffic Municipal Street Delay	5.42	5.42	0.00	0.00	2.71	2.71	2.71	2.71	2.71	2.71
TOTAL	52.24	41.12	7.49	10.95	40.24	42.74	43.70	46.20	43.70	46.20
Social and Cultural Environment										
Impact to Emergency Response	4.49	3.00	0.00	0.00	4.99	4.49	4.99	4.49	4.99	4.49
Potentially Contaminated Property	2.28	2.28	1.14	1.14	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	6.77	5.28	1.14	1.14	4.99	4.49	4.99	4.49	4.99	4.49
Land Use and Property										
Temporary Property Impacts	5.36	5.36	5.36	5.36	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	5.36	5.36	5.36	5.36	0.00	0.00	0.00	0.00	0.00	0.00
Cost										
Capital Cost	11.25	10.12	9.00	7.87	3.37	3.37	0.00	0.00	1.12	1.12
Life Cycle Cost	19.30	17.37	15.44	13.51	7.72	5.79	1.93	0.00	3.86	1.93
TOTAL	30.55	27.49	24.44	21.38	11.09	9.16	1.93	0.00	4.98	3.05
Score	**94.92**	**79.25**	**38.43**	**38.84**	**56.32**	**56.40**	**50.62**	**50.70**	**53.67**	**53.75**

[14] All alternative descriptors/abbreviations are defined on Figure 6.1.

[15] All alternative descriptors/abbreviations are defined in the last column of Figure 6.1.

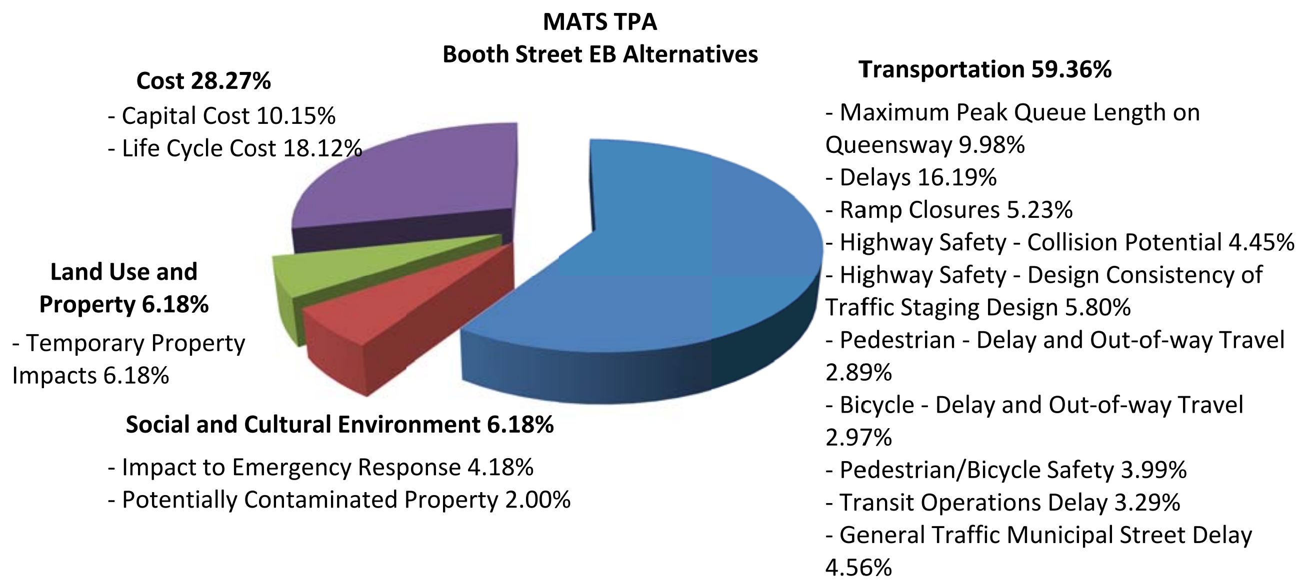
7.5.1.8 Booth Street

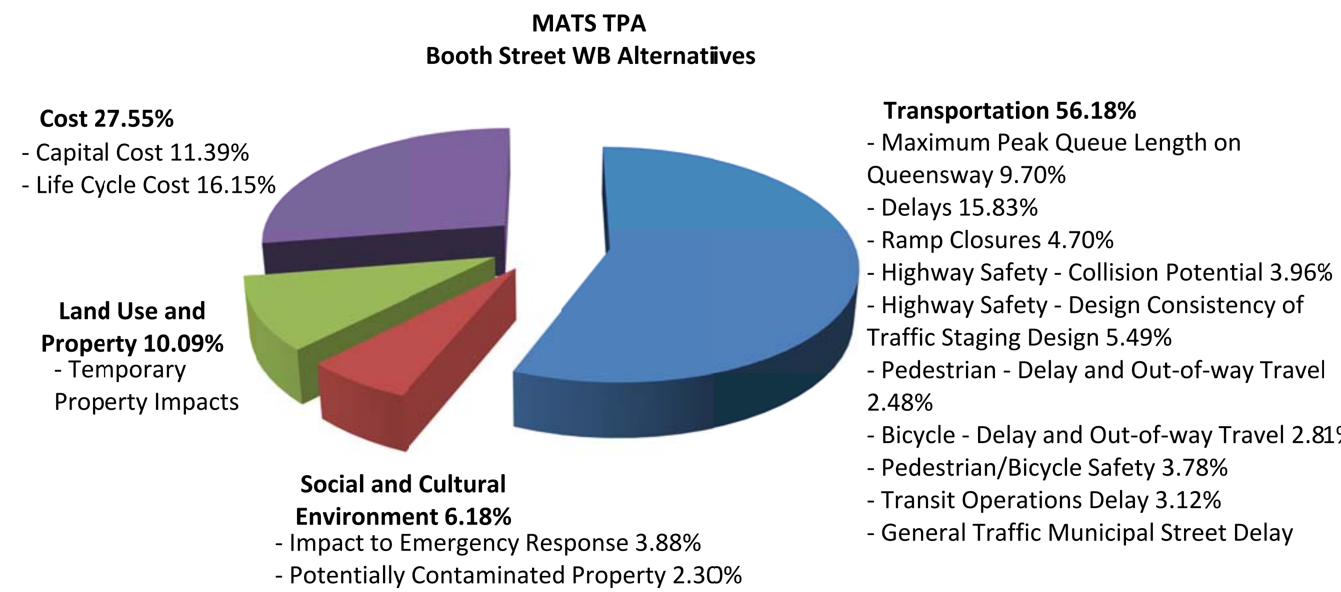
The results of the weights and rankings for Booth Street are illustrated on **Figure 7.9**, with the results of the weights for each sub-factor shown in **Table 7.18** and **Table 7.19** for Booth Street eastbound and westbound, respectively.

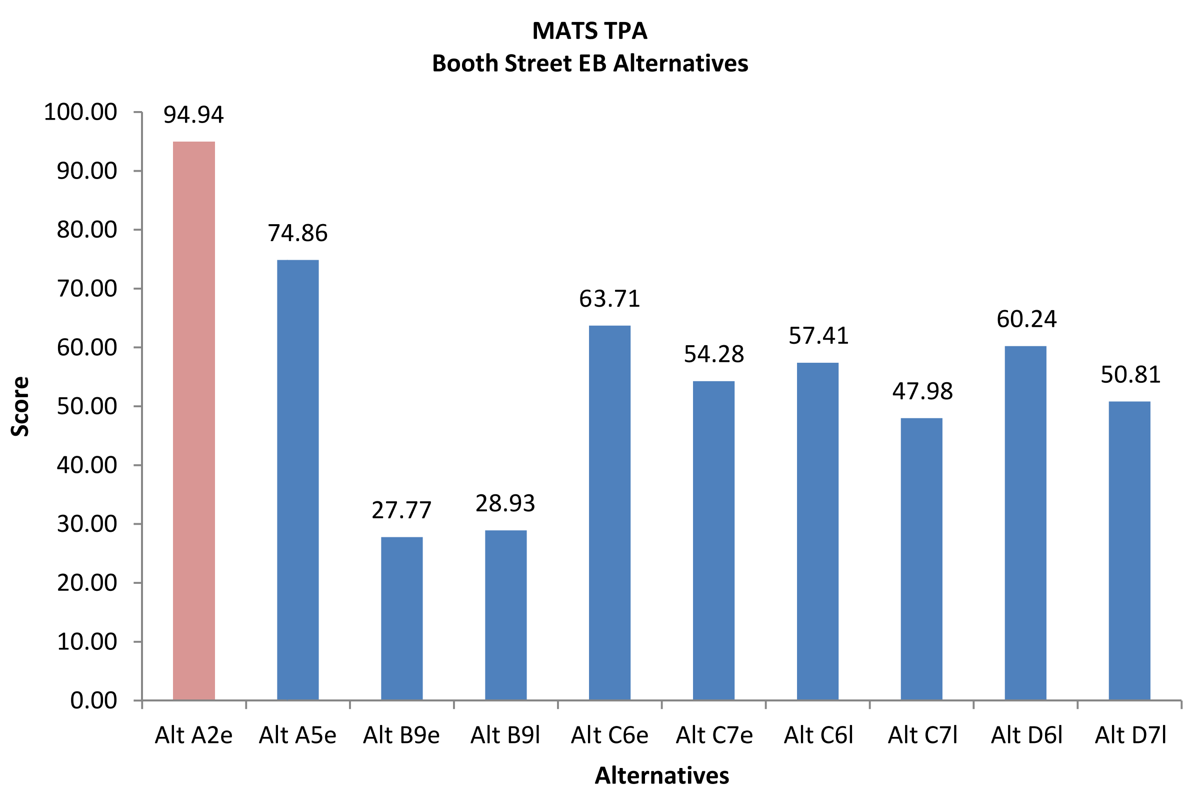
For the eastbound and westbound alternatives, the MATS ranked Alternative A2e, Rapid Bridge Rehabilitation, as the Technically Preferred Alternative for both directions. Taking into consideration the implementation of each alternative, the TPA for Booth Street eastbound and westbound is Alternative C6e.

The Evaluation Committee recommended that the TESR, which will describe the project to be carried forward, be defined to allow flexibility in the project to be delivered. Although the project to be implemented is a rapid replacement, the MTO should retain the flexibility to advance the rehabilitation of the bridge, Alternative A2e, should the structural condition of the bridge show additional significant deterioration as the project is delivered/ postponed or there are changes to Provincial priorities. This will be noted as a Statement of Flexibility in the TESR.

Figure 7.9: Booth Street MATS Weights and Rankings







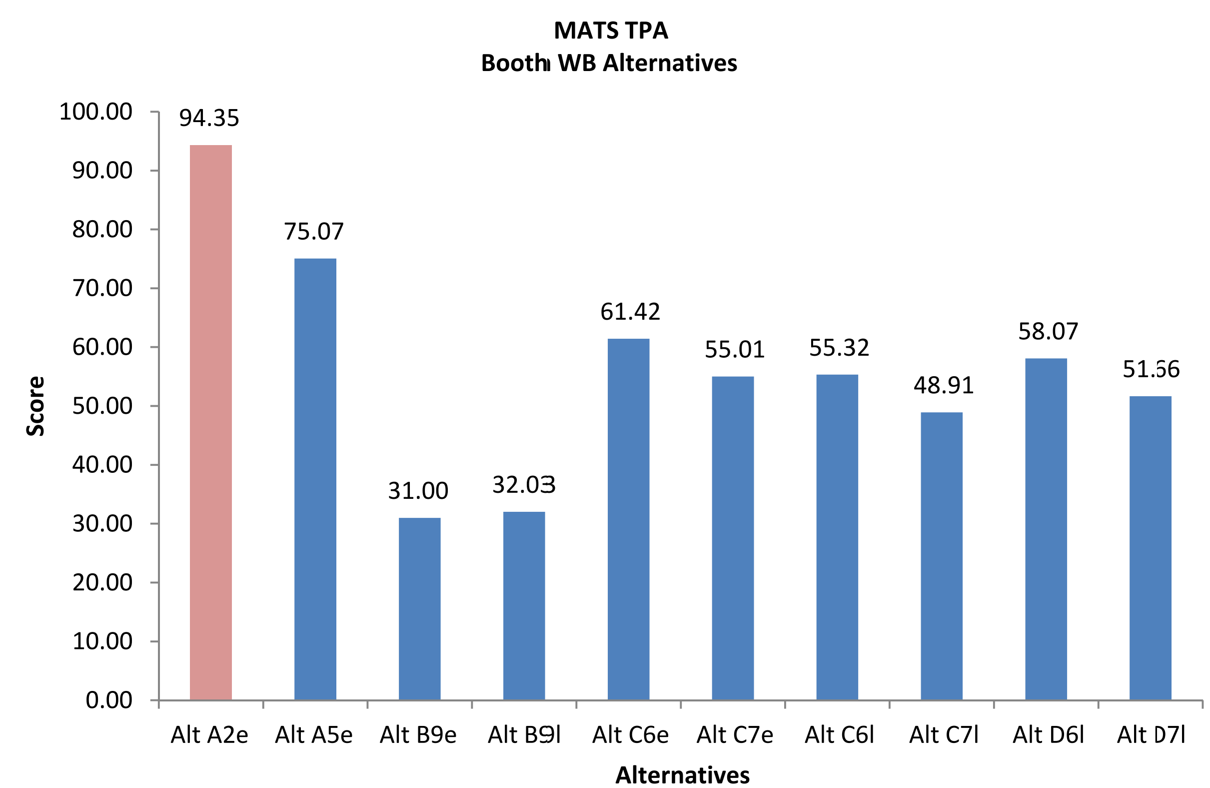


Table 7.18: Summary of Booth Street EB MATS Weighted Scores

Booth Avenue EB	Alternative[16]									
	Alt A2e	**Alt A5e**	**Alt B9e**	**Alt B9l**	**Alt C6e**	**Alt C7e**	**Alt C6l**	**Alt C7l**	**Alt D6l**	**Alt D7l**
Transportation										
Maximum Peak Queue Length on Queensway	9.78	5.89	0.00	0.00	9.98	8.99	9.98	8.99	9.98	8.99
Delays	16.19	9.71	0.00	0.00	16.19	14.57	16.19	14.57	16.19	14.57
Ramp Closures	5.23	1.36	0.00	0.00	4.14	0.00	4.14	0.00	4.14	0.00
Highway Safety - Collision Potential	4.01	2.67	0.00	0.00	4.45	4.01	4.45	4.01	4.45	4.01
Highway Safety - Design Consistency of Traffic Staging Design	5.80	5.80	0.00	0.00	5.80	5.80	5.80	5.80	5.80	5.80
Pedestrian - Delay and Out-of-way Travel	2.89	2.89	0.00	0.00	1.44	1.44	1.44	1.44	1.44	1.44
Bicycle - Delay and Out-of-way Travel	2.97	2.97	0.00	0.00	1.48	1.48	1.48	1.48	1.48	1.48
Pedestrian/Bicycle Safety	0.00	0.00	0.00	3.99	0.00	0.00	3.99	3.99	3.99	3.99
Transit Operations Delay	3.29	3.29	0.00	0.00	1.65	1.65	1.65	1.65	1.65	1.65
General Traffic Municipal Street Delay	4.56	4.56	0.00	0.00	2.28	2.28	2.28	2.28	2.28	2.28
TOTAL	54.73	39.15	0.00	3.99	47.42	40.22	51.41	44.21	51.41	44.21
Social and Cultural Environment										
Impact to Emergency Response	3.77	2.09	0.00	0.00	4.19	3.77	4.19	3.77	4.19	3.77
Potentially Contaminated Property	2.00	2.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	5.76	4.09	1.00	1.00	4.19	3.77	4.19	3.77	4.19	3.77
Land Use and Property										
Temporary Property Impacts	6.18	6.18	6.18	6.18	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	6.18	6.18	6.18	6.18	0.00	0.00	0.00	0.00	0.00	0.00
Cost										
Capital Cost	10.15	9.14	6.09	5.08	3.05	3.05	0.00	0.00	1.02	1.02
Life Cycle Cost	18.12	16.31	14.50	12.68	9.06	7.25	1.81	0.00	3.62	1.81
TOTAL	28.27	25.45	20.59	17.76	12.11	10.29	1.81	0.00	4.64	2.83
Score	**94.94**	**74.86**	**27.77**	**28.93**	**63.71**	**54.28**	**57.41**	**47.98**	**60.24**	**50.81**

Table 7.19: Summary of Booth Street WB MATS Weighted Scores

Booth Avenue WB	Alternative[17]									
	Alt A2e	**Alt A5e**	**Alt B9e**	**Alt B9l**	**Alt C6e**	**Alt C7e**	**Alt C6l**	**Alt C7l**	**Alt D6l**	**Alt D7l**
Transportation										
Maximum Peak Queue Length on Queensway	9.51	5.73	0.00	0.00	9.70	8.73	9.70	8.73	9.70	8.73
Delays	15.83	9.50	0.00	0.00	15.83	14.25	15.83	14.25	15.83	14.25
Ramp Closures	3.81	0.14	0.00	0.00	4.70	3.24	4.70	3.24	4.70	3.24
Highway Safety - Collision Potential	3.56	1.98	0.00	0.00	3.96	3.56	3.96	3.56	3.96	3.56
Highway Safety - Design Consistency of Traffic Staging Design	5.49	5.49	0.00	0.00	5.49	5.49	5.49	5.49	5.49	5.49
Pedestrian - Delay and Out-of-way Travel	2.48	2.48	0.00	0.00	1.24	1.24	1.24	1.24	1.24	1.24
Bicycle - Delay and Out-of-way Travel	2.81	2.81	0.00	0.00	1.40	1.40	1.40	1.40	1.40	1.40
Pedestrian/Bicycle Safety	0.00	0.00	0.00	3.78	0.00	0.00	3.78	3.78	3.78	3.78
Transit Operations Delay	3.12	3.12	0.00	0.00	1.56	1.56	1.56	1.56	1.56	1.56
General Traffic Municipal Street Delay	4.32	4.32	0.00	0.00	2.16	2.16	2.16	2.16	2.16	2.16
TOTAL	50.92	35.55	0.00	3.78	46.04	41.64	49.82	45.42	49.82	45.42
Social and Cultural Environment										
Impact to Emergency Response	3.49	2.33	0.00	0.00	3.88	3.49	3.88	3.49	3.88	3.49
Potentially Contaminated Property	2.30	2.30	1.15	1.15	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	5.79	4.63	1.15	1.15	3.88	3.49	3.88	3.49	3.88	3.49
Land Use and Property										
Temporary Property Impacts	10.09	10.09	10.09	10.09	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	10.09	10.09	10.09	10.09	0.00	0.00	0.00	0.00	0.00	0.00
Cost										
Capital Cost	11.39	10.25	6.84	5.70	3.42	3.42	0.00	0.00	1.14	1.14
Life Cycle Cost	16.15	14.54	12.92	11.31	8.08	6.46	1.62	0.00	3.23	1.62
TOTAL	27.55	24.79	19.76	17.00	11.49	9.88	1.62	0.00	4.37	2.75
Score	**94.35**	**75.07**	**31.00**	**32.03**	**61.42**	**55.01**	**55.32**	**48.91**	**58.07**	**51.66**

[16] All alternative descriptors/abbreviations are defined on Figure 6.1.

[17] All alternative descriptors/abbreviations are defined in the last column of Figure 6.1.

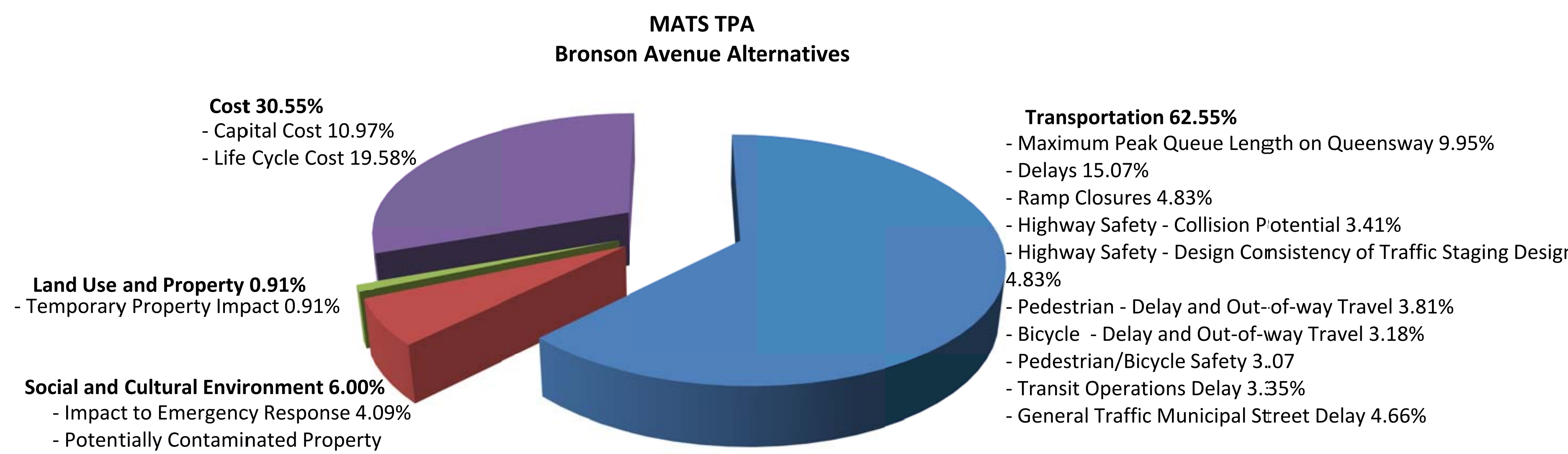
7.5.1.9 Bronson Avenue

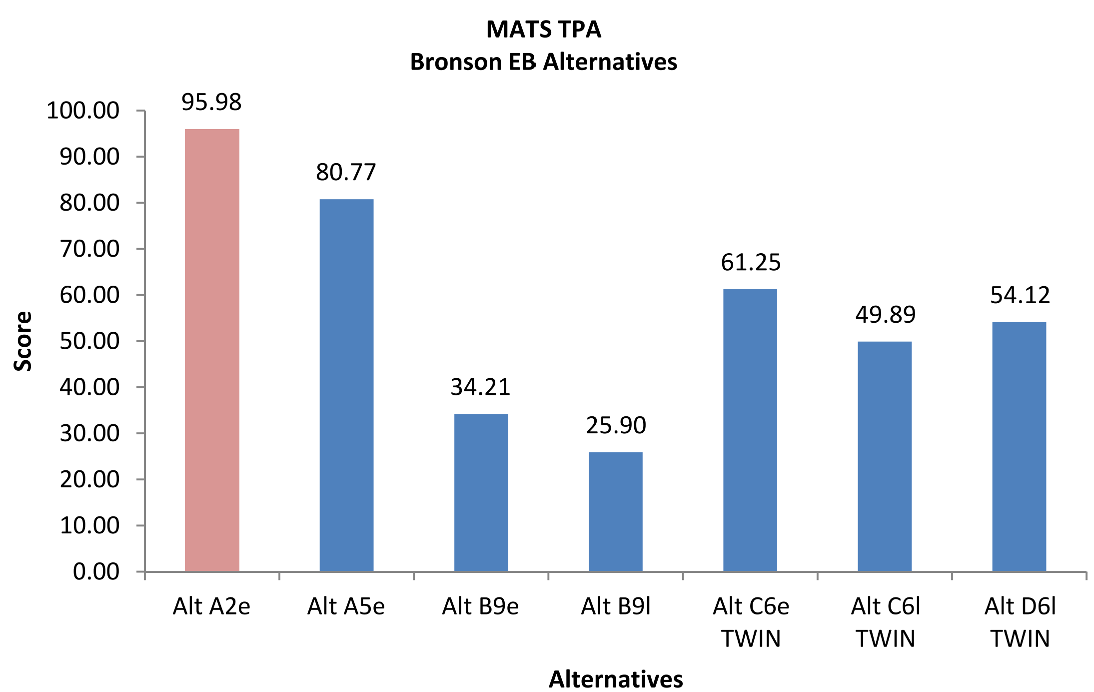
The results of the weights and rankings for Bronson Avenue are illustrated on **Figure 7.10**, with the results of the weights for each sub-factor shown in **Table 7.20** and **Table 7.21** for Bronson Avenue eastbound and westbound, respectively.

For the eastbound and westbound alternatives, the MATS ranked Alternative A2e, Rapid Bridge Rehabilitation, as the Technically Preferred Alternative for both directions. Taking into consideration the implementation of each alternative, the TPA for Bronson Avenue eastbound and westbound is Alternative C6e.

The Evaluation Committee recommended that the TESR, which will describe the project to be carried forward, be defined to allow flexibility in the project to be delivered. Although the project to be implemented is a rapid replacement, the MTO should retain the flexibility to advance the rehabilitation of the bridge, Alternative A2e, should the structural condition of the bridge show additional significant deterioration as the project is delivered/ postponed or there are changes to Provincial priorities. This will be noted as a Statement of Flexibility in the TESR.

Figure 7.10: Bronson Avenue MATS Weights and Rankings





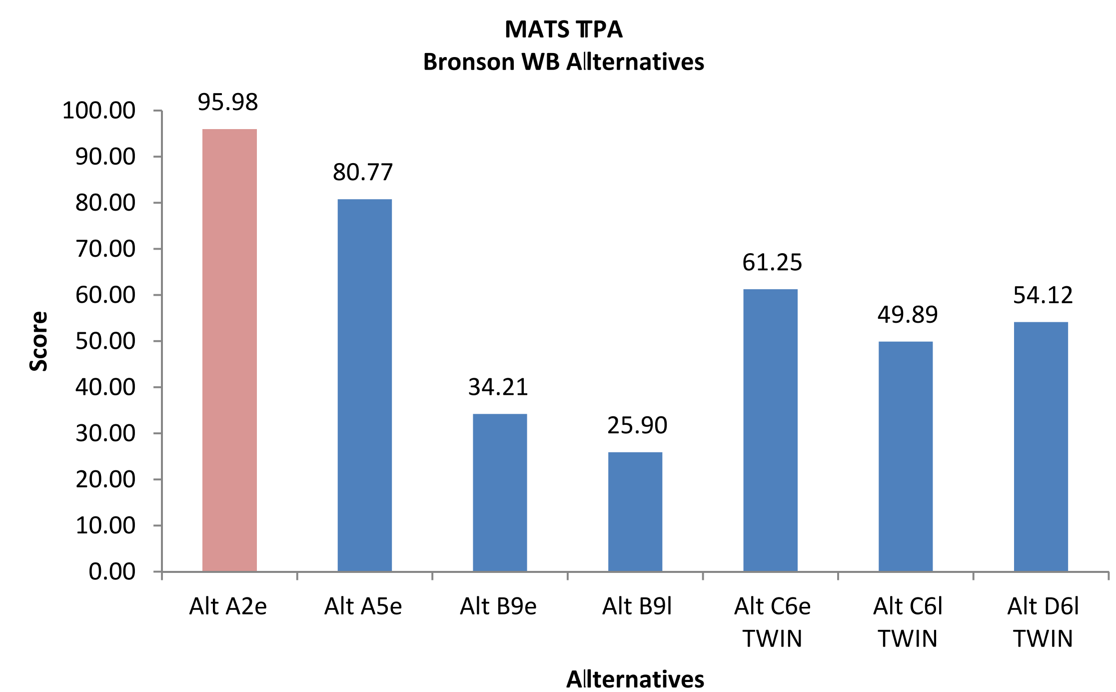


Table 7.20: Summary of Bronson Avenue EB MATS Weighted Scores

Bronson Avenue EB	Alternative[18]						
	Alt A2e	Alt A5e	Alt B9e	Alt B9l	Alt C6e	Alt C7e	Alt C6l
Transportation							
Maximum Peak Queue Length on Queensway	9.75	5.87	0.00	0.00	9.95	9.95	8.86
Delays	15.07	9.04	0.00	0.00	15.07	15.07	13.26
Ramp Closures	4.83	4.83	4.83	4.83	0.00	0.00	4.83
Highway Safety - Collision Potential	3.07	2.05	0.00	0.00	3.41	3.41	3.07
Highway Safety - Design Consistency of Traffic Staging Design	4.83	4.83	0.00	0.00	4.83	4.83	4.83
Pedestrian - Delay and Out-of-way Travel	3.81	3.81	0.00	0.00	1.90	1.90	1.90
Bicycle - Delay and Out-of-way Travel	3.18	3.18	0.00	0.00	1.59	1.59	1.59
Pedestrian/Bicycle Safety	0.00	0.00	0.00	3.07	0.00	3.07	3.07
Transit Operations Delay	3.35	3.35	0.00	0.00	1.68	1.68	1.68
General Traffic Municipal Street Delay	4.66	4.66	0.00	0.00	2.33	2.33	2.33
Provision of Ramp Terminal LT	6.37	6.37	6.37	0.00	6.37	0.00	0.00
TOTAL	58.93	48.00	11.20	7.90	47.14	43.84	45.43
Social and Cultural Environment							
Impact to Emergency Response	3.68	2.45	0.00	0.00	4.09	4.09	3.68
Potentially Contaminated Property	1.91	1.91	0.95	0.95	0.00	0.00	0.00
TOTAL	5.59	4.36	0.95	0.95	4.09	4.09	3.68
Land Use and Property							
Temporary Property Impacts	0.91	0.91	0.91	0.91	0.00	0.00	0.00
TOTAL	0.91	0.91	0.91	0.91	0.00	0.00	0.00
Cost							
Capital Cost	10.97	9.87	5.48	4.39	2.19	0.00	1.10
Life Cycle Cost	19.58	17.62	15.66	11.75	7.83	1.96	3.92
TOTAL	30.55	27.49	21.15	16.13	10.02	1.96	5.01
Score	**95.98**	**80.77**	**34.21**	**25.90**	**61.25**	**49.89**	**54.12**

Table 7.21: Summary of Bronson Avenue EB MATS Weighted Scores

Bronson Avenue WB	Alternative[19]						
	Alt A2e	Alt A5e	Alt B9e	Alt B9l	Alt C6e	Alt C7e	Alt C6l
Transportation							
Maximum Peak Queue Length on Queensway	9.75	5.87	0.00	0.00	9.95	9.95	8.86
Delays	15.07	9.04	0.00	0.00	15.07	15.07	13.26
Ramp Closures	4.83	4.83	4.83	4.83	0.00	0.00	4.83
Highway Safety - Collision Potential	3.07	2.05	0.00	0.00	3.41	3.41	3.07
Highway Safety - Design Consistency of Traffic Staging Design	4.83	4.83	0.00	0.00	4.83	4.83	4.83
Pedestrian - Delay and Out-of-way Travel	3.81	3.81	0.00	0.00	1.90	1.90	1.90
Bicycle - Delay and Out-of-way Travel	3.18	3.18	0.00	0.00	1.59	1.59	1.59
Pedestrian/Bicycle Safety	0.00	0.00	0.00	3.07	0.00	3.07	3.07
Transit Operations Delay	3.35	3.35	0.00	0.00	1.68	1.68	1.68
General Traffic Municipal Street Delay	4.66	4.66	0.00	0.00	2.33	2.33	2.33
Provision of Ramp Terminal LT	6.37	6.37	6.37	0.00	6.37	0.00	0.00
TOTAL	58.93	48.00	11.20	7.90	47.14	43.84	45.43
Social and Cultural Environment							
Impact to Emergency Response	3.68	2.45	0.00	0.00	4.09	4.09	3.68
Potentially Contaminated Property	1.91	1.91	0.95	0.95	0.00	0.00	0.00
TOTAL	5.59	4.36	0.95	0.95	4.09	4.09	3.68
Land Use and Property							
Temporary Property Impacts	0.91	0.91	0.91	0.91	0.00	0.00	0.00
TOTAL	0.91	0.91	0.91	0.91	0.00	0.00	0.00
Cost							
Capital Cost	10.97	9.87	5.48	4.39	2.19	0.00	1.10
Life Cycle Cost	19.58	17.62	15.66	11.75	7.83	1.96	3.92
TOTAL	30.55	27.49	21.15	16.13	10.02	1.96	5.01
Score	**95.98**	**80.77**	**34.21**	**25.90**	**61.25**	**49.89**	**54.12**

[18] All alternative descriptors/abbreviations are defined on Figure 6.1.

[19] All alternative descriptors/abbreviations are defined in the last column of Figure 6.1.

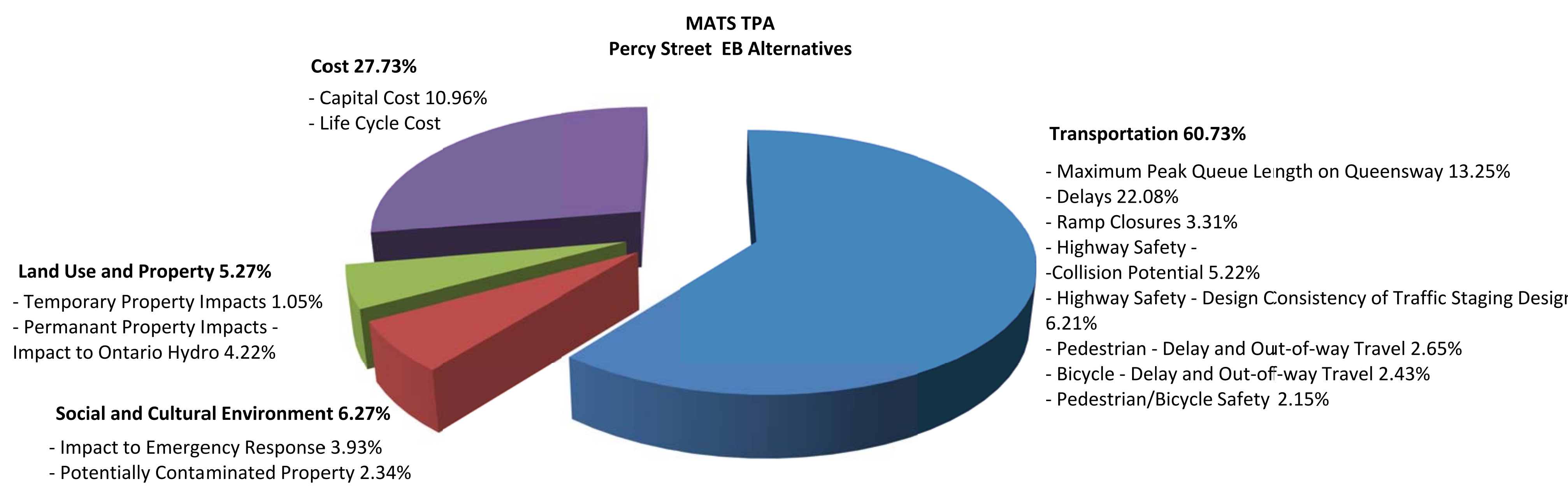
7.5.1.10 Percy Avenue

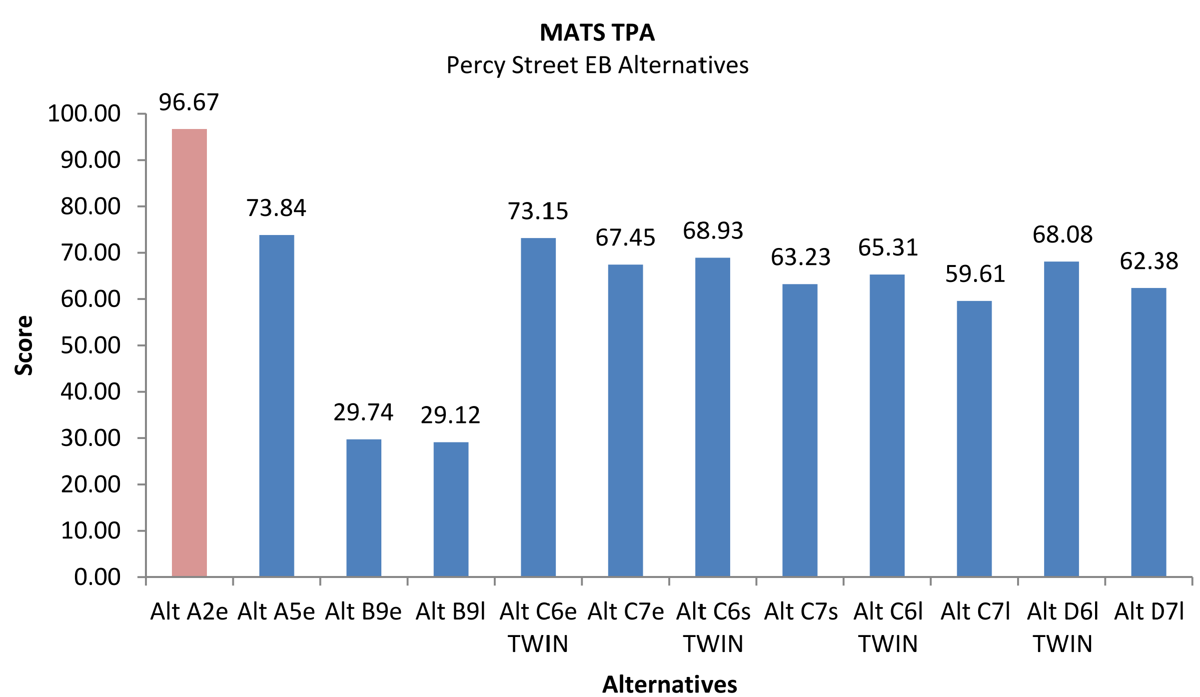
The results of the weights and rankings for Percy Avenue are illustrated on **Figure 7.11**, with the results of the weights for each sub-factor shown in **Table 7.22** and **Table 7.23** for Percy Avenue eastbound and westbound, respectively.

For the eastbound and westbound alternatives, the MATS ranked Alternative A2e, Rapid Bridge Rehabilitation, as the Technically Preferred Alternative for both directions. Taking into consideration the implementation of each alternative, the TPA for Percy Avenue eastbound and westbound is Alternative C6e.

The Evaluation Committee recommended that the TESR, which will describe the project to be carried forward, be defined to allow flexibility in the project to be delivered. Although the project to be implemented is a rapid replacement, the MTO should retain the flexibility to advance the rehabilitation of the bridge, Alternative A2e, should the structural condition of the bridge show additional significant deterioration as the project is delivered/ postponed or there are changes to Provincial priorities. This will be noted as a Statement of Flexibility in the TESR.

Figure 7.11: Percy Street MATS Weights and Rankings





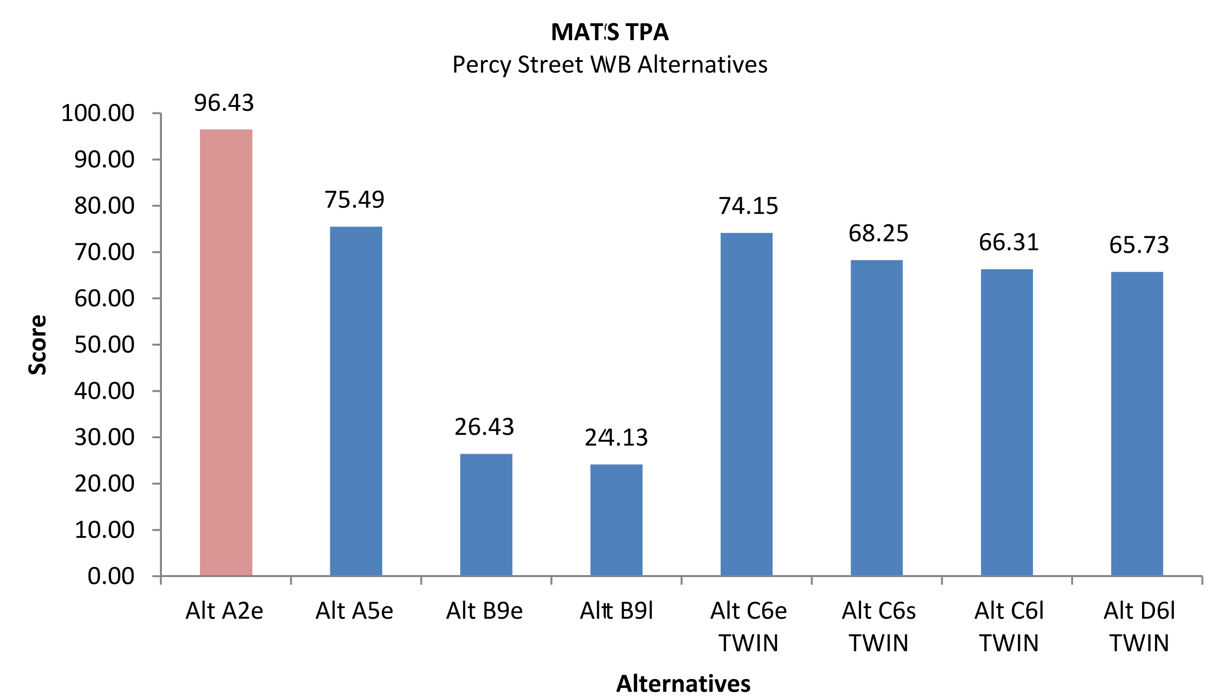


Table 7.22: Summary of Percy Street EB MATS Weighted Scores

Percy Avenue EB	Alternative[20]											
	Alt A2e	**Alt A5e**	**Alt B9e**	**Alt B9l**	**Alt C6e TWIN[21]**	**Alt C7e**	**Alt C6s TWIN**	**Alt C7s**	**Alt C6l TWIN**	**Alt C7l**	**Alt D6l TWIN**	**Alt D7l**
Transportation												
Maximum Peak Queue Length on Queensway	12.98	7.82	0.00	0.00	13.25	11.79	13.25	11.79	13.25	11.79	13.25	11.79
Delays	22.08	13.25	0.00	0.00	22.08	19.43	22.08	19.43	22.08	19.43	22.08	19.43
Ramp Closures	3.31	0.00	3.31	3.31	2.32	3.31	2.32	3.31	2.32	3.31	2.32	3.31
Highway Safety - Collision Potential	4.70	3.13	0.00	0.00	5.22	4.70	5.22	4.70	5.22	4.70	5.22	4.70
Highway Safety - Design Consistency of Traffic Staging Design	6.21	6.21	0.00	0.00	6.21	6.21	6.21	6.21	6.21	6.21	6.21	6.21
Pedestrian - Delay and Out-of-way Travel	2.65	2.65	0.00	0.00	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32
Bicycle - Delay and Out-of-way Travel	2.43	2.43	0.00	0.00	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21
Pedestrian/Bicycle Safety	0.00	0.00	0.00	2.15	0.00	0.00	0.00	0.00	2.15	2.15	2.15	2.15
General Traffic Municipal Street Delay	3.42	3.42	0.00	0.00	1.71	1.71	1.71	1.71	1.71	1.71	1.71	1.71
TOTAL	57.79	38.91	3.31	5.47	53.33	49.69	53.33	49.69	55.48	51.85	55.48	51.85
Social and Cultural Environment												
Impact to Emergency Response	3.54	2.36	0.00	0.00	3.93	3.54	3.93	3.54	3.93	3.54	3.93	3.54
Potentially Contaminated Property	2.34	2.34	1.17	1.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	5.88	4.70	1.17	1.17	3.93	3.54	3.93	3.54	3.93	3.54	3.93	3.54
Land Use and Property												
Temporary Property Impacts	1.05	1.05	1.05	1.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Permanent Property Impacts - Impact to Ontario Hydro	4.22	4.22	4.22	4.22	4.22	4.22	0.00	0.00	4.22	4.22	4.22	4.22
TOTAL	5.27	5.27	5.27	5.27	4.22	4.22	0.00	0.00	4.22	4.22	4.22	4.22
Cost												
Capital Cost	10.96	9.87	6.58	5.48	3.29	3.29	3.29	3.29	0.00	0.00	1.10	1.10
Life Cycle Cost	16.76	15.09	13.41	11.73	8.38	6.70	8.38	6.70	1.68	0.00	3.35	1.68
TOTAL	27.73	24.95	19.99	17.22	11.67	9.99	11.67	9.99	1.68	0.00	4.45	2.77
Score	**96.67**	**73.84**	**29.74**	**29.12**	**73.15**	**67.45**	**68.93**	**63.23**	**65.31**	**59.61**	**68.08**	**62.38**

[20] All alternative descriptors/abbreviations are defined on Figure 6.1.
[21] "TWIN" references that a common staging area on the north side of the Queensway is to be used for both eastbound and westbound structure replacements. Therefore, both eastbound and westbound structures must be completed on the same weekend.

Table 7.23: Summary of Percy Street WB MATS Weighted Scores

Percy Avenue WB	Alternative[22]							
	Alt A2e	**Alt A5e**	**Alt B9e**	**Alt B9l**	**Alt C6e TWIN[23]**	**Alt C6s TWIN**	**Alt C6l TWIN**	**Alt D6l TWIN**
Transportation								
Maximum Peak Queue Length on Queensway	12.98	7.82	0.00	0.00	13.25	13.25	13.25	13.25
Delays	22.08	13.25	0.00	0.00	22.08	22.08	22.08	22.08
Ramp Closures	3.08	1.66	0.00	0.00	3.31	3.31	3.31	3.31
Highway Safety - Collision Potential	4.70	3.13	0.00	0.00	5.22	5.22	5.22	5.22
Highway Safety - Design Consistency of Traffic Staging Design	6.21	6.21	0.00	0.00	6.21	6.21	6.21	6.21
Pedestrian - Delay and Out-of-way Travel	2.65	2.65	0.00	0.00	1.32	1.32	1.32	1.32
Bicycle - Delay and Out-of-way Travel	2.43	2.43	0.00	0.00	1.21	1.21	1.21	1.21
Pedestrian/Bicycle Safety	0.00	0.00	0.00	2.15	0.00	0.00	2.15	2.15
Transit Operations Delay	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
General Traffic Municipal Street Delay	3.42	3.42	0.00	0.00	1.71	1.71	1.71	1.71
TOTAL	57.56	40.57	0.00	2.15	54.32	54.32	56.48	56.48
Social and Cultural Environment								
Impact to Emergency Response	3.54	2.36	0.00	0.00	3.93	3.93	3.93	3.93
Potentially Contaminated Property	2.34	2.34	1.17	1.17	0.00	0.00	0.00	0.00
TOTAL	5.88	4.70	1.17	1.17	3.93	3.93	3.93	3.93
Land Use and Property								
Temporary Property Impacts	1.05	1.05	1.05	1.05	0.00	0.00	0.00	0.00
Permanent Property Impacts - Impact to Ontario Hydro	4.22	4.22	4.22	4.22	4.22	0.00	4.22	4.22
TOTAL	5.27	5.27	5.27	5.27	4.22	0.00	4.22	4.22
Cost								
Capital Cost	10.96	9.87	6.58	5.48	3.29	3.29	0.00	1.10
Life Cycle Cost	16.76	15.09	13.41	10.06	8.38	6.70	1.68	0.00
TOTAL	27.73	24.95	19.99	15.54	11.67	9.99	1.68	1.10
Score	**96.43**	**75.49**	**26.43**	**24.13**	**74.15**	**68.25**	**66.31**	**65.73**

[22] All alternative descriptors/abbreviations are defined in the last column of Figure 6.1.
[23] "TWIN" references that a common staging area on the north side of the Queensway is to be used for both eastbound and westbound structure replacements. Therefore, both eastbound and westbound structures must be completed on the same weekend.

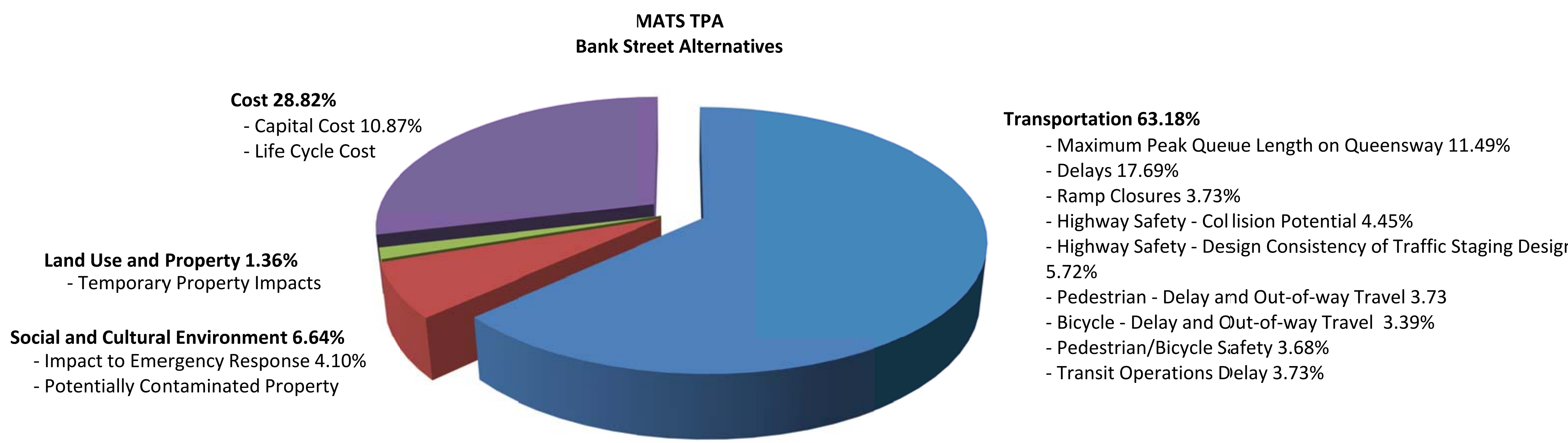
7.5.1.11 Bank Street

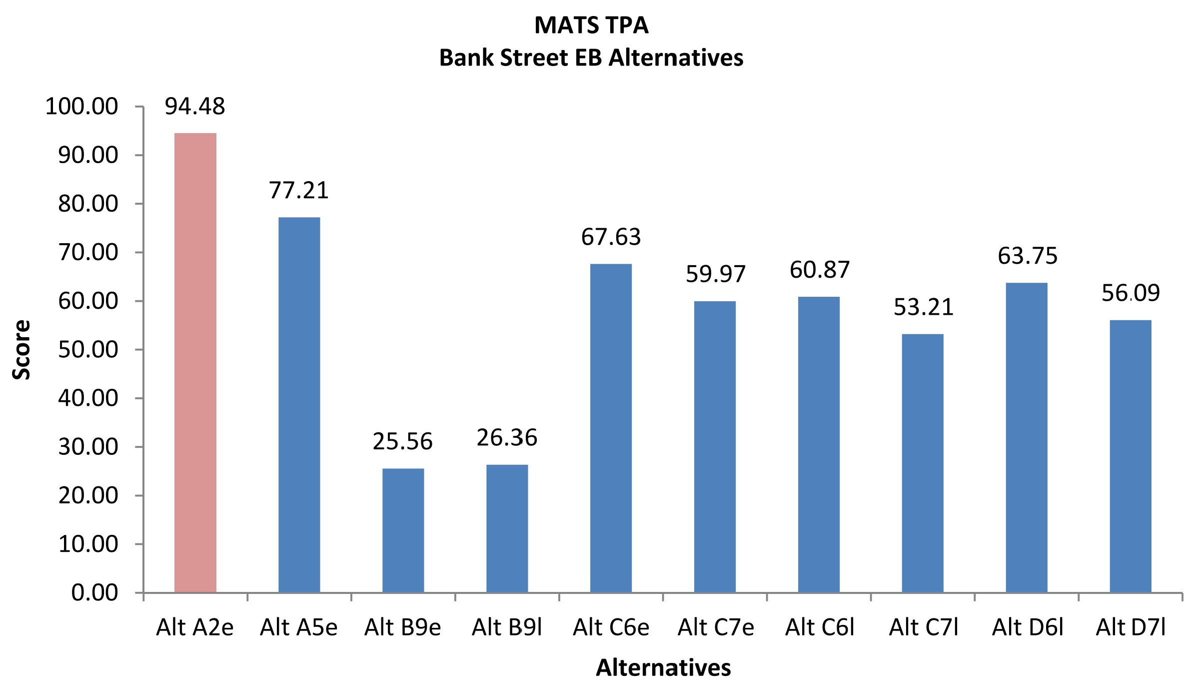
The results of the weights and rankings for Bank Street are illustrated on **Figure 7.12**, with the results of the weights for each sub-factor shown in **Table 7.24** and **Table 7.25** for Bank Street eastbound and westbound, respectively.

For the eastbound and westbound alternatives, the MATS ranked Alternative A2e, Rapid Bridge Rehabilitation, as the Technically Preferred Alternative for both directions. Taking into consideration the implementation of each alternative, the TPA for Bank Street eastbound and westbound remains Alternative A2e.

The Evaluation Committee recommended that the TESR, which will describe the project to be carried forward, be defined to allow flexibility in the project to be delivered. Although the project to be implemented is a rapid rehabilitation, the MTO should retain the flexibility to advance the replacement of the bridge, Alternative C6e, should the structural condition of the bridge show additional significant deterioration as the project is delivered/ postponed or there are changes to Provincial priorities. This will be noted as a Statement of Flexibility in the TESR.

Figure 7.12: Bank Street MATS Weights and Rankings





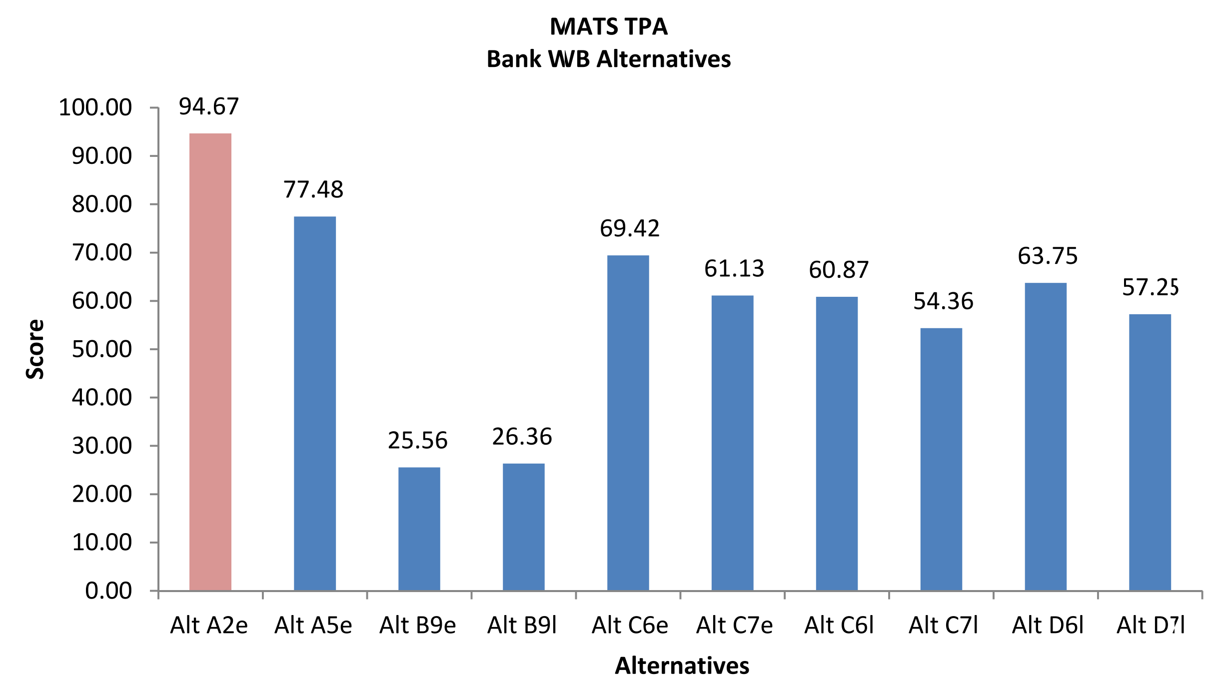


Table 7.24: Summary of Bank Street EB MATS Weighted Scores

Bank Street EB	Alternative[24]									
	Alt A2e	**Alt A5e**	**Alt B9e**	**Alt B9l**	**Alt C6e**	**Alt C7e**	**Alt C6l**	**Alt C7l**	**Alt D6l**	**Alt D7l**
Transportation										
Maximum Peak Queue Length on Queensway	11.26	6.78	0.00	0.00	11.49	10.34	11.49	10.34	11.49	10.34
Delays	17.69	10.61	0.00	0.00	17.69	15.92	17.69	15.92	17.69	15.92
Ramp Closures	3.10	2.84	0.00	0.00	3.73	1.64	3.73	1.64	3.73	1.64
Highway Safety - Collision Potential	4.01	2.67	0.00	0.00	4.45	4.01	4.45	4.01	4.45	4.01
Highway Safety - Design Consistency of Traffic Staging Design	5.72	5.72	0.00	0.00	5.72	5.72	5.72	5.72	5.72	5.72
Pedestrian - Delay and Out-of-way Travel	3.73	3.73	0.00	0.00	1.87	1.87	1.87	1.87	1.87	1.87
Bicycle - Delay and Out-of-way Travel	3.39	3.39	0.00	0.00	1.69	1.69	1.69	1.69	1.69	1.69
Pedestrian/Bicycle Safety	0.00	0.00	0.00	3.68	0.00	0.00	3.68	3.68	3.68	3.68
Transit Operations Delay	3.73	3.73	0.00	0.00	1.87	1.87	1.87	1.87	1.87	1.87
General Traffic Municipal Street Delay	5.57	5.57	0.00	0.00	2.79	2.79	2.79	2.79	2.79	2.79
TOTAL	58.20	45.04	0.00	3.68	51.29	45.84	54.97	49.51	54.97	49.51
Social and Cultural Environment										
Impact to Emergency Response	3.69	2.46	0.00	0.00	4.10	3.69	4.10	3.69	4.10	3.69
Potentially Contaminated Property	2.53	2.53	1.27	1.27	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	6.23	5.00	1.27	1.27	4.10	3.69	4.10	3.69	4.10	3.69
Land Use and Property										
Temporary Property Impacts	1.24	1.24	1.24	1.24	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	1.24	1.24	1.24	1.24	0.00	0.00	0.00	0.00	0.00	0.00
Cost										
Capital Cost	10.87	9.79	8.70	7.61	3.26	3.26	0.00	0.00	1.09	1.09
Life Cycle Cost	17.95	16.15	14.36	12.56	8.97	7.18	1.79	0.00	3.59	1.79
TOTAL	28.82	25.94	23.05	20.17	12.23	10.44	1.79	0.00	4.68	2.88
Score	**94.48**	**77.21**	**25.56**	**26.36**	**67.63**	**59.97**	**60.87**	**53.21**	**63.75**	**56.09**

[24] All alternative descriptors/abbreviations are defined on Figure 6.1.

Table 7.25: Summary of Bank Street EB MATS Weighted Scores

Bank Street WB	Alternative[25]									
	Alt A2e	**Alt A5e**	**Alt B9e**	**Alt B9l**	**Alt C6e TWIN[26]**	**Alt C6e TWIN**	**Alt C6l TWIN**	**Alt C6l TWIN**	**Alt D6l TWIN**	**Alt D6l TWIN**
Transportation										
Maximum Peak Queue Length on Queensway	11.26	6.78	0.00	0.00	11.49	10.34	11.49	10.34	11.49	10.34
Delays	17.69	10.61	0.00	0.00	17.69	15.92	17.69	15.92	17.69	15.92
Ramp Closures	3.29	3.10	0.00	0.00	3.73	2.80	3.73	2.80	3.73	2.80
Highway Safety - Collision Potential	4.01	2.67	0.00	0.00	4.45	4.01	4.45	4.01	4.45	4.01
Highway Safety - Design Consistency of Traffic Staging Design	5.72	5.72	0.00	0.00	5.72	5.72	5.72	5.72	5.72	5.72
Pedestrian - Delay and Out-of-way Travel	3.73	3.73	0.00	0.00	1.87	1.87	1.87	1.87	1.87	1.87
Bicycle - Delay and Out-of-way Travel	3.39	3.39	0.00	0.00	1.69	1.69	1.69	1.69	1.69	1.69
Pedestrian/Bicycle Safety	0.00	0.00	0.00	3.68	0.00	0.00	3.68	3.68	3.68	3.68
Transit Operations Delay	3.73	3.73	0.00	0.00	1.87	1.87	1.87	1.87	1.87	1.87
General Traffic Municipal Street Delay	5.57	5.57	0.00	0.00	2.79	2.79	2.79	2.79	2.79	2.79
TOTAL	58.38	45.30	0.00	3.68	51.29	47.00	54.97	50.67	54.97	50.67
Social and Cultural Environment										
Impact to Emergency Response	3.69	2.46	0.00	0.00	4.10	3.69	4.10	3.69	4.10	3.69
Potentially Contaminated Property	2.53	2.53	1.27	1.27	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	6.23	5.00	1.27	1.27	4.10	3.69	4.10	3.69	4.10	3.69
Land Use and Property										
Temporary Property Impacts	1.24	1.24	1.24	1.24	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	1.24	1.24	1.24	1.24	0.00	0.00	0.00	0.00	0.00	0.00
Cost										
Capital Cost	10.87	9.79	8.70	7.61	3.26	3.26	0.00	0.00	1.09	1.09
Life Cycle Cost	17.95	16.15	14.36	12.56	10.77	7.18	1.79	0.00	3.59	1.79
TOTAL	28.82	25.94	23.05	20.17	14.03	10.44	1.79	0.00	4.68	2.88
Score	**94.67**	**77.48**	**25.56**	**26.36**	**69.42**	**61.13**	**60.87**	**54.36**	**63.75**	**57.25**

[25] All alternative descriptors/abbreviations are defined on Figure 6.1.

[26] "TWIN" references that a common staging area on the north side of the Queensway is to be used for both eastbound and westbound structure replacements. Therefore, both eastbound and westbound structures must be completed on the same weekend.

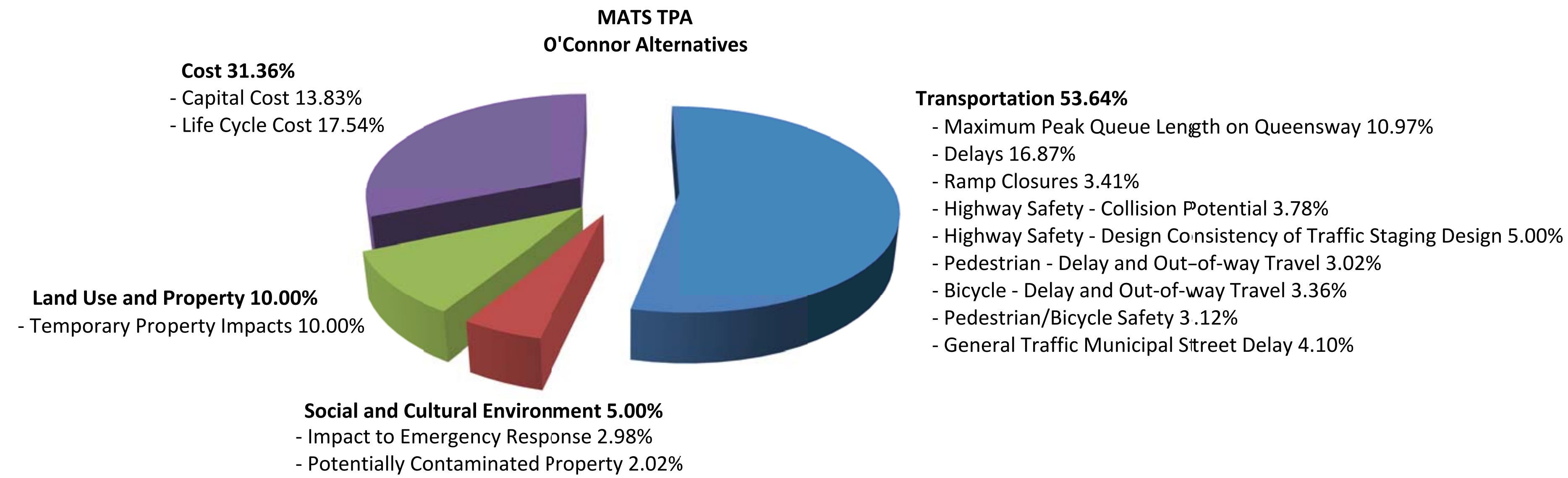
7.5.1.12 O'Connor Street

The results of the weights and rankings for O'Connor Street are illustrated on **Figure 7.13**, with the results of the weights for each sub-factor shown in **Table 7.26**.

For the alternatives, the MATS ranked Alternative A2e, Rapid Bridge Rehabilitation, as the Technically Preferred Alternative for both directions. Taking into consideration the implementation of each alternative, the TPA for O'Connor Street eastbound and westbound remains Alternative A2e.

The Evaluation Committee recommended that the TESR, which will describe the project to be carried forward, be defined to allow flexibility in the project to be delivered. Although the project to be implemented is a rapid rehabilitation, the MTO should retain the flexibility to advance the replacement of the bridge, Alternative C6e, should the structural condition of the bridge show additional significant deterioration as the project is delivered/ postponed or there are changes to Provincial priorities. This will be noted as a Statement of Flexibility in the TESR.

Figure 7.13: O'Connor Street MATS Weights and Ranking



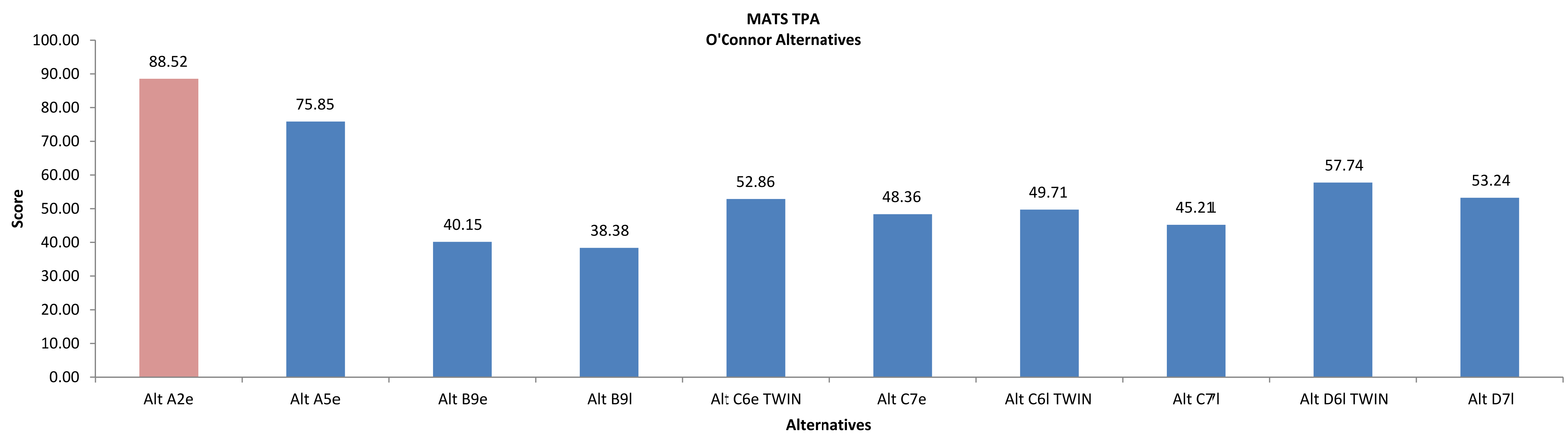


Table 7.26: Summary of O'Connor Street MATS Weighted Scores

O'Connor Street	Alternative[27]									
	Alt A2e	**Alt A5e**	**Alt B9e**	**Alt B9l**	**Alt C6e TWIN[28]**	**Alt C7e**	**Alt C6l TWIN**	**Alt C7l**	**Alt D6l TWIN**	**Alt D7l**
Transportation										
Maximum Peak Queue Length on Queensway	10.20	0.00	1.65	1.65	10.97	9.87	10.97	9.87	10.97	9.87
Delays	9.95	12.65	0.00	0.00	16.87	12.48	16.87	12.48	16.87	12.48
Ramp Closures	3.41	3.41	3.41	3.41	0.00	3.41	0.00	3.41	0.00	3.41
Highway Safety - Collision Potential	3.40	2.27	0.00	0.00	3.78	3.40	3.78	3.40	3.78	3.40
Highway Safety - Design Consistency of Traffic Staging Design	5.00	5.00	0.00	0.00	5.00	5.00	5.00	5.00	5.00	5.00
Pedestrian - Delay and Out-of-way Travel	3.02	3.02	0.00	0.00	1.51	1.51	1.51	1.51	1.51	1.51
Bicycle - Delay and Out-of-way Travel	3.36	3.36	0.00	0.00	1.68	1.68	1.68	1.68	1.68	1.68
Pedestrian/Bicycle Safety	0.00	0.00	0.00	3.12	0.00	0.00	3.12	3.12	3.12	3.12
General Traffic Municipal Street Delay	4.10	4.10	0.00	0.00	2.05	2.05	2.05	2.05	2.05	2.05
TOTAL	42.45	33.82	5.06	8.18	41.86	39.41	44.98	42.53	44.98	42.53
Social and Cultural Environment										
Impact to Emergency Response	2.68	1.79	0.00	0.00	2.98	2.68	2.98	2.68	2.98	2.68
Potentially Contaminated Property	2.02	2.02	1.01	1.01	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	4.70	3.81	1.01	1.01	2.98	2.68	2.98	2.68	2.98	2.68
Land Use and Property										
Temporary Property Impacts	10.00	10.00	10.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	10.00	10.00	10.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00
Cost										
Capital Cost	13.83	12.45	8.30	6.91	2.77	2.77	0.00	0.00	2.77	2.77
Life Cycle Cost	17.54	15.78	15.78	12.27	5.26	3.51	1.75	0.00	7.01	5.26
TOTAL	31.36	28.23	24.08	19.19	8.03	6.27	1.75	0.00	9.78	8.03
Score	**88.52**	**75.85**	**40.15**	**38.38**	**52.86**	**48.36**	**49.71**	**45.21**	**57.74**	**53.24**

[27] All alternative descriptors/abbreviations are defined on Figure 6.1.

[28] "TWIN" references that a common staging area on the north side of the Queensway is to be used for both eastbound and westbound structure replacements. Therefore, both eastbound and westbound structures must be completed on the same weekend.

7.6 Sensitivity Testing

It should be recognized that the scope of the evaluation and determination of weights for the evaluation criteria are a matter of professional judgment. Accordingly, it is considered essential to conduct sensitivity testing to determine if the nature of the evaluation is sensitive to the weights assigned to each criterion.

There is a spread of values among the groups of evaluators for the selection of weights. The range is dependent on the value judgment of individuals and specialists. Using the average of the group does not necessarily capture what the standard deviation was among the individual scores. Therefore, sensitivity testing is conducted to test a range of weights either higher or lower than the group's average.

For this study an independent test was undertaken which placed greater or less emphasis on a global factor and redistributing the weight to the other factors using the average values of the TAC. In fact, a separate test will be completed for each factor using the highest weight given by anyone in the TAC as well as the lowest weight.

Following this methodology a series of tests will be completed varying the weight for each global factor. The three tests will include:

- Average TAC Weight
- Highest Weight in a factor group by any TAC member
- Lowest Weight in a factor group by any TAC member

Following this series of tests, the results will be reviewed to assess whether the preferred alternative changed when the weights were varied.

Using this information alone will not be the only justification for selecting a particular option, but it will provide a level of confidence in the selection and the ability to assess trade-offs. This information will be considered and used in the decision-making process before a TPA is recommended to be carried forward. The sensitivity testing will be presented at PIC No. 2.

7.6.1 *Holland Avenue Sensitivity Testing Results*

The sensitivity test results for both Holland Avenue eastbound and westbound showed that the preferred alternative, Alternative A2e, was not affected by the highest or lowest weight in any factor group by any TAC member. **Table 7.27** and **Table 7.28** tabulate the results of the sensitivity tests for Holland Avenue eastbound and westbound, respectively.

Table 7.27: Summary of Holland Avenue EB Sensitivity Testing Results

Alternatives for Holland EB		Alt A2e	Alt A5e	Alt B9e	Alt B9l	Alt C6e TWIN	Alt C6l TWIN	Alt D6l TWIN
FACTORS	WEIGHT	95.59	80.68	37.61	33.91	56.34	46.36	52.64
TAC Weights		1	2	6	7	3	5	4
Transportation	High	1	2	7	6	4	5	3
	Low	1	2	3	5	4	7	6
Social and Cultural Environment	High	1	2	6	7	3	5	4
	Low	1	2	6	7	3	5	4
Land Use and Property	High	1	2	5	6	3	7	4
	Low	1	2	6	7	3	5	4
Cost	High	1	2	3	5	4	7	6
	Low	1	2	7	6	4	5	3

Table 7.28: Summary of Holland Avenue WB Sensitivity Testing Results

Alternatives for Holland WB		Alt A2e	Alt A5e	Alt B9e	Alt B9l	Alt C6e TWIN	Alt C6l TWIN	Alt D6l TWIN
FACTORS	WEIGHT	94.93	76.14	37.75	33.90	55.42	46.363	52.639
TAC Weights		1	2	6	7	3	5	4
Transportation	High	1	2	7	6	4	5	3
	Low	1	2	3	5	4	7	6
Social and Cultural Environment	High	1	2	6	7	3	5	4
	Low	1	2	6	7	3	5	4
Land Use and Property	High	1	2	5	6	3	7	4
	Low	1	2	6	7	3	5	4
Cost	High	1	2	3	5	4	7	6
	Low	1	2	7	6	4	5	3

7.6.2 *Parkdale Avenue Sensitivity Testing Results*

The sensitivity test results for both Parkdale Avenue eastbound and westbound showed that the preferred alternative, Alternative A2e, was not affected by the highest or lowest weight in any factor group by any TAC member. **Table 7.29** and **Table 7.30** tabulate the results of the sensitivity tests for Parkdale Avenue eastbound and westbound, respectively.

Table 7.29: Summary of Parkdale Avenue EB Sensitivity Testing Results

Alternatives for Parkdale EB		**Alt A2e**	**Alt A5e**	**Alt B9e**	**Alt B9l**
FACTORS	WEIGHT	96.17	67.07	12.94	0.00
TAC Weights		1	2	3	4
Transportation	High	1	2	3	4
	Low	1	2	3	4
Social and Cultural Environment	High	1	2	3	4
	Low	1	2	3	4
Cost	High	1	2	3	4
	Low	1	2	3	4

Table 7.30: Summary of Parkdale Avenue WB Sensitivity Testing Results

Alternatives for Parkdale WB		**Alt A2e**	**Alt A5e**	**Alt B9e**	**Alt B9l**
FACTORS	WEIGHT	96.17	66.43	14.46	0.00
TAC Weights		1	2	3	4
Transportation	High	1	2	3	4
	Low	1	2	3	4
Social and Cultural Environment	High	1	2	3	4
	Low	1	2	3	4
Cost	High	1	2	3	4
	Low	1	2	3	4

7.6.3 *Fairmont Avenue Sensitivity Testing Results*

The sensitivity test results for both Fairmont Avenue eastbound and westbound showed that the preferred alternative, Alternative A2e, was not affected by the highest or lowest weight in any factor group by any TAC member. **Table 7.31** and **Table 7.32** tabulate the results of the sensitivity tests for Fairmont Avenue eastbound and westbound, respectively.

Table 7.31: Summary of Fairmont Avenue EB Sensitivity Testing Results

Alternatives for Fairmont WB		**Alt A2e**	**Alt A5e**	**Alt B9e**	**Alt B9l**
FACTORS	WEIGHT	100.00	71.42	12.35	0.00
TAC Weights		1	2	3	4
Transportation	High	1	2	3	4
	Low	1	2	3	4
Social and Cultural Environment	High	1	2	3	4
	Low	1	2	3	4
Cost	High	1	2	3	4
	Low	1	2	3	4

Table 7.32: Summary of Fairmont Avenue WB Sensitivity Testing Results

Alternatives for Fairmont WB		**Alt A2e**	**Alt A5e**	**Alt B9e**	**Alt B9l**
FACTORS	WEIGHT	100.00	71.42	12.35	0.00
TAC Weights		1	2	3	4
Transportation	High	1	2	3	4
	Low	1	2	3	4
Social and Cultural Environment	High	1	2	3	4
	Low	1	2	3	4
Cost	High	1	2	3	4
	Low	1	2	3	4

7.6.4 *Bayswater Avenue Sensitivity Testing Results*

The sensitivity test results for both Bayswater Avenue eastbound and westbound showed that the preferred alternative, Alternative A2e, was not affected by the highest or lowest weight in any factor group by any TAC member. **Table 7.33** and **Table 7.34** tabulate the results of the sensitivity tests for Bayswater Avenue eastbound and westbound, respectively.

Table 7.33: Summary of Bayswater Avenue EB Sensitivity Testing Results

Alternatives for Bayswater EB		Alt A2e	Alt A5e	Alt B9e	Alt B9l
FACTORS	WEIGHT	100.00	65.83	17.11	0.00
TAC Weights		1	2	3	4
Transportation	High	1	2	3	4
	Low	1	2	3	4
Social and Cultural Environment	High	1	2	3	4
	Low	1	2	3	4
Cost	High	1	2	3	4
	Low	1	2	3	4

Table 7.34: Summary of Bayswater Avenue WB Sensitivity Testing Results

Alternatives for Bayswater WB		Alt A2e	Alt A5e	Alt B9e	Alt B9l
FACTORS	WEIGHT	100.00	65.83	17.52	0.00
TAC Weights		1	2	3	4
Transportation	High	1	2	3	4
	Low	1	2	3	4
Social and Cultural Environment	High	1	2	3	4
	Low	1	2	3	4
Cost	High	1	2	3	4
	Low	1	2	3	4

7.6.5 *CPR/O-Train Sensitivity Testing Results*

The sensitivity test results for CPR/O-Train showed that the preferred alternative, Alternative H6e, was affected only by the highest cost weight test. Alternative E2e becomes the preferred alternative only when the high cost weights sensitivity test was undertaken. This reflects that there is a trade-off between cost and the other evaluation criteria. However, the evaluation team recognizes this trade-off and endorsed carrying forward Alternative H6e as the best balanced alternative for the site. **Table 7.35** tabulates the results of the sensitivity tests for CPR/O-Train.

Table 7.35: Summary of CPR O-Train Sensitivity Testing Results

Alternatives for CPR O-TRAIN		**Alt A2e**	**Alt A2r**	**Alt A5e**	**Alt A5r**	**Alt B2e**	**Alt B2r**	**Alt B5e**	**Alt B5r**	**Alt C2e**	**Alt C5e**	**Alt D2e**	**Alt D5e**	**Alt E2e**	**Alt E2r**	**Alt E5e**	**Alt E5r**	**Alt F2e**	**Alt F5e**	**Alt G2e**	**Alt G5e**	**Alt H6e**	**Alt H7e**	**Alt I6e**	**Alt I7e**
FACTORS	WEIGHT	82.10	45.13	67.43	47.99	71.47	52.16	56.80	37.36	84.92	70.40	76.17	62.20	82.40	63.09	67.73	48.29	84.83	70.30	81.20	66.67	91.66	75.54	56.02	42.02
TAC Weights		5	22	13	21	9	19	17	24	2	10	7	16	4	15	12	20	3	11	6	14	1	8	18	23
Transportation	High	6	15	17	23	9	19	20	24	3	12	7	18	5	14	16	22	4	13	2	11	1	8	10	21
	Low	5	17	11	20	13	21	18	23	2	8	12	15	4	16	10	19	3	9	6	14	1	7	22	24
Social and Cultural Environment	High	5	17	13	22	9	20	19	24	2	10	8	15	4	16	12	21	3	11	6	14	1	7	18	23
	Low	5	16	13	22	9	20	18	24	2	10	7	17	4	15	12	21	3	11	6	14	1	8	19	23
Economic	High	5	17	13	22	9	20	18	24	2	10	7	15	4	16	12	21	3	11	6	14	1	8	19	23
	Low	5	13	15	22	9	18	20	24	2	10	7	17	4	12	14	21	3	11	6	16	1	8	19	23
Land Use and Property	High	5	16	13	22	11	20	19	24	2	9	8	17	4	15	12	21	3	10	6	14	1	7	18	23
	Low	5	17	13	22	9	20	18	24	2	10	7	15	4	16	12	21	3	11	6	14	1	8	19	23
Cost	High	3	15	10	20	14	21	18	22	2	8	6	16	1	13	7	19	4	9	11	17	5	12	23	24
	Low	6	18	14	23	9	20	19	24	3	11	8	16	5	17	13	22	4	12	2	10	1	7	15	21
Schedule Uncertainty	High	5	16	13	21	8	19	18	22	2	10	7	17	4	15	12	20	3	11	6	14	1	9	23	24
	Low	5	17	14	23	9	21	19	24	2	10	6	18	4	16	13	22	3	11	8	15	1	7	12	20

7.6.6 *Preston Street Sensitivity Testing Results*

The sensitivity test results for both Preston Street eastbound and westbound showed that the preferred alternative, Alternative A2e, was not affected by the highest or lowest weight in any factor group by any TAC member. **Table 7.36** and **Table 7.37** tabulate the results of the sensitivity tests for Preston Street eastbound and westbound, respectively.

Table 7.36: Summary of Preston Street EB Sensitivity Testing Results

Alternatives for Preston EB		Alt A2e	Alt A5e	Alt B9e	Alt B9l	Alt C6e	Alt C7e	Alt C6l	Alt C7l	Alt D6l	Alt D7l
FACTORS	WEIGHT	94.99	74.89	26.30	25.25	61.52	55.34	57.59	51.41	60.48	54.30
TAC Weights		1	2	9	10	3	6	5	8	4	7
Transportation	High	1	5	10	9	4	8	3	7	2	6
	Low	1	2	8	10	3	5	6	9	4	7
Social and Cultural Environment	High	1	2	9	10	3	6	5	8	4	7
	Low	1	2	9	10	3	6	5	8	4	7
Land Use and Property	High	1	2	9	10	3	6	5	8	4	7
	Low	1	2	9	10	3	6	5	8	4	7
Cost	High	1	2	9	10	3	5	6	8	4	7
	Low	1	4	10	9	5	8	3	7	2	6

Table 7.37: Summary of Preston Street WB Sensitivity Testing Results

Alternatives for Preston WB		Alt A2e	Alt A5e	Alt B9e	Alt B9l	Alt C6e	Alt C7e	Alt C6l	Alt C7l	Alt D6l	Alt D7l
FACTORS	WEIGHT	91.48	69.96	24.21	19.17	64.94	55.28	58.82	51.01	61.74	53.92
TAC Weights		1	2	9	10	3	6	5	8	4	7
Transportation	High	1	5	9	10	3	7	4	8	2	6
	Low	1	2	8	10	3	5	6	9	4	7
Social and Cultural Environment	High	1	2	9	10	3	6	5	8	4	7
	Low	1	2	9	10	3	6	5	8	4	7
Cost	High	1	2	9	10	3	5	6	8	4	7
	Low	1	7	10	9	4	8	3	6	2	5

7.6.7 *Rochester Street Sensitivity Testing Results*

The sensitivity test results for both Rochester Street eastbound and westbound showed that the preferred alternative, Alternative A2e, was not affected by the highest or lowest weight in any factor group by any TAC member. **Table 7.38** and **Table 7.39** tabulate the results of the sensitivity tests for Rochester Street eastbound and westbound, respectively.

Table 7.38: Summary of Rochester Street EB Sensitivity Testing Results

Alternatives for Rochester EB		Alt A2e	Alt A5e	Alt B9e	Alt B9l	Alt C6e	Alt C7e	Alt C6l	Alt C7l	Alt D6l	Alt D7l
FACTORS	WEIGHT	94.92	80.08	35.80	37.88	59.90	54.18	55.40	52.61	57.22	54.43
TAC Weights		1	2	10	9	3	7	5	8	4	6
Transportation	High	1	2	10	9	6	8	4	7	3	5
	Low	1	2	4	5	3	7	8	10	6	9
Social and Cultural Environment	High	1	2	10	9	3	7	5	8	4	6
	Low	1	2	10	9	3	7	5	8	4	6
Land Use and Property	High	1	2	10	9	3	7	5	8	4	6
	Low	1	2	10	9	3	7	5	8	4	6
Cost	High	1	2	7	6	3	5	8	10	4	9

Table 7.39: Summary of Rochester Street WB Sensitivity Testing Results

Alternatives for Rochester WB		Alt A2e	Alt A5e	Alt B9e	Alt B9l	Alt C6e	Alt C7e	Alt C6l	Alt C7l	Alt D6l	Alt D7l
FACTORS	WEIGHT	94.92	79.26	38.43	38.84	56.32	56.40	50.62	50.70	53.68	53.75
TAC Weights		1	2	10	9	4	3	8	7	6	5
Transportation	High	1	2	10	9	8	5	7	4	6	3
	Low	1	2	5	6	3	4	9	10	7	8
Social and Cultural Environment	High	1	2	10	9	3	4	7	8	5	6
	Low	1	2	10	9	4	3	8	7	6	5
Land Use and Property	High	1	2	10	9	4	3	8	7	6	5
	Low	1	2	10	9	4	3	8	7	6	5
Cost	High	1	2	5	7	3	4	9	10	6	8
	Low	1	2	10	9	8	6	7	4	5	3

7.6.8 *Booth Street Sensitivity Testing Results*

The sensitivity test results for both Booth Street eastbound and westbound showed that the preferred alternative, Alternative A2e, was not affected by the highest or lowest weight in any factor group by any TAC member. **Table 7.40** and **Table 7.41** tabulate the results of the sensitivity tests for Booth Street eastbound and westbound, respectively.

Table 7.40: Summary of Booth Street EB Sensitivity Testing Results

Alternatives for Booth EB		Alt A2e	Alt A5e	Alt B9e	Alt B9l	Alt C6e	Alt C7e	Alt C6l	Alt C7l	Alt D6l	Alt D7l
FACTORS	WEIGHT	94.94	74.86	27.77	28.93	63.71	54.28	57.41	47.98	60.24	50.81
TAC Weights		1	2	10	9	3	6	5	8	4	7
Transportation	High	1	5	10	9	4	8	3	7	2	6
	Low	1	2	9	10	3	5	6	8	4	7
Social and Cultural Environment	High	1	2	10	9	3	6	5	8	4	7
	Low	1	2	10	9	3	6	5	8	4	7
Land Use and Property	High	1	2	10	9	3	6	5	8	4	7
	Low	1	2	10	9	3	6	5	8	4	7
Cost	High	1	2	8	9	3	4	6	10	5	7
	Low	1	2	10	9	4	7	5	8	3	6

Table 7.41: Summary of Booth Street WB Sensitivity Testing Results

Alternatives for Booth WB		Alt A2e	Alt A5e	Alt B9e	Alt B9l	Alt C6e	Alt C7e	Alt C6l	Alt C7l	Alt D6l	Alt D7l
FACTORS	WEIGHT	94.35	75.07	31.00	32.03	61.42	55.01	55.32	48.91	58.07	51.66
TAC Weights		1	2	10	9	3	6	5	8	4	7
Transportation	High	1	2	10	9	4	7	5	8	3	6
	Low	1	2	9	10	3	5	6	8	4	7
Social and Cultural Environment	High	1	2	10	9	3	6	5	8	4	7
	Low	1	2	10	9	3	5	6	8	4	7
Land Use and Property	High	1	2	10	9	3	6	5	8	4	7
	Low	1	2	10	9	3	6	5	8	4	7
Cost	High	1	2	9	10	3	4	6	8	5	7
	Low	1	2	10	9	4	7	5	8	3	6

7.6.9 *Bronson Avenue Sensitivity Testing Results*

The sensitivity test results for both Bronson Avenue eastbound and westbound showed that the preferred alternative, Alternative A2e, was not affected by the highest or lowest weight in any factor group by any TAC member. **Table 7.42** and **Table 7.43** tabulate the results of the sensitivity tests for Bronson Avenue eastbound and westbound, respectively.

Table 7.42: Summary of Bronson Avenue EB Sensitivity Testing Results

Alternatives for Bronson EB		Alt A2e	Alt A5e	Alt B9e	Alt B9l	Alt C6e TWIN	Alt C6l TWIN	Alt D6l TWIN
FACTORS	WEIGHT	95.98	80.77	34.21	25.90	61.25	49.89	54.12
TAC Weights		1	2	6	7	3	5	4
Transportation	High	1	2	6	7	3	5	4
	Low	1	2	6	7	3	5	4
Social and Cultural Environment	High	1	2	6	7	3	5	4
	Low	1	2	6	7	3	5	4
Land Use and Property	High	1	2	6	7	3	5	4
	Low	1	2	6	7	3	5	4
Cost	High	1	2	5	7	3	6	4
	Low	1	2	6	7	3	5	4

Table 7.43: Summary of Bronson Avenue WB Sensitivity Testing Results

Alternatives for Bronson WB		Alt A2e	Alt A5e	Alt B9e	Alt B9l	Alt C6e TWIN	Alt C6l TWIN	Alt D6l TWIN
FACTORS	WEIGHT	95.98	80.77	34.21	25.90	61.25	49.89	54.12
TAC Weights		1	2	6	7	3	5	4
Transportation	High	1	2	6	7	3	5	4
	Low	1	2	6	7	3	5	4
Social and Cultural Environment	High	1	2	6	7	3	5	4
	Low	1	2	6	7	3	5	4
Land Use and Property	High	1	2	6	7	3	5	4
	Low	1	2	6	7	3	5	4
Cost	High	1	2	5	7	3	6	4
	Low	1	2	6	7	3	5	4

7.6.10 *Percy Street Sensitivity Testing Results*

The sensitivity test results for both Percy Street eastbound and westbound showed that the preferred alternative, Alternative A2e, was not affected by the highest or lowest weight in any factor group by any TAC member. **Table 7.44** and **Table 7.45** tabulate the results of the sensitivity tests for Percy Street eastbound and westbound, respectively.

Table 7.44: Summary of Percy Street EB Sensitivity Testing Results

Alternatives for Percy EB		**Alt A2e**	**Alt A5e**	**Alt B9e**	**Alt B9l**	**Alt C6e TWIN**	**Alt C7e**	**Alt C6s TWIN**	**Alt C7s**	**Alt C6l TWIN**	**Alt C7l**	**Alt D6l TWIN**	**Alt D7l**
FACTORS	WEIGHT	96.67	73.84	29.74	29.12	73.15	67.45	68.93	63.23	65.31	59.61	68.08	62.38
TAC Weights		1	2	11	12	3	6	4	8	7	10	5	9
Transportation	High	1	10	12	11	2	6	5	9	4	8	3	7
	Low	1	2	11	12	3	5	4	8	7	10	6	9
Social and Cultural Environment	High	1	2	11	12	3	6	4	8	7	10	5	9
	Low	1	2	11	12	3	6	4	8	7	10	5	9
Land Use and Property	High	1	2	11	12	3	5	8	10	6	9	4	7
	Low	1	4	11	12	2	6	2	6	8	10	5	9
Cost	High	1	2	11	12	3	5	4	6	8	10	7	9
	Low	1	10	12	11	3	7	5	9	4	8	2	6

Table 7.45: Summary of Percy Street WB Sensitivity Testing Results

Alternatives for Percy WB		**Alt A2e**	**Alt A5e**	**Alt B9e**	**Alt B9l**	**Alt C6e TWIN**	**Alt C6s TWIN**	**Alt C6l TWIN**	**Alt D6l TWIN**
FACTORS	WEIGHT	96.43	75.49	26.43	24.13	74.15	68.25	66.31	65.73
TAC Weights		1	2	7	8	3	4	5	6
Transportation	High	1	6	8	7	2	5	3	4
	Low	1	2	7	8	3	4	5	6
Social and Cultural Environment	High	1	2	7	8	3	4	5	6
	Low	1	2	7	8	3	4	5	6
Land Use and Property	High	1	2	7	8	3	6	4	5
	Low	1	2	7	8	3	4	5	6
Cost	High	1	2	7	8	3	4	5	6
	Low	1	6	8	7	2	5	3	4

7.6.11 *Bank Street Sensitivity Testing Results*

The sensitivity test results for both Bank Street eastbound and westbound showed that the preferred alternative, Alternative A2e, was not affected by the highest or lowest weight in any factor group by any TAC member. **Table 7.46** and **Table 7.47** tabulate the results of the sensitivity tests for Bank Street eastbound and westbound, respectively.

Table 7.46: Summary of Bank Street EB Sensitivity Testing Results

Alternatives for Bank EB		Alt A2e	Alt A5e	Alt B9e	Alt B9l	Alt C6e	Alt C7e	Alt C6l	Alt C7l	Alt D6l	Alt D7l
FACTORS	WEIGHT	94.48	77.21	25.56	26.36	67.63	59.97	60.87	53.21	63.75	56.09
TAC Weights		1	2	10	9	3	6	5	8	4	7
Transportation	High	1	2	10	9	4	7	5	8	3	6
	Low	1	8	9	10	3	6	2	5	4	7
Social and Cultural Environment	High	1	2	10	9	3	6	5	8	4	7
	Low	1	2	10	9	3	6	5	8	4	7
Land Use and Property	High	1	2	10	9	3	6	5	8	4	7
	Low	1	2	10	9	3	6	5	8	4	7
Cost	High	1	2	9	10	3	5	6	8	4	7
	Low	1	2	10	9	3	6	5	8	4	7

Table 7.47: Summary of Bank Street WB Sensitivity Testing Results

Alternatives for Bank WB		Alt A2e	Alt A5e	Alt B9e	Alt B9l	Alt C6e	Alt C7e	Alt C6l	Alt C7l	Alt D6l	Alt D7l
FACTORS	WEIGHT	95.22	76.10	23.66	24.93	67.75	61.47	64.07	58.27	66.07	60.27
TAC Weights		1	2	10	9	3	6	5	8	4	7
Transportation	High	1	2	10	9	3	6	5	8	4	7
	Low	1	2	10	9	3	5	6	8	4	7
Social and Cultural Environment	High	1	2	10	9	3	6	5	8	4	7
	Low	1	2	10	9	3	6	5	8	4	7
Land Use and Property	High	1	2	10	9	3	6	5	8	4	7
	Low	1	2	10	9	3	6	5	8	4	7
Cost	High	1	2	10	9	3	6	5	8	4	7
	Low	1	2	10	9	3	6	5	8	4	7

7.6.12 *O'Connor Street Sensitivity Testing Results*

The sensitivity test results for both O'Connor Street eastbound and westbound showed that the preferred alternative, Alternative A2e, was not affected by the highest or lowest weight in any factor group by any TAC member. Table **7.48** tabulates the results of the sensitivity tests for O'Connor Street.

Table 7.48: Summary of O'Connor Street Sensitivity Testing Results

Alternatives for O'Connor		Alt A2e	Alt A5e	Alt B9e	Alt B9l	Alt C6e TWIN	Alt C7e	Alt C6l TWIN	Alt C7l	Alt D6l TWIN	Alt D7l
FACTORS	WEIGHT	88.52	75.85	40.15	38.38	52.86	48.36	49.71	45.21	57.74	53.24
TAC Weights		1	2	9	10	5	7	6	8	3	4
Transportation	High	1	2	10	9	6	8	5	7	3	4
	Low	1	2	3	4	6	8	9	10	5	7
Social and Cultural Environment	High	1	2	9	10	5	7	6	8	3	4
	Low	1	2	9	10	5	7	6	8	3	4
Land Use and Property	High	1	2	6	7	5	9	8	10	3	4
	Low	1	2	9	10	5	7	6	8	3	4
Cost	High	1	2	3	5	7	8	9	10	4	6
	Low	1	2	10	9	5	7	6	8	3	4

8 SELECTION OF TECHNICALLY PREFERRED ALTERNATIVE

The Technically Preferred Alternatives (TPA's) identify the preferred rehabilitation or replacement approach at all the bridge sites, taking into account the technical analysis, environmental considerations and comments of all study participants.

The TPA's will be presented to the public and external stakeholders at the second PIC scheduled for 2015.

The analysis and evaluation of alternatives for the future bridge management plan for the rigid frame structures was undertaken considering the performance of alternatives using the Multi-Attribute Trade-off System (MATS) evaluation process. This process characterizes the performance and effects of alternatives considering environmental effects (natural, social and cultural environments), societal transportation performance (safety and delays) and costs (capital and life cycle costs). The MATS process provides a traceable tool for quantifying differences among alternatives and ranking the preference of these options. In this review it tested whether the bridge management approach would include a second major rehabilitation (the first rehabilitations occurred in 1984/85) of the existing rigid frame bridges in approximately 2020 followed by replacement (possibly in the 2050 planning horizon), or replacement (in approximately 2020) as the next cycle of bridge management.

Based on the MATS evaluation, the technical evaluation generally rated the rehabilitation project followed by future replacement as the preferred approach for the bridge management plan for these bridges. However, it was agreed the TESR will document both rehabilitation and replacement approaches and this will allow MTO flexibility in choosing either approach. The decision will be based on continued monitoring of the structural condition, funding availability or provincial priorities, and (as described below) the potential to replace select bridges based on the current availability of staging areas to build replacement bridges. The MATS ranking and evaluation approach was only one tool when making the decision to replace the bridges.

The MATS evaluation and ranking was the initial tool to assess bridge management strategies. As described above it consistently recommended rehabilitating the existing bridges to maximize the useable service lives of the bridges. However, one aspect of the decision-making process not captured by the MATS comparison was the availability of large adjacent staging areas which can be used to build new bridges. If such sites are available it can warrant accelerating the replacement of the bridges.

The implementation aspects of the decision-making process considered the following arguments/reasons to determine whether to accelerate replacement:

1. Would future traffic impacts be greater for the freeway closure?
2. Does this site have a staging area that may not be available in the future?
3. Is there is a common RBR staging area that is feasible to act as a "bridge farm" i.e. to re-use the substructure, etc. to reduce costs of multiple replacements?

In addition, the Evaluation Group considered the following implementation arguments/reasons to confirm whether the rehabilitation strategy should be implemented first and then be followed by a future replacement sequence:

1. It may be possible to achieve another rehabilitation cycle and further postpone the high capital cost of replacement.
2. Other factors such as the 1200mm watermain may not be present at the future decision time. The City of Ottawa may replace this aging infrastructure and remove it as a constraint for the project.
3. A staging area may be available in 30 years (e.g. when the City replaces their large diameter watermain, the site adjacent to Fairmont Avenue may be a candidate).

Based on the decision making process and implementation issues, the Technical Advisory Committee endorsed **Rapid Rehabilitation** as the project to carry forward at Holland Avenue, Parkdale Avenue, Fairmont Avenue, Bayswater Avenue, Bank Street and O'Connor Street. The Technical Advisory Committee endorsed **Rapid Replacement** as the project to carry forward at Parkdale Avenue, Rochester Street, Booth Street, Bronson Avenue and Percy Street. The summary of the evaluation, Technically Preferred Alternative (TPA), and where the TESR will identify a statement of flexibility is illustrated in **Table 8.1**.

Table 8.1: Ottawa Queensway Mid-town Bridges Rigid Frame Bridges Summary of Evaluation Results

Bridge Site	MATS Evaluation Rankings/Scores			TPA (based on MATS rankings and Implementation Considerations)	Statement of Flexibility within TESR for Alternate TPA
	1st	2nd	3rd		
Holland EB	Alt A2e / 95.59	Alt A5e / 80.68	Alt C6e TWIN[29] / 56.34	Rehabilitation (Alt A2e)	Replacement (Alt C6e)
Holland WB	Alt A2e / 94.94	Alt A5e / 76.15	Alt C6e TWIN / 55.43	Rehabilitation (Alt A2e)	Replacement (Alt C6e)
Parkdale EB	Alt A2e / 100.0	Alt A5e / 70.90	Alt B9e / 12.94	Rehabilitation (Alt A2e)	
Parkdale WB	Alt A2e /	Alt A5e /	Alt B9e /	Rehabilitation	

[29] "TWIN" references that a common staging area on the north side of the Queensway is to be used for both eastbound and westbound structure replacements. Therefore, both eastbound and westbound structures must be completed on the same weekend.

	100.0	70.15	13.35	(Alt A2e)	
Fairmont EB	Alt A2e / 100.0	Alt A5e / 72.70	Alt B9e / 15.39	Rehabilitation (Alt A2e)	
Fairmont WB	Alt A2e / 100.0	Alt A5e / 71.42	Alt B9e / 12.35	Rehabilitation (Alt A2e)	
Bayswater EB	Alt A2e / 100.0	Alt A5e / 65.83	Alt B9e / 17.11	Rehabilitation (Alt A2e)	
Bayswater WB	Alt A2e / 100.0	Alt A5e / 65.83	Alt B9e / 17.52	Rehabilitation (Alt A2e)	
Preston EB	Alt A2e / 94.99	Alt A5e / 74.89	Alt C6e / 61.52	Rapid Replacement (Alt C6e)	Rehabilitation (Alt A2e)
Preston WB	Alt A2e / 95.84	Alt A5e / 74.32	Alt C6e / 64.94	Rapid Replacement (Alt C6e)	Rehabilitation (Alt A2e)
Rochester EB	Alt A2e / 94.92	Alt A5e / 80.08	Alt C6e / 59.90	Rapid Replacement (Alt C6e)	Rehabilitation (Alt A2e)
Rochester WB	Alt A2e / 94.92	Alt A5e / 79.25	Alt C7e / 56.40	Rapid Replacement (Alt C6e)	Rehabilitation (Alt A2e)
Booth EB	Alt A2e / 94.94	Alt A5e / 74.86	Alt C6e / 63.71	Rapid Replacement (Alt C6e)	Rehabilitation (Alt A2e)
Booth WB	Alt A2e / 94.35	Alt A5e / 75.07	Alt D6l / 61.42	Rapid Replacement (Alt C6e)	Rehabilitation (Alt A2e)
Bronson EB	Alt A2e / 95.98	Alt A5e / 80.77	Alt C6e TWIN / 61.25	Rapid Replacement (Alt C6e)	Rehabilitation (Alt A2e)
Bronson WB	Alt A2e / 95.98	Alt A5e / 80.77	Alt C6e TWIN / 61.25	Rapid Replacement (Alt C6e)	Rehabilitation (Alt A2e)
Percy EB	Alt A2e / 96.67	Alt A5e / 73.84	Alt C6e TWIN / 73.15	Rapid Replacement (Alt C6e)	Rehabilitation (Alt A2e)
Percy WB	Alt A2e / 96.43	Alt A5e / 75.49	Alt C6e TWIN / 74.15	Rapid Replacement (Alt C6e)	Rehabilitation (Alt A2e)
Bank EB	Alt A2e / 94.48	Alt A5e / 77.21	Alt C6e / 67.63	Rehabilitation (Alt A2e)	Rapid Replacement (Alt C6e)
Bank WB	Alt A2e / 94.67	Alt A5e / 77.48	Alt C6e / 69.42	Rehabilitation (Alt A2e)	Rapid Replacement (Alt C6e)
O'Connor	Alt A2e /	Alt A5e /	Alt D6l TWIN	Rehabilitation	Rapid

	88.52	75.85	57.74	(Alt A2e)	Replacement (Alt C6e)

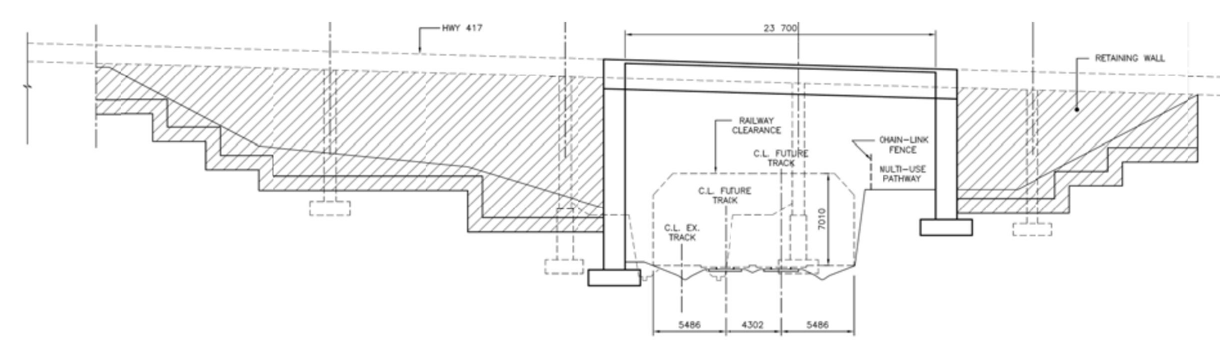
CPR/Ottawa O-Train Structure Recommendations

The CPR/O-Train Structure considered only replacement alternatives. The range of alternatives considered rigid frame bridges constructed below the existing bridge, and rapid replacement bridges using a jack and slide technology. The alternatives considered changes to the Multi-use Path with alternatives that maintained the path and those that relocated the path. The technical evaluation ranked the single span jack and slide alternative as the preferred alternative. The more open structure that provided superior safety and security for active modes of travel, and maintaining the path on the existing alignment, were attributes that led to this option rating highest. The ranking and ratings of the alternatives are summarized in **Table 8.2**.

Table 8.2: CPR/Ottawa O-Train Summary of Evaluation Results

Bridge Site	**MATS Evaluation Rankings/Scores**			**TPA (based on MATS rankings and Implementation Considerations)**
	1st	**2nd**	**3rd**	
CPR O-Train	Alt H6e / 91.66	Alt C2e / 84.92	Alt F2e / 84.83	Single Span Jack and Slide Replacement (Alternative H6e)

The TPA for the CPR/O-Train site is illustrated below:



Technically Preferred CPR/O-Train Replacement Alternative – Single Span Jack and Slice (maintaining Multi-use Trail on existing alignment)

APPENDIX A: Assessment of the Alternatives to the Undertaking

BYTOWN ENGINEERING

ASSESSMENT OF THE
ALTERNATIVES TO THE UNDERTAKING

Preliminary Design and Environmental Assessment Study for the Rehabilitation / Replacement of Ottawa Queensway Mid-town Bridges from Holland Avenue to O'Connor Street

G.W.P. 4075-11-00

Agreement # 4011-E-0025

MH Project # 1124127-00

Presented to:

Ministry of Transportation
1355 John Counter Boulevard
Postal Bag 4000
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Project No. 1124127.00 October 2, 2013

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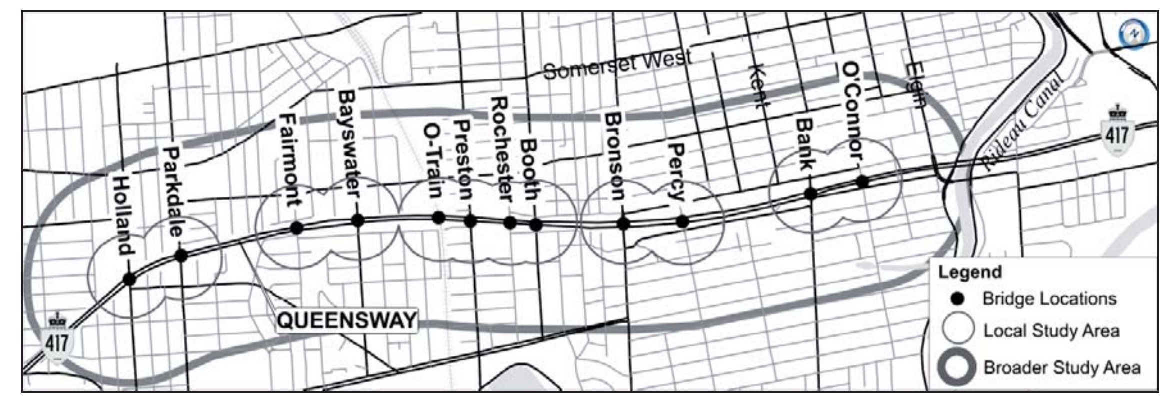
1. INTRODUCTION

The Ontario Ministry of Transportation (MTO) has retained Morrison Hershfield Ltd. (MH) to undertake a preliminary design and environmental assessment study for the rehabilitation and / or replacement of twenty-three bridges (twelve locations) on Highway 417 (Ottawa Queensway) from Holland Avenue to O'Connor Street, in the City of Ottawa. This study will determine the appropriate strategy for the rehabilitation or replacement of the bridges. The Study Area, as shown in **Figure 1**, is located in the City of Ottawa.

Several alternatives will be reviewed for each bridge including structural and construction staging options in order to minimize disruption to Highway 417. In addition, engineering, environmental, and property requirements will be established, along with the identification of mitigation measures to reduce or negate short and long term residual effects.

Figure 1 - Study Area



2. BACKGROUND

The context for the overall network "planning" for the Queensway corridor was previously reviewed and defined as part of an Environmental Assessment (EA) Study completed in 2007. That study concluded that there would be no expansion (widening) within the study area being considered as part of this current EA. The 2007 EA study completed the "planning" phase of the Queensway corridor plan. Subsequent post-2007 studies are being undertaken to consider "preliminary design projects". This current study is a preliminary design study that focuses on 23 bridges in the Study area. Other post-2007 projects are also being implemented that focus on ramp operational improvements and bridge replacements (the Kent Street bridge).

2.1 Purpose of the Report

The purpose of this report is to document the analysis and evaluation of Alternatives to the Undertaking (Alternative Planning Solutions) for this preliminary design project that will be carried forward to address the problem of aging bridge infrastructure.

2.2 Scope

This project will identify a bridge management strategy to address the structural needs of the Queensway Mid-town bridges. These overpass bridges include:

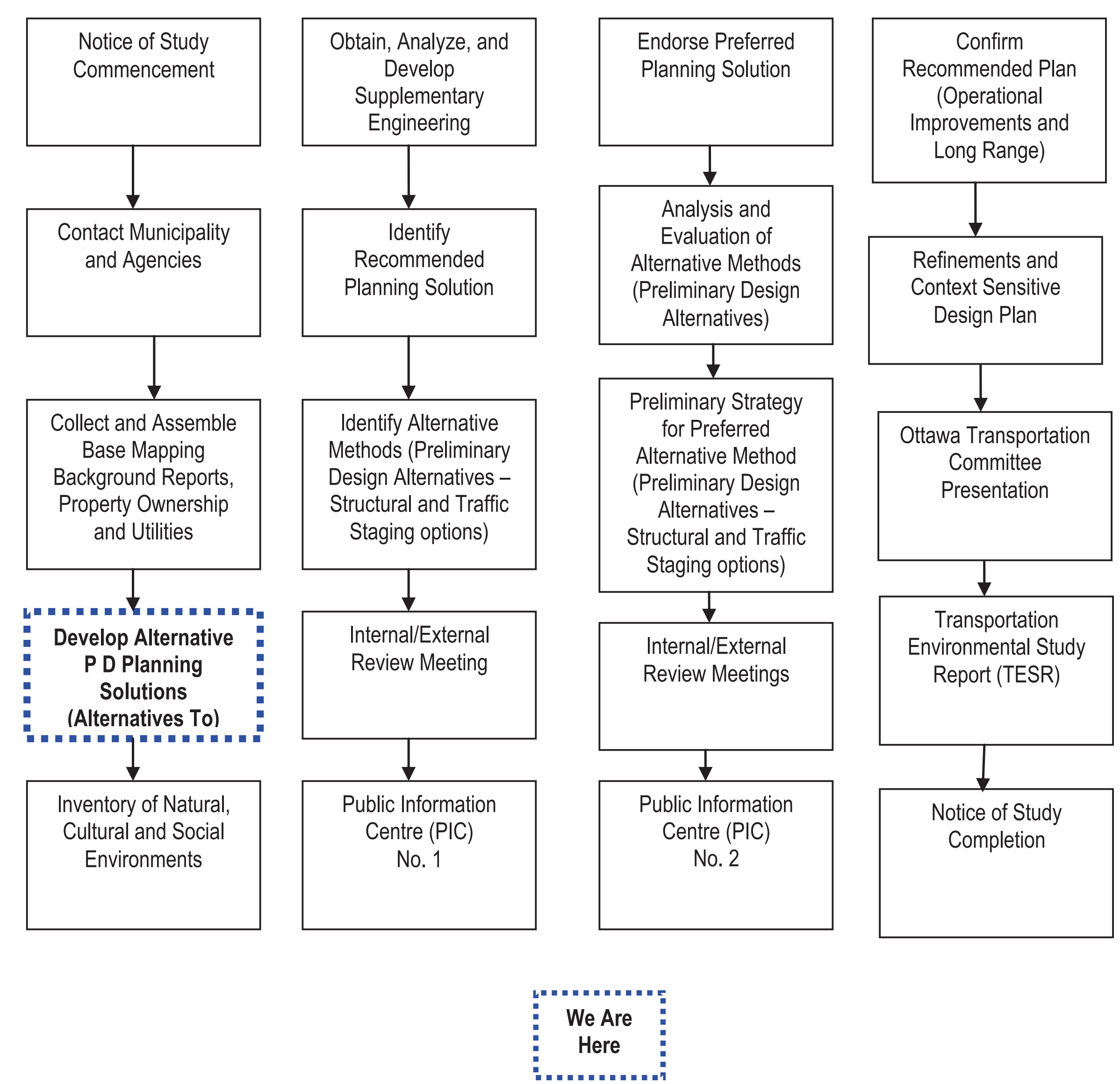
- Site No. 3-050.1 - Highway 417 EBL over Holland Avenue
- Site No. 3-050.2 - Highway 417 WBL over Holland Avenue
- Site No. 3-051.1 - Highway 417 EBL over Parkdale Avenue
- Site No. 3-051.2 - Highway 417 WBL over Parkdale Avenue
- Site No. 3-052.1 - Highway 417 EBL over Fairmont Avenue
- Site No. 3-052.2 - Highway 417 WBL over Fairmont Avenue
- Site No. 3-053.1 - Highway 417 EBL over Bayswater Avenue
- Site No. 3-053.2 - Highway 417 WBL over Bayswater Avenue
- Site No. 3-054.1 - Highway 417 EBL over O-Train/CPR
- Site No. 3-054.2 - Highway 417 WBL over O-Train/CPR
- Site No. 3-055.1 - Highway 417 EBL over Preston Street
- Site No. 3-055.2 - Highway 417 WBL over Preston Street
- Site No. 3-056.1 - Highway 417 EBL over Rochester Street
- Site No. 3-056.2 - Highway 417 WBL over Rochester Street
- Site No. 3-057.1 - Highway 417 EBL over Booth Street
- Site No. 3-057.2 - Highway 417 WBL over Booth Street
- Site No. 3-060.1 - Highway 417 EBL over Bronson Avenue
- Site No. 3-060.2 - Highway 417 WBL over Bronson Avenue
- Site No. 3-061.1 - Highway 417 EBL over Percy Street
- Site No. 3-061.2 - Highway 417 WBL over Percy Street
- Site No. 3-063.1 - Highway 417 EBL over Bank Street

- Site No. 3-063.2 - Highway 417 WBL over Bank Street
- Site No. 3-064 - Highway 417 WBL and EBL over O'Connor Street

This assignment is following the Class Environmental Assessment process for Group B projects under MTO's Class Environmental Assessment for Provincial Transportation Facilities, 2000. At the completion of this study, a Transportation Environmental Study Report will be prepared and published for public review.

The assessment of the Alternatives to the Undertaking is a mandatory requirement of the Class EA and is completed early in the preliminary design process, as shown in **Figure 2**.

Figure 2 - Generalized Preliminary Design (PD) Planning Process



3. PROBLEM / OPPORTUNITY STATEMENT

The 23 Ottawa Queensway Mid-town bridges reflect two overpass bridge types from the original Queensway construction during the 1959 to 1968 period. The City of Ottawa's O-Train line is operated by OC-Transpo/Capital Rail. The Queensway CPR/O-Train bridge is a beam type structure and the remaining 22 bridges are rigid frame type bridges which are jointless and continuous from the deck to the footings, making them a more durable bridge type. An overall study is required to determine the most feasible rehabilitation / replacement strategy with emphasis on the CPR/O-Train bridge. The CPR/O-Train bridge is nearing the end of its service life and the plan for this bridge may influence or govern the traffic staging plan for the adjacent rehabilitation or replacement of the rigid frame bridges. In this way all 23 bridges have a possible common traffic staging component.

Based on the engineering assessments completed to date, the Problem / Opportunity Statement for this study is as follows:

- This project's goal is to establish a bridge management plan for 23 bridges on the Ottawa Queensway east and west of the CPR/O-Train bridge with consideration of traffic staging options & impacts.
- The CPR/O-Train bridge is nearing the end of its service life and is also in need of design upgrades (seismic).
- Replacement or rehabilitation of the adjacent rigid frame bridges to the east and west - which also require work - may be staged to coincide with the O-Train improvements which may dictate the overall traffic staging strategy.

4. ALTERNATIVES TO THE UNDERTAKING

Alternatives to the Undertaking represent alternative ways or methods of addressing the Problem / Opportunity Statement. These reflect different strategies and include the "Do Nothing" approach (maintaining the status quo but not addressing the Problem / Opportunity Statement).

Following the assessment of Alternatives to the Undertaking, those alternatives judged to address the Problem / Opportunity Statement will be carried forward and will form the Recommended Planning Solution or "Transportation Undertaking". The selected "Transportation Undertaking" will be deemed to address the problem statement required to plan for the safety of the travelling public on these bridges and provide a cost effective bridge management plan, while providing the best overall balance between the structural and transportation engineering objectives, life cycle costs, and other environmental, cultural, socio-economic, and land use planning objectives.

In developing "Preliminary Design" Alternative Planning Solutions (Alternatives to the Undertaking), a number of general principles and objectives are being considered including:

- Satisfy existing code requirements of the bridges;
- Provide for the efficient movement of people and goods during the staging of the projects by minimizing or avoiding long term multi-lane closures on the Queensway;
- Ensure the safety of the travelling public;
- Ensure the technical feasibility of construction, operation and maintenance;
- Minimize the environmental impacts and the use of non-renewable natural resources such as aggregates;
- Minimize the number of disruptions to the travelling public by grouping of projects together in order that they occur in the same time period; and
- Consider the linkage of the communities divided by the Queensway and context sensitive design solutions that may improve the aesthetics of these bridges as viewed from the streets and avenues.

The "Preliminary Design" Alternative Planning Solutions take into consideration the location, type and number of project sites. It should be noted that the assessment of broader transportation strategies, such as mass transit initiatives or other transportation modes, are more appropriately considered for larger network links in the overall provincial transportation system and were considered in the 2007 EA study. They are not considered applicable for a bridge management plan such as this study.

The following reasonable Preliminary Design Alternatives to the Undertaking were identified:

1. Alternative 1: The "Do Nothing" Alternative maintains the status quo of the existing bridges with no significant actions taken to manage aging infrastructure. This approach would accept further deterioration within the 20 year planning horizon.
2. Alternative 2: Rehabilitate the existing bridges to extend their service lives including structural upgrades to meet existing seismic code requirements.
3. Alternative 3: Replace the existing bridges.

Other Alternative Planning Solutions such as New Provincial-level Infrastructure were not considered as they do not address the site specific Problem / Opportunity Statement of this project regarding the structural needs of the 23 existing bridges.

The identified opportunities for enhanced safety and aesthetics through context sensitive design are important aspects of the project that will be considered as part of the criteria used for the evaluation of the above Alternatives to the Undertaking and through the subsequent evaluation of Alternative Methods (or Preliminary Design Alternatives). Similarly the opportunity to maintain / improve personal safety and security for users of the multi-use pathway along the O-Train corridor at Highway 417 will be considered as part of the evaluation of the above Alternative Planning Solutions and through the subsequent evaluation of Alternative Methods.

5. EVALUATION OF ALTERNATIVES TO THE UNDERTAKING

The analysis and evaluation of Alternative Planning Solutions (Alternatives to the Undertaking) is a critical requirement of the Environmental Assessment process.

A qualitative evaluation process was utilized for the assessment of Alternatives to the Undertaking, as the number of alternatives and evaluation criteria were limited. The alternatives were assessed using the following evaluation factors:

- **SAFETY:** How well does the strategy protect the travelling public by ensuring adequate structural capacity and by meeting current seismic requirements for earthquake events?
- **DURABILITY** How does this strategy provide a durable structure to inhibit deterioration of the bridges for the next cycle of repairs / rehabilitation?
- **CONSTRUCTABILITY** Is this strategy constructible in the Queensway corridor?
- **TRANSPORTATION SERVICE**: How well does the planning solution manage existing infrastructure to maintain the transportation system and accommodate local pedestrian, cyclist, vehicle and transit trips currently travelling under these bridges?
- **ENVIRONMENTAL**: How does the solution affect the natural, cultural, and social environments including the potential for context sensitive design?
- **COST**: What are the financial implications of the solution?

The description and assessment of the Alternatives to the Undertaking (Alternative Planning Solutions) are summarized in **Table 1 - Description of Alternatives to the Undertaking.**

Table 1 - Description and Assessment of Alternatives to the Undertaking

Alternative 1 - The "Do Nothing" Alternative	Alternative 2 - Rehabilitate Overpass Bridges	Alternative 3 - Replace Overpass Bridges
• Alternative 1: The "Do Nothing" Alternative maintains the status quo of existing bridge infrastructure with no significant actions taken to manage aging infrastructure. This approach would accept further deterioration within the 20 year planning horizon.	• Alternative 2: Rehabilitate the existing bridges to extend their service lives including structural upgrades to meet existing seismic code requirements.	• Alternative 3: Replace the existing bridges.
	STRUCTURAL	
• Existing design does not meet current code requirements	• CPR/O-Train bridge to include seismic retrofit • Rigid frames to include replacement of barrier walls, approach slabs, removal of pavement and waterproofing and concrete overlay and deck repairs to deteriorated areas of deck (assumed to be 10 %); soffit repairs and frame leg repairs.	• The replacement approach will meets current code requirements
	DURABILITY	
• Does not address the deterioration of existing structures and will accelerate deterioration of structure	• Will extend the service lives of bridges. The CPR/O-Train bridge requires extensive repairs to extend its service life.	• Will extend the service life of each bridge and provide a 75 year service life
	CONSTRUCTIBILITY	
• Construction risk / uncertainty associated with emergency repairs	• Moderate constructability requirements to stage construction	• Moderate constructability requirements to stage construction
	TRANSPORTATION	
• This approach will not maintain the existing road network without continued ongoing repairs to the existing bridges. As the bridges reach the end of their service lives the risk of failure and lane closures will increase.	• This approach will manage the infrastructure asset. • Limited potential for enhancement of pedestrian / cycling safety and facilities at rigid frames bridges – with higher potential at CPR/O-Train bridge.	• This approach will manage the infrastructure asset. • Higher potential for enhancement of pedestrian / cycling safety and facilities.
	ENVIRONMENTAL	
• No significant negative or positive effects • Context sensitive design elements could be undertaken.	• Minimal environmental effects within existing Highway 417 right-of-way • Temporary disruption to local streets / avenues and Highway 417 traffic. • Potential for positive environmental effects to community through context sensitive design.	• Minimal environmental effects within existing Highway 417 right-of-way • Temporary disruption to local streets / avenues and Highway 417 traffic. • Potential for positive environmental effects to community through context sensitive design.
	COST	
Magnitude of Cost (Capital Cost of Project) (Note: All costs are based on a single EB or WB structure.)	**Magnitude of Capital Cost:** **$1.4 to $2.6 Million per site (for rigid frames)** **$7.4 Million (for CPR/O-Train)**	**Magnitude of Capital Cost:** **$5.5 Million per site (rigid frames) conventional replacement** **$7.7 to 11.5 Million (rigid frames) for Rapid Replacement** **$9.64 to $11.62 (for O-Train) conventional replacement** **$10.6 – $11.4 (for O-Train) rapid jack and slide technology**

Magnitude of Cost (Net Present Value including future rehabilitations and replacements): The Rigid frame LCC analysis has identified the two bridges with highest and lowest replacement costs (Holland and Rochester). All other sites will fall between the ranges of these two bridges. The net present value of the Holland Avenue site (highest cost location) is shown. NPV for Rehabilitation now is $4.5 M; NPV for replacement conventionally now is NPV $5.7 M, and NPV for replacement now using RBR is $7.9 to 11.7 M. (All costs are based on a single EB or WB structure.)	**Magnitude of Net Present Value Cost:** **$ 4.5 Million per site (rigid frames)** **$10.1 Million (for CPR/O-Train)**	**Magnitude of Net Present Value Cost:** **$5.7 Million per site (rigid frames) conventional replacement** **$7.9 to 11.7 Million per site (rigid frames) for Rapid Replacement** $**9.8 – 11.9m Million (for CPR/O-Train) conventional replacement** **$10.9 to 11.8 Million (for CPR/O-Train) rapid jack ad slide technology**
Based on the significance of maintaining the provincial road network it is recommended that the "Do Nothing" approach **not be carried forward**.	**Rigid Frame Bridges:** Based on the condition assessments of the existing rigid frame bridges there is additional service life available in these bridges and this is a cost effective approach for the next bridge management cycle. Therefore **rehabilitation of the rigid frame bridges is recommended to be carried forward.** **CPR/O-Train Bridge:** Based on the poor condition of the existing bridge and the significant cost of seismic upgrades required for this bridge type, rehabilitation is **not recommended** to be carried forward.	**Rigid Frame Bridges:**Iit is recommended that the new bridge replacement options **be carried forward for comparison with the rehabilitation alternatives**. **CPR/O-Train Bridge:** Based on the poor condition of the existing bridge and the significant cost of seismic upgrades required for this bridge type, replacement alternatives **are recommended to be carried forward**.

6. SUMMARY AND PRELIMINARY RECOMMENDATIONS

Rigid Frame Bridges:

To address the immediate needs of the Ottawa Queensway mid-town bridges, it is recommended that the rigid frame bridge structures be rehabilitated or replaced and that the methods of staging the construction be considered in order to select the most preferred approach that can minimize community disruption and costs during these works. The range of environmental effects associated with staging these improvements (within the 20 year planning horizon) will be assessed. Context sensitive design features can be included.

CPR/O-Train Bridge:

Based on the structural investigation, the existing multi-span bridge overpass of the CPR/O-Train and City of Ottawa multi-use pathway will require significant capital investment to repair the deterioration to the bridge and upgrade the structural capacity for current seismic loading. In addition, because the spans currently required for the O-Train and multi-use pathway are significantly less than the span of the existing bridge, it will be more cost effective to replace the bridge rather than repair it. Therefore the replacement strategy is recommended to be carried forward and alternative methods investigated. Context sensitive design features can be included.

Context Sensitive Design Treatments

The inclusion of context sensitive design treatments, that can improve the aesthetics of each bridge site, is recommended to be considered further as part of the Assessment of Alternative Methods. These elements need to be assessed at each potential location with community input to define site specific landscaping, lighting and aesthetic elements that can be coordinated with the proposed bridge projects.

Table 2 presents the results of the preliminary evaluation of Alternatives to the Undertaking.

The preliminary assessment of Alternatives to the Undertaking will be presented at Public Information Centre No. 1 to solicit public input. The Recommended Undertaking may be modified, based on public input following the PIC.

Table 2 - Summary of the Assessment of Alternatives to the Undertaking

Alternative 1 - The "Do Nothing" Alternative	Alternative 2	Alternative 3
The "Do Nothing" Alternative maintains the status quo of existing bridge infrastructure with no significant actions taken to manage aging infrastructure. This approach would accept further deterioration within the 20 year planning horizon.	Alternative 2 -Rehabilitate Overpass Bridges	Alternative 3 - Replace Overpass Bridges
X	✓	✓
DO NOT CARRY FORWARD	CARRY FORWARD (Rigid Frame Bridges)	CARRY FORWARD (CPR/O-Train Bridge and Rigid Frame Bridges)

APPENDIX B: Evaluation Methodology Report

BYTOWN
ENGINEERING

ANALYSIS AND EVALUATION METHODOLOGY REPORT

Preliminary Design and Environmental Assessment Study for the Rehabilitation / Replacement of Ottawa Queensway Mid-town Bridges from Holland Avenue to O'Connor Street

G.W.P. 4075-11-00

Agreement # 4011-E-0025

BTE Project # 2013-001

Presented to:

Ministry of Transportation
1355 John Counter Boulevard
Postal Bag 4000
Kingston, ON
K7L 5A3

Project No. 2013-001 July 2014

Z:\BTE PROJECTS\2013 PROJECTS\BTE13-001 - MTO 23 BRIDGES QUEENSWAY\013-ANALYSIS AND EVALUATION\ANALYSIS AND EVALUATION REPORTS\APP B - METHODOLOGY REPORT\13-001 ANALYSIS AND EVALUATION METHODOLOGY JULY 2014 VER5.DOCX

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EXECUTIVE SUMMARY

A Group B Environmental Assessment (EA) is being carried out by the Ministry of Transportation, under their Class Environmental Assessment for Provincial Transportation Facilities (July 2000), to confirm/validate the extent of current and future bridge management needs in the Study Area extending from Holland Avenue easterly to O'Connor Street, in the City of Ottawa.

The analysis and evaluation process is a requirement of the EA process. The Ministry of the Environment's (MOE's) review of Evaluation Methods in Environmental Assessment provided the framework for the evaluation process.

This document describes the qualitative and the quantitative methods of evaluation and which approaches will be utilized for different groups of alternatives. An evaluation method may be defined as a formal procedure for establishing an order of preference among alternatives. Evaluation methods in EAs provide a framework to organize and use predictions of impacts and public views from the public consultation process.

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GLOSSARY OF TERMS

AASHTO	American Association of State and Highway Transportation Officials
Adjacent	Adjacent indicates lying near MTO or Municipal roadway rights-of-way, although not necessarily contiguous to them.
Aesthetics	Methods of providing visual relief and appealing characteristics to planned noise barriers thorough the application of landscaping designs.
Alternative	Well-defined and distinct course of action that fulfills a given set of requirements. The EA Act distinguishes between Alternatives to the Undertaking and Alternative Methods of Carrying out the Undertaking.
Coarse Screening	Initial screening of a group of alternatives. Also see Screening.
Criterion(a)	Explicit feature or consideration used for comparison of alternatives.
Dichotomous Utility Function	A utility function that represents a desirable or undesirable response from a criterion (yes/no, present/absent, true/false).
Dimensionless Number	A number that does not have a unit of measurement, such as length (m), time (s), mass (kg) associated with it. Examples include Utility Score and Overall Score.
Do Nothing Alternative	This alternative is a mandatory requirement of the Class EA. This option is the null or no action alternative and it becomes the baseline to which all alternatives are compared.
Double Counting	Unintentional accounting for a particular factor or attribute more than once in the evaluation.
EA	Environmental Assessment
Evaluation	The outcome of a process that appraises the advantages and disadvantages of alternatives.
Evaluation Criteria	See Criteria.

Evaluation Process	The process involving the identification of criteria, rating of predicted impacts, assignment of weights to criteria, aggregation of weights, and rating to produce an ordering of preference of alternatives.
Factor	See Global Factors.
Freeway	Freeway is defined as an existing completed, partially developed (staged) or proposed divided highway with full control of access and grade separated intersections. This definition may include some highways that are not officially designated as freeways.
Function Form	See Utility Function
Global Factors	The main categories of factors, (i.e. Transportation, Economic Environment, Natural Environment, Social and Cultural, Land Use and Property and Cost). All sub-factors are components or a subset of global factors.
Jack and Slide	An accelerated bridge method which laterally moves a replacement bridge in place from an adjacent staging area.
Linear Utility Function	A function that can be defined using a linear equation of the form: $y = a + bx$, where y is the dependent variable (raw score) x is the independent variable (measurement) b is the slope of the function, and a is the y intercept, normalized in this study to be equal to one or zero
MAC	Municipal Advisory Committee
Matrix	A rectangular array of criteria and values.
Mitigation	Taking actions that either remove or alleviate to some degree the negative impacts associated with the implementation of alternatives.
Overall Score	The final value of an alternative's score derived by summing all of the weighted scores.

PAC	Public Advisory Committee
Performance Factor	See Utility Function
PIC	Public Information Centre
Ranking	The ordering of alternatives from first to last for comparison purposes.
Raw Data	The measurement of the impact, or measured data, under each criterion.
Risk	Probability that a given outcome will or will not materialize. Distinct from uncertainty in that the alternative outcomes are known or defined and that the probability of each is measureable.
Screening	Process of eliminating alternatives from further consideration, which do not meet minimum conditions or categorical requirements.
Self Propelled Mobile Transporters (SPMTs)	Mobile heavy lift transporters capable of lifting and transporting pre-assembled bridges or bridge superstructures from staging areas to the bridge site.
Semi Integral abutments	A bridge superstructure design that removes the use of expansion joints for a simply supported bridge deck.
Step Function	A utility function can be defined by several linear functions within separate ranges that have a slope equal to zero. For this study, two step functions are used: Case A: y = 1, for x = desirable and y = 0, for x = undesirable Case B: y = 1 for x = desirable, y = 0.5 for x = medium performance and y = o for x = undesirable
Sub-factor	A single criterion used for the evaluation. Each sub-factor is grouped under one of the factors.
TAC	Technical Advisory Committee
TPA	Technically Preferred Alternative
Traceability	Characteristic of an evaluation process which enables its development and implementation to be followed with ease.

Transportation Environmental Study Report (TESR)	This report is prepared in compliance with the EA Act requirements and the Ministry of the Environment for acceptance, approval, informational or monitoring purposes and the public record.
Utility Function	A function (linear, step, dichotomous) that represents the Utility Score versus the criterion measurement or desirableness.
Utility Score	The “y” value derived from the Utility Function of the measurement of the impact induced by a particular alternative’s criterion. A measurement of the usefulness or attractiveness of an alternative with respect to an individual evaluation criterion based on its measured effect (a number between 0 and 1). The utility score is dimensionless.
Weight	The importance attributed to a criterion relative to other criterion. The value of the weight is expressed in a percentage and the sum of all criterion weights is equal to 100%.
Weighted Additive Method	The method used in the quantitative evaluation of alternatives, which reduces the project’s numerous criteria into a dimensionless number for each alternative suitable for comparison.
Weighted Score	A raw score that has been multiplied by the criterion weights. The weighted scores reflect the social value or importance of the specific group providing weights.

1 INTRODUCTION

The analysis and evaluation process is a requirement of the Environmental Assessment (EA) Process. The Ministry of the Environment's (MOE's) review of Evaluation Methods in Environmental Assessment provides the framework for the evaluation process.

This document describes the qualitative versus the quantitative methods of evaluation and which approaches will be utilized for different groups of alternatives for this study. An evaluation method may be defined as a formal procedure for establishing an order of preference among alternatives[1]. The purpose of an evaluation method is to clarify and articulate environmental preferences and translate them into preferences among alternative undertakings. The use of a formal evaluation method has two main advantages: it provides a better basis for decision-making than would otherwise exist and it results in reasons for decisions that, on examination, can be traced.

The selection of an evaluation method should consider:

- Various methods have different capabilities which make possible different planning processes that may be better suited to a particular project or stage of the EA.
- With any particular planning process, all the steps (such as identifying alternatives, selecting criteria, consulting and involving interested parties, as well as evaluating) must be reasonable and provide a systematic assessment of the net effects of the project.

The selection of the appropriate evaluation methodology depends upon:

- Complexity of the decision-making;
- The number of alternatives;
- The number of criteria; and,
- The sensitivity of the decision.

These issues are described in the succeeding sections and explain the rationale for utilizing the most appropriate evaluation methodology in each stage of the EA study.

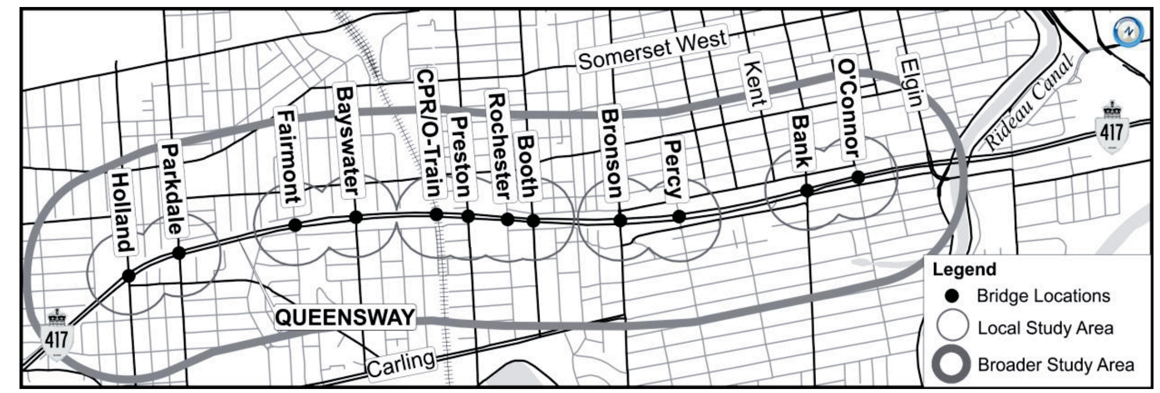
2 STUDY AREA

The Ontario Ministry of Transportation (MTO) has retained Morrison Hershfield Ltd. (MH) to undertake a preliminary design and environmental assessment study for the rehabilitation and / or replacement of twenty-three bridges (twelve locations) on Highway 417 (Ottawa Queensway) from Holland Avenue to O'Connor Street, in the City of Ottawa. This study will determine the appropriate strategy for the rehabilitation or replacement of the bridges. The Study Area, as shown in **Figure 2.1**, is located in the City of Ottawa.

[1] Evaluation Methods in Environmental Assessment, Ministry of Environment, 1990.

Several alternatives will be reviewed for each bridge including structural, construction staging and active modes of transportation (pedestrian/cycling) at the CPR/O-Train bridge in order to minimize disruption to Highway 417. In addition, engineering, environmental, and property requirements will be established, along with the identification of mitigation measures to reduce or negate short and long term residual effects.

Figure 2.1: Study Area



3 PUBLIC PARTICIPATION

Public participation is a key component to the success of this project. Early public involvement is encouraged to establish a sound understanding of the public's concerns and views, to identify areas of concern and major study issues; and to promote a working relationship with the public that is amicable and co-operative rather than adversarial.

3.1 Public, Property Owner, and Stakeholder Consultation

The public will be engaged through the use of a study web site (Queenswaymidtownbridges.com), Public Information Centre (PIC) meetings and one-on-one meetings with directly affected property owners. This includes meetings and consultation with Business Improvement Areas (BIAs) who have an interest in providing comments on the context sensitive designs at each of the bridges.

3.2 Municipal Advisory Committee (MAC)

Consultation with a Municipal Advisory Committee (MAC) is an on-going task during the project. The City of Ottawa and National Capital Commission will provide feedback to the Technical Advisory Committee (TAC) on issues concerning the general public, municipal and federal interests.

3.3 Public Information Centre (PIC) No. 1

The purpose of the initial PIC is to present background information, inventories, a preliminary list of evaluation factors and a long list of Preliminary Design Alternatives.

3.4 Public Information Centre (PIC) No. 2

The second PIC will be to present the Technically Preferred Alternative (TPA) for each bridge site and respond to questions and concerns from the public.

4 QUALITATIVE EVALUATION METHODOLOGY

A qualitative evaluation method involves describing impacts in narrative terms, or through qualitative measures, without the explicit specification of criteria, ratings or weights. This method, often termed "professional judgment" is widely used in EA's to assess 'alternatives to' the undertaking. For example, an EA involving the selection of a corridor might evaluate alternative routes in considerable detail using a formal quantitative evaluation, but the evaluation of 'alternatives to' might be done using a qualitative approach; no specific measureable criteria are identified and systematically applied to all alternatives, and the dismissal of alternatives is done using a narrative approach. See **Table 4.1** for an example of the qualitative evaluation approach.

A disadvantage of the qualitative approach is the difficulty in recognizing when a comparison will have intuitive choice or universal support (public), i.e. a simple decision easily accepted. A qualitative approach may also be less defensible or subject to criticism. Risk management is an important issue and should the public or stakeholders question these early decisions, additional information may be required to substantiate or detail the rationale for the early decisions. When alternatives are not systematically compared against a specified set of criteria, it may be difficult to follow how the decision was made and what evidence supports it.

Some advantages of using a qualitative approach over a quantitative approach include: reduced cost, reduced time, and ease of presentation to the public. A qualitative approach is predominantly used to evaluate alternatives where there is a clear conclusion and low public scrutiny.

The use of a qualitative approach is best suited where there are few alternatives, and few criteria where there are measureable and meaningful differences between options being considered.

Table 4.1: Sample Qualitative Evaluation

Alt. No.	Safety	Operations/ Capacity
1	• Turn movement must occur from shared left turn/through lane. This arrangement exhibits a higher incidence of collisions compared to the provision of separate lanes. **RATING:** ✘	• Capacity of two ramp terminals reduced because of shared use of lane. The north ramp terminal most problematic because of significant NBLT volume. **RATING:** ✘
2	• Turn movement occurs from separate left turn lane. • Median treatment prevents left turn movements to/from Old Densmore Road. **RATING:** ✓	• Increased capacity of two ramp terminals because of dedicated lanes. • Retains standard lane widths. **RATING:** ✓
3	• Turn movement occurs from separate left turn lane. • Median treatment south of south ramp terminal prevents left turn movements to/from Old Densmore Road. • The narrow lane widths are below the 3.5 m standard. These are considered a long-term safety concern as this area functions as a transition zone from a high speed rural area (north) to a lower speed urban area (south). **RATING:** ✓	• Increased capacity of two ramp terminals because of dedicated lanes. • Implementation of a fifth lane across structure requires reduction in lane widths (3.0 m lanes provided). Narrower lanes have lower capacities. **RATING:** -

✓ Good in Comparison - Fair in Comparison ✘ Poor in Comparison Preferred Alternative

Where there are few criteria, such as in **Table 4.1**, it is generally acceptable to use a qualitative analysis because the trade-offs are clear and understandable. The more rigorous definition of the attributes of each alternative, as would be possible using a quantitative approach, is not required because there are too few variables. This approach will be used to assess Alternatives to the Undertaking and Coarse Screening of the initial long list of preliminary design alternatives.

The use of a more comprehensive evaluation technique becomes necessary as the complexity increases (i.e. number of alternatives and number of criteria). In these situations, as described in Section 5, this project will utilize a quantitative approach.

5 QUANTITATIVE EVALUATION METHOD

Key principles of the EA Act and MOE's Guidelines on Environmental Assessment Planning and Approval are that there be accountability and traceability. A quantitative evaluation method allows both of these key principles to be maintained. A quantitative method based on the simple "Weighted Additive Method" will be used for this study and is referred to as the "Multi-Attribute Trade-off System" (MATS).

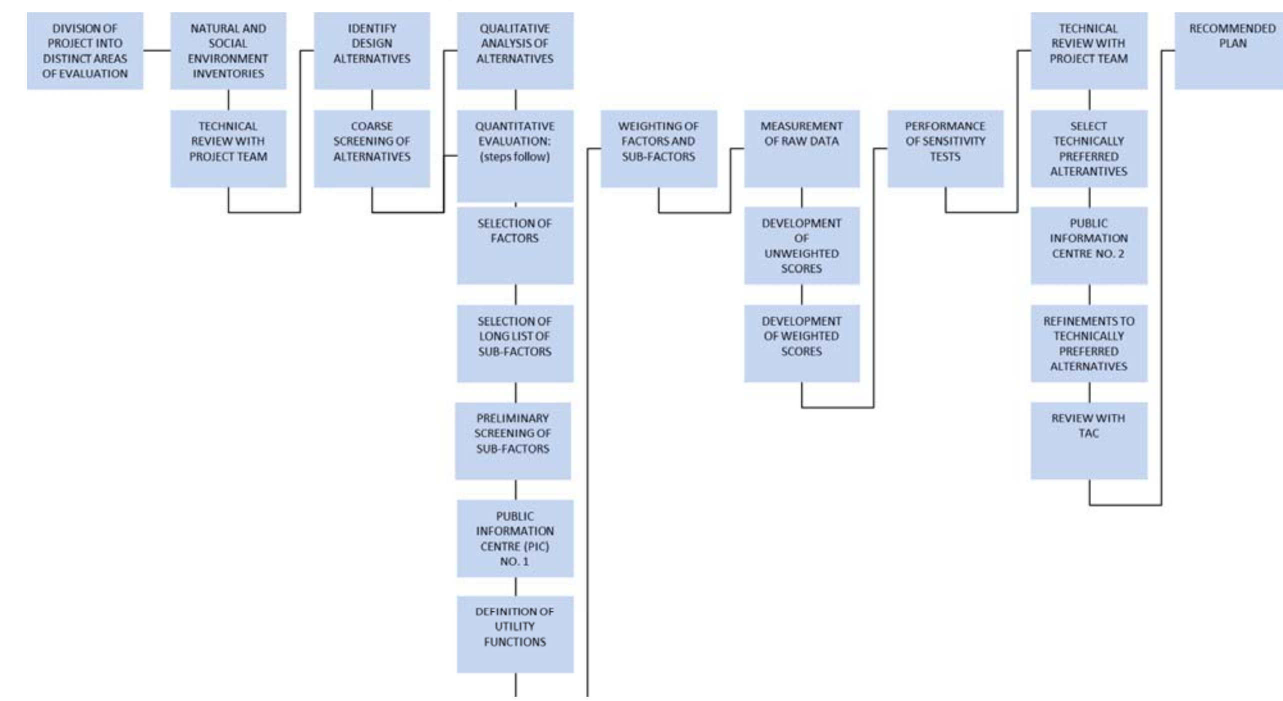
The Weighted Additive Method has proven to be invaluable for the evaluation of complex groups of alternatives. The methodology allows for sensitivity testing and the ability to answer "what if" questions. This method is used on projects where alternatives are to be evaluated and the decision making process is faced with either a large number of alternatives or a large number of competing criteria among the alternatives being evaluated.

This systematic approach is consistent with MOE practices for the evaluation of alternatives. It avoids many of the pitfalls associated with qualitative assessments by using an analytical approach that measures scores based on a mathematical relationship, i.e. the degree of subjectivity by the TAC is minimized. A traceable process allows the TAC and public an opportunity to assess trade-offs involved in the evaluation and use of this information in the decision-making process. In addition, this quantitative method allows sensitivity tests to be performed to determine if the highest ranked alternative is affected by changing the weights (perspective of importance) of the Global Factors.

For this project, alternatives will be compared and scores assigned to each of the various assessment factors and a sensitivity-testing program will be completed in consultation with the public and external agency interaction.

When using the Weighted Additive Method, each member of the TAC assigns a weight to the Global Factors and sub-factors. The Average TAC Weight is assigned to each of the alternatives. The alternative with the highest score is selected as the TPA. The steps followed to arrive at an overall score for each alternative are shown in **Figure 5.1**.

Figure 5.1: Quantitative Evaluation Process



This systematic approach includes the following steps:

- Collection of data/environmental inventories
- Development of a long list of reasonable alternatives (including coarse screening options unfeasible or unreasonable in comparison to those being carried forward)
- Development of a long list of evaluation criteria/performance factors
- Short listing of sub-factors to those where there are meaningful differences among the alternatives to be compared
- Establish Social Utility Functions (Performance Factors or Function Forms) for the short listed sub-factors
- Weighting of Evaluation Criteria (assigning importance based on the specific set of alternatives)
- Rating of Alternatives
- Sensitivity Testing
- Selection of TPAs
- Public Review
- Refinements to the Technically Preferred Plan
- Recommended Plan

These steps, as they relate to this project, are briefly described in the following sections.

5.1 Evaluation Criteria – Factors

The initial test in the evaluation is to develop evaluation criteria from which alternatives will be assessed. This is broken down into a two-step process that involves the selection of a "global" group of factors and a number of "local" sub-factors under the global groups.

The global factors groups will be presented to the public, and following this consultation will be accepted as describing the broad definition of the environment to be evaluated. Factors considered for this study may include:

- Traffic and Transportation;
- Natural Environment;
- Social and Cultural Environment;
- Economic Environment;
- Cultural Environment;
- Land Use and Property; and
- Cost.

While these factor groups are the starting point for the evaluation, one or more factors could be removed if it was determined that there was no sub-factor in this category i.e. there is not a meaningful and measureable difference among the alternatives being assessed in this category. When a particular factor is carried forward, then one or more sub-factors are

considered under this group. These sub-factors are the individual descriptors for the evaluation. The selection of the sub-factors is very important to the decision making process because they must adequately describe the issue to be evaluated and the alternatives being compared. See **Table 5.1** for a sample preliminary listing of sub-factors. Any information regarding an alternative, where there are differences among alternatives, is incorporated into the decision-making process by including it as a sub-factor. The benefit to incorporating two levels of evaluation criteria (global factors and local sub-factors) is the prevention of the unbalancing of the evaluation (that could occur by adding more criteria under one group). Weights are assigned to the global factors to eliminate any possibility of skewing the results by selecting a large number of sub-factors in one particular factor group.

Table 5.1: Sample Long List of Evaluation Criteria (Global Factors and Sub-factors)
Highway 401 Cornwall Centre Road Highway 401 Cornwall Centre Road

Traffic and Transportation	
1. Highway 401 Safety	✗
2. Highway 401 Detour Duration	✓
3. Cornwall Centre Road Detour Duration3 Cornwall Centre Road Detour Duration	✓
4. Out Of Way Travel	✓
5. Traffic Delay, Highway 401	✗
6. Risk of Queuing	✓
7. Disruption to Bicycles and Pedestrians	✓
8. Design Standard	✓
9. Design Speed	✗
10. Radius of Horizontal Curves	✗
11. Radius of Vertical Curves	✗
12. Consistency with Adjacent Highway Design Elements	✗
13. Safety of Residential Entrances	✗
14. Sight Distances	✗
15. Level of Service on Cross Streets	✗
16. Ability to be implemented for 2011 construction contract	✗
17. Consistency with Southern Ontario Highways Plan	✗
18. Ease of driver task	✗
Natural Environment	
1. Area of Wetland Impacted	✗
2. Fish Habitat Impacted	✓
3. Impact to Natural Woodland Habitat3 Impact to Natural Woodland Habitat	✗
4. Wildlife Corridors Impacted	✗
5. Number of Watercourse Crossings	✗

6. Number of Groundwater Wells Impacted	✗
7. Stormwater Impact	✓
Cultural Environment	
1. Areas of Archaeological Potential Impacted	✓
2. Loss of Visual Screening along the north side of Hwy 401	✓
3. Cultural Landscape Features Impacted	✗
4. Built Heritage Features Impacted	✗
5. Community Cohesion	✗
6. Impact to Existing Bicycle Path	✗
7. Snowmobile Trails Impacted7 Snowmobile Trails Impacted	✗
8. Vibration Impacts	✗
9. Bridge Aesthetics	✓
Socio-Economic Environment	
1. Out-of-way travel to businesses	✓
2. Impact to Cornwall Motor Speedway	✓
3. Impact to McGregor Grain Impact to McGregor Grain	✗
4. Impact to Cornwall Landfill	✗
5. Impact to Aggregate Resources	✗
6. Impact to Farming Activities	✓
7. Impact to Existing Utilities	✓
8. Number of Noise-Sensitive Areas Impacted	✓
9. Out-Of-Way Travel, Emergency Services	✗
10. Out-Of-Way Travel, School Buses	✗
11. Potential to Support Regional Development	✗
12. Loss of Surface and Mineral Rights	✗
Land Use and Property	
1. Temporary Limited Interest Required	✓
2. Number of Properties Impacted (Total)	✓
3. Number of Buyouts (Total)	✗
4. Area of Residential Property Required	✗
5. Number of Residential Buyouts	✗
6. Area of Industrial Property Required	✗
7. Number of Industrial Buyouts	✗
8. Area of Institutional Land Required	✗
9. Number of Institutional Buyouts	✗
10. Area of Public Service Facility Land Required	✗
11. Number of Public Service Facility Buyouts	✗
12. Area of Prime Agricultural Land Required	✗
13. Number of Agricultural Buyouts	✗

14. Area of Commercial Land Required	✗
15. Number of Commercial Buyouts	✗
16. Parks/Open Space Area Required	✗
17. Utility Corridors Impacted	✗
18. Potentially Contaminated Sites Impacted	✗
Cost	
1. Life Cycle Cost	✓
2. Durability	✓
3. Maintenance	✓
4. Constructability	✓
5. Long Term Lighting	✓
6. Potential for Settlement	✗

Legend:

✓ Carried Forward ✗ Not Carried Forward

Generally, the process begins by establishing a long list of potential or candidate sub-factors through discussions with community associations, the MAC, interest groups and the TAC or from previous studies of the same nature. Then, for each group of alternatives being evaluated, the sub-factors are reviewed and screened by eliminating those that are considered equal among alternatives being considered as well as those that do not apply to the study area, based on the site inventories carried out.

Table 5.2 provides a sample of a typical Factor, Sub-Factor, Unit and Utility Function Type from a similar Transportation Study. Similar Factor, Sub-factor and Utility functions will be developed for this study.

Table 5.2: Typical Evaluation Factor, Sub-Factor

Factor	Sub-Factor	Unit	Utility Function Type
Traffic and Transportation	• Level of Service (LOS)	Letter (A, B, C, D, E or F)	Stepped Function
	• Number of conflicts	Number	Linear
	• Number of intersections	Number	Linear
	• Number of entrances	Number	Linear
	• Out-of-way travel	Minutes	Linear
	• Flexibility for staged construction	Yes/No	Dichotomous
	• Ease to implement detour for new structure	Yes/No	Dichotomous
	• Design consistency	Yes/No	Dichotomous
	• Ability to stage construction	Yes/No	Dichotomous

5.2 Factor and Sub-factor Weights

The selection of weights for the factors and the sub-factors is based on assessments by the TAC of their relative importance. Within a group of factors, inevitably there is an ordering, with some factors having more importance than others. This is accounted for by each individual assigning a weight to each factor, which is reflected in the “Factor Weight” and “Sub-Factor Weight” column. An example of typical results is shown in **Table 5.3**.

Table 5.3: Sample TAC Average Weights for a Factor Group and Sub-Factors in that Group

Factors	TAC	
	Factor Weight	Sub-Factor Weight
Traffic and Transportation	40.9%	
• Level of Service (LOS)		27.6%
• Number of conflicts		13.5%
• Number of intersections		7.3%
• Number of entrances		6.1%
• Out-of-way travel		2.6%
• Flexibility for staged construction		9.6%
• Ease to implement detour for new structure		13.9%
• Design consistency		9.2%
• Ability to stage construction		10.2%
	Total	**100%**

As shown in **Table 5.3**, in this example, the group of evaluators judged the Traffic and Transportation Factor Group to be valued at 40.9% of the overall importance of the decision between the alternatives being considered.

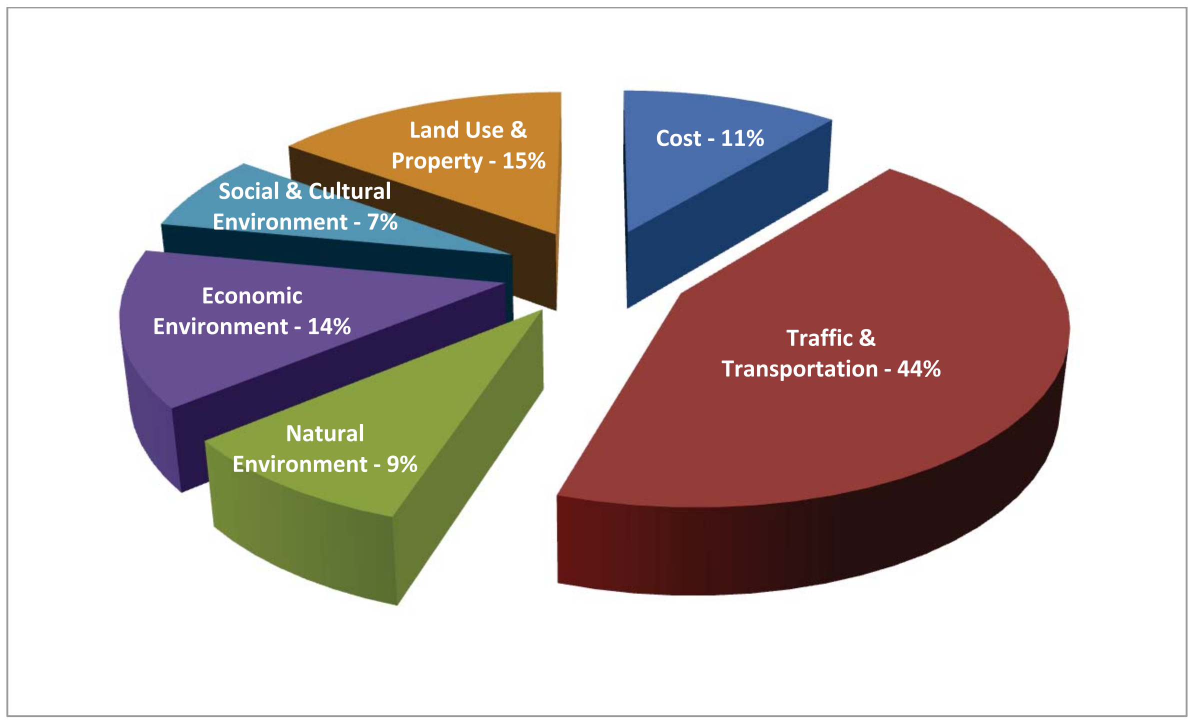
Within each Factor Group the sum of the percentage weights of all sub-factors listed under each factor totals 100%. As shown in Table 5.3 several of the sub-factors were judged to be more important /less important when compared to each other for this specific evaluation of alternatives being considered.

The weights for each factor and sub-factor are determined by averaging the weights assigned by the TAC (Evaluation Committee). Each member gives a judgement of the importance of each global factor and local sub-factor (a percentage value) based on his or her personal assessment and professional judgement, considering the net effects and input of stakeholders and the public.

There is usually a range of perspectives in deciding the weights (importance) of factors and sub-factors. Every person assigning weights has a personal perspective and understanding of the scope of the project. Hence, there is an advantage to having a diversified team of professionals with varied backgrounds performing the evaluation.

An example of the weighting of each of the global factors is shown in **Figure 5.2**. The weighting of sub-factors within each factor group would be a similar distribution among the available sub-factors.

Figure 5.2: Sample Weighting of Global Factors



5.3 Social Utility Functions

The Weighted Additive Method used to evaluate alternatives relates the performance or attractiveness of alternatives using a mathematical relationship. This includes two variables; the first is the raw data or measured or modelled data and the second is the utility or utility score, which is the measure of attractiveness of the alternative.

For this project, the relationship between these two variables was described, as shown in **Figure 5.3**, by either a dichotomous, stepped, or linear social utility function. A dimensionless utility score between zero (0) and 1 is assigned to an alternative for each

sub-factor. The shape of this function can vary from linear to stepped or exponential, and is defined by a subject area specialist.

The use of utility curves or functions is a step that transforms each of the measured effects to a dimensionless number and measure of utility. This step is required because the effects of each sub-factor are measured in different units (length, area, time, volume, dollars etc). To produce a mathematical measure of the performance, each effect is transformed to a measure of utility. The combined effect or performance of each alternative is a measure of utility (attractiveness) which is a dimensionless measure. The utility function (also commonly described as performance factor or function form) defines the relationship of effect to the attractiveness (utility). These utility functions are defined by subject area specialists in the field of study.

Examples of Social Utility Functions for the 'Ease of Maintenance' sub-factor definition are shown below in **Figure 5.4**.

Figure 5.3: Sample Utility Functions

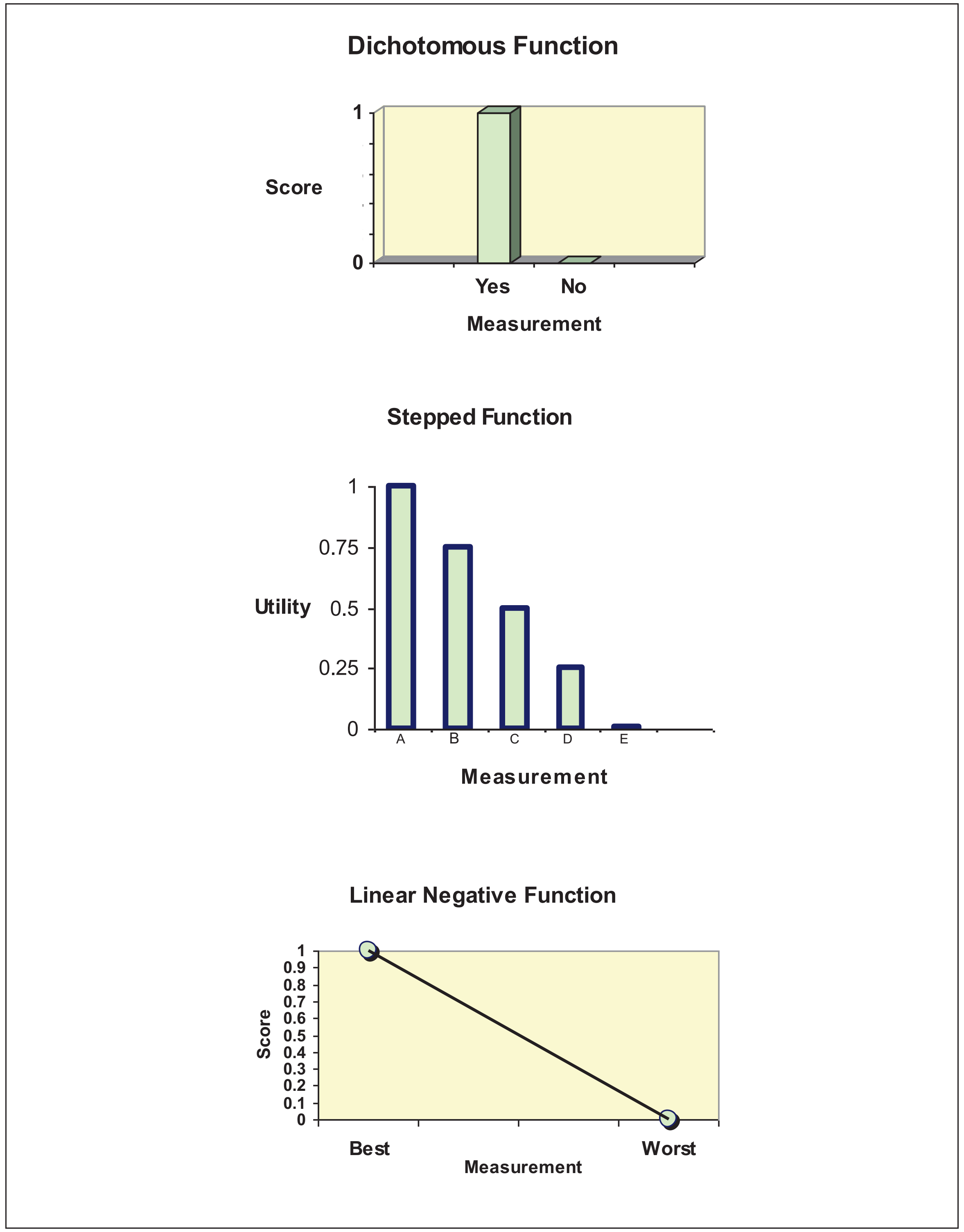
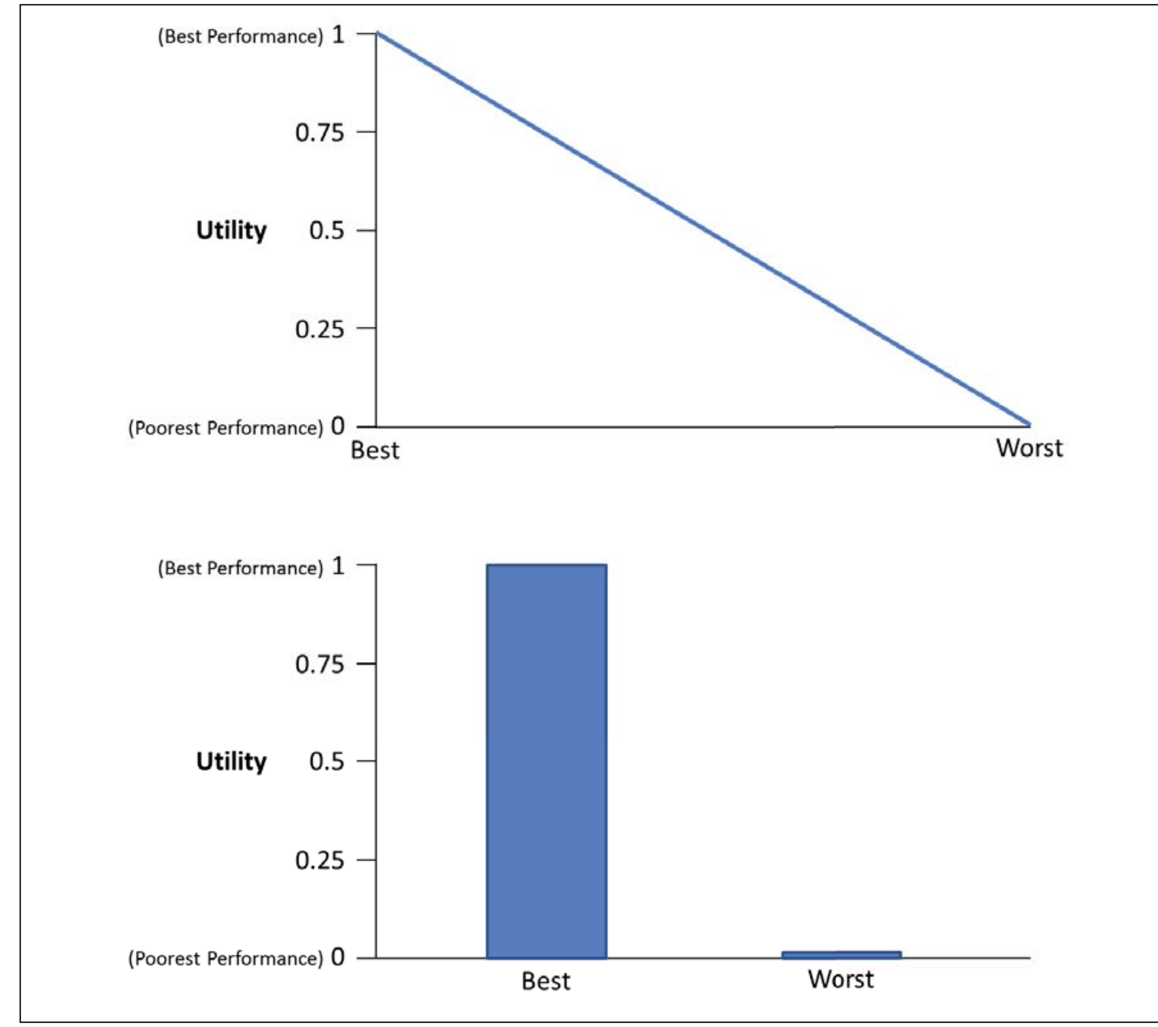


Figure 5.4: Social Utility Function



A dichotomous utility function enables the decision-maker to establish criteria that presents an "either–or" situation (desirable or undesirable, negative or positive, present or absent). If it were decided beforehand that a "yes" answer is desirable, then a utility score of one would be assigned to this criterion, otherwise zero would be assigned. Only one or zero are the available options, no other utility score is available.

A linear function is used to convert scores for sub-factors that have varying measurements. Given a measurement, a unique utility score between zero and one can be assigned to a sub-factor. The slope of the linear utility function can be negative or positive depending on desirability of the impact.

5.4 Weighted Score

The total un-weighted utility score of a given alternative can be expressed as:

U (Alternative A) = $\varnothing_1 X_1 + \varnothing_2 X_2 \ldots + \varnothing_n X_n$, where

U (A) = Total un-weighted utility score for Alternative A

$\varnothing_1$ = attractiveness with respect to parameters

X_1 = measurement of parameter X

Weighted scores are computed using the weights selected by the TAC. The weighted score for each alternative under a specific sub-factor is calculated as follows:

(weighted score) = (utility score x [(factor weight) x (sub-factor weight)])

Using this approach, a generic weighted attractiveness function can be expressed as:

U_w (Alternative A) = $U_1W_1 + U_2W_2 + \ldots + U_nW_n$

OR

U_w (Alternative A) = $W_1\varnothing_1X_1 + W_2\varnothing_2X_2 \ldots + W_n\varnothing_nX_n$

Where: U = Total un-weighted utility score for Alternative A

U_w (A) = Total weighted utility score for Alternative A

W_1= Weighted parameter (factor weight x sub-factor weight)

$\varnothing_1$ = Attractiveness with respect to parameter 1

X_1 = Measurement of parameter

The weighted scores of all the sub-factors are then added to give total score for each alternative.

$$U_w(A) = \sum_{X=1}^{n} W_n \varnothing_n X_n$$

Ontario
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5.5 Rating Alternatives

Following the selection of evaluation factors and sub-factors, measurements of the impacts are made using topographic plans, field surveys, and numerical modelling. These measurements result in data being available under each of the evaluation criteria from which ratings are made for each alternative.

The Weighted Additive Method focuses on the differences of the alternative, addresses the complexity of the base data collected and provides a traceable and defensible decision-making process. This process is a numerical calculation where alternative scores are determined through the use of a mathematical relationship to equate impacts to scores. It eliminates any possible subjective opinions of scores for alternatives because the team does not estimate the score for an alternative.

The scores for each alternative under each of the respective sub-factors are normalized based on measured impacts. Social utility functions are defined to relate impacts to the attractiveness of an alternative. This means that under each sub-factor, the alternative receives an un-weighted rating of between zero and one based on these measurements. The mathematical relationships for calculating scores are developed in consultation with the TAC.

5.6 Sensitivity Testing Program

It should be recognized that the scope of the evaluation and determination of weights for the evaluation criteria are a matter of personal and professional judgement. Accordingly, it is considered essential to conduct sensitivity testing to determine the effect of changing weights assigned to each criterion.

To test how sensitive the outcome of the evaluation is with respect to the assigned weights (i.e. would the result have changed if different weights were used), a sensitivity testing program is undertaken. This results in greater confidence in the selection process and reduces the potential that the average weights bias the outcome of the evaluation.

Often, there is a diversity of opinion in the group as to what weight is appropriate for a factor or sub-factor. When an average weight is used to capture the preferences of the group it loses valuable information on the range of values of the group. To test the range of perspective of the TAC, the highest and lowest weights suggested by anyone in the group are defined as a reasonable range of weights to test. A series of sensitivity tests are performed for the evaluation of alternatives. This allows the team an opportunity to assess the outcome of the evaluation if different weights (different perspectives of importance) are assigned to the factors and sub-factors from the average weights defined by the TAC members. In this way, trade-offs can be identified, credibility can be achieved with the public, and "what if" questions can be answered quickly. See **Figure 5.5** for an example of the typical range of project team weights and

Table 5.4: Sample Ranking of Alternatives

for a sample ranking of alternatives.

Following the above methodology, a series of tests can be performed varying the weights for each factor. These tests include:

- Average TAC Team Weight
- Highest Weight by any Team Member
- Lowest Weight by any Team Member

Following this series of tests, the results can be reviewed to assess whether the preferred alternative changes when the weights are varied.

Using this information alone is not the only justification for selecting a particular alternative, but it does provide a level of confidence in the selection. This information is used in the decision-making process before the TPAs are recommended to be carried forward.

Figure 5.5: Sample Range of Weights for Traffic and Transportation

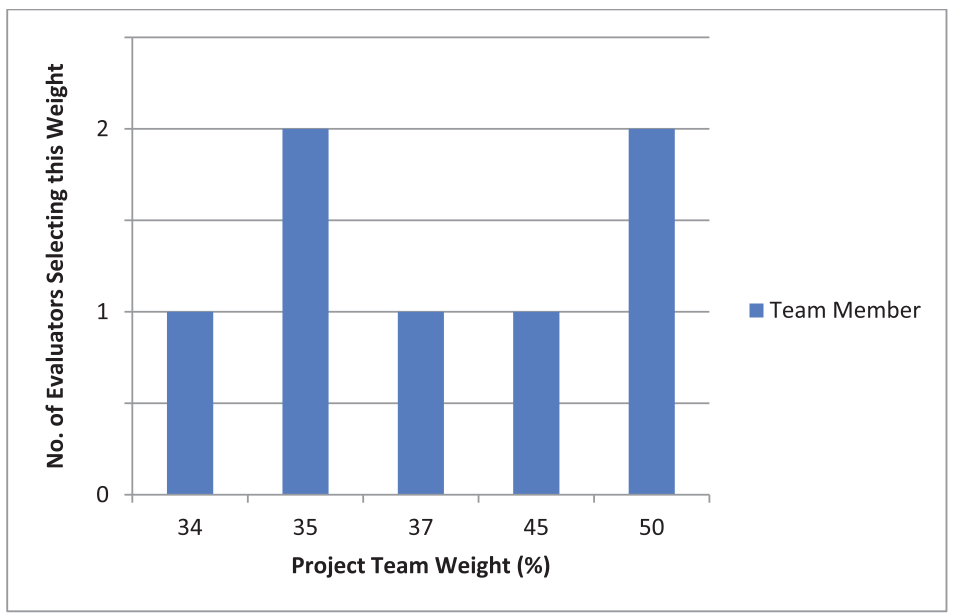


Table 5.4: Sample Ranking of Alternatives

Testing	Weight	Alt 1A	Alt 1A'	Alt 1B	Alt 1C
TAC Average Team Scores	N/A	2	1	3	4
High Traffic and Transportation	65%	2	1	3	4
Low Traffic and Transportation	30%	2	1	3	4
High Natural Environment	20%	2	1	3	4
Low Natural Environment	5%	1	2	3	4
High Economic Environment	30%	1	2	3	4
Low Economic Environment	5%	2	1	3	4

5.7 Selection of Technically Preferred Alternatives

The TPA identifies the preferred solution by taking into account the technical analysis, environmental considerations and comments of all study participants.

The TPA is then presented to the public and external stakeholders at the second PIC. This allows for any comments or questions regarding the proposed design.

It should be recognized that the information and conclusions obtained using the evaluation method are only tools used to assist in the evaluation process and identifying trade-offs. In the end, it is the TAC (Evaluation Committee) which makes the final decision on the selection of the TPA(s), using both the information obtained throughout the evaluation process and their individual experience and expertise, and through additional input from senior management on funding availability or other program constraints.

The findings of the analysis and evaluation process will be included as a component of the EA Process and documented in the Transportation Environmental Study Report (TESR). The principles and methodology of the EA process assist the TAC in the analysis and evaluation of alternatives and the selection of the TPA. The public and government agencies have the opportunity to provide input throughout the course of the study.

APPENDIX C: Rapid Bridge Replacement (RBR) Staging Area Construction Sites Screening Analysis

100 Craig Henry Drive, Suite 103
Ottawa, Ontario, K2G 5W3

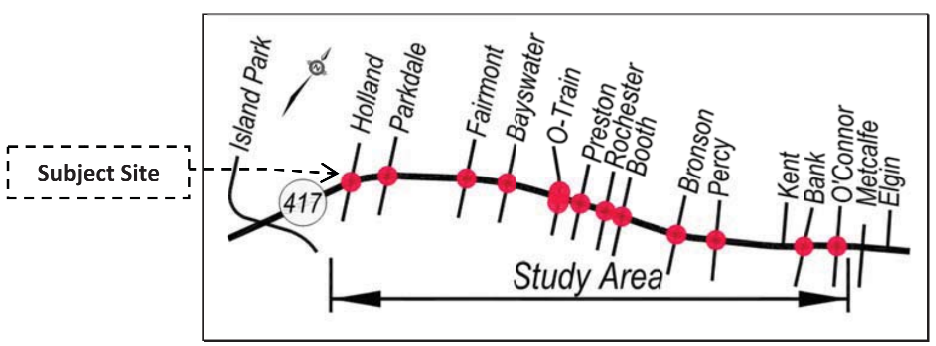
MEMORANDUM

TO:	File BTE13-001	**DATE:**	September 2, 2014
FROM:	Bytown Engineering	**PROJECT #:**	BTE13-001
PROJECT:	Preliminary Design and Environmental Assessment Study for the Rehabilitation/Replacement of Ottawa Queensway Mid-Town Bridges from Holland to O'Connor, GWP# 4075-11-00		
SUBJECT:	Preliminary Review of Staging Area Sites for Rapid Bridge Replacement Option/UPDATE 3 **Holland Avenue - Sites 3-050.1** and **3-050.2**		

1. INTRODUCTION

The Ontario Ministry of Transportation (MTO) will, over the next decade, undertake the rehabilitation or replacement of 23 structures on Highway 417 in the City of Ottawa. The structures are generally located within the central part of the City extending from Holland Avenue to O'Connor Street (see ***Figure 1***). The location considered in this review is also highlighted.

Figure 1: Study Area



Bridge replacement and rehabilitation options are being considered for all 23 structures under study. The rehabilitation options extend the service life of the bridge by making appropriate and targeted repairs; replacement is considered if a new bridge can be constructed as a cost effective alternative to repairing the existing bridge. The replacement approach considers different bridge types and construction methods. One replacement option includes a Rapid Bridge Replacement (RBR) which entails the removal of the existing structure and insertion of a new structure**.** This process has been used at other bridge sites on Highway 417 immediately west of the study area; MTO has recently employed the RBR process for structures at Carling Avenue (westbound) and Kirkwood Avenue bridges. This approach requires the closure of the freeway (eastbound and westbound lanes) while the old structure is removed and the new bridge is placed.

MTO has also tendered the first RBR for a rigid frame bridge in Ontario (i.e. Highway 401/Cornwall Centre Road). For a rigid frame bridge, the RBR process requires a duration that exceeds most recent deck replacements employed on Highway 417. For example, the Highway 401/Cornwall Centre Road pilot project allows 8 weeks for the removal and installation of a new rigid frame bridge.

A Group 'B' Environmental Assessment (EA) is being undertaken by the Ministry of Transportation for a bridge management plan for structural improvements (rehabilitation or replacements) to bridges on the Ottawa Queensway from Holland Avenue easterly to O'Connor Street. The project is being described as the Ottawa Queensway Mid-town bridges project.

The MTO's Provincial Class EA is a planning and design procedure developed to ensure that all potential natural, social/cultural and economic environments as well as property and land use effects are considered in undertaking certain projects.

This document summarizes part of the analysis and evaluation process to define staging areas that could be used to construct replacement bridges using Accelerated Bridge Construction (ABC). The staging areas would provide an area to build new rigid frame bridges and a lay-down area for the contractor, and house the existing bridge temporarily after it is removed for it to be demolished.

This memo reviews candidate staging areas for each of the bridge sites and selects one as a preferred location based on the experience of the previous ABC projects completed by MTO on the Queensway. This will demonstrate that ABC is achievable and then allow for the temporary effects of creating a site and clearing a path from the site to the bridge, to be considered in the evaluation of alternatives. The subsequent evaluation of alternatives will be completed after Public Information Centre (PIC) No. 1. It will systematically analyze, evaluate and select the Technically Preferred Alternatives (TPA's) for the 23 bridge sites under study. This sequential methodology will include community and stakeholder input at all key milestones of the study including consideration of the temporary staging areas. The effects and mitigation as a result of the TPA may be modified during subsequent stages of public consultation and will be further defined at the detail design stage. This document will become a component of the Transportation Environmental Study Report (TESR). The use of temporary staging areas will be negotiated by the MTO Property Section, and the locations identified in this memorandum may be changed at the time of replacement if there are other more suitable sites that can be identified. At this point the identification of a staging area reflects the technical feasibility to implement an ABC project as a candidate alternative using Rapid Bridge Replacement (RBR) with heavy lift technology.

The staging areas for the Queensway Bridges in this study need to be large enough to accommodate the temporary structure where the new bridge is built and the 2 SPMT's that need to be assembled and disassembled. There is also a requirement for a construction lay-down area.

A key consideration for the use of RBR relates to the provision of a construction staging area where the new structure is constructed and prepared for insertion into the existing location (i.e. replaces the old structure). The sequencing of bridge replacement will be addressed following the structural reviews/investigations. This memorandum provides a preliminary assessment of possible RBR construction staging areas at the subject site. Both north side and south side locations are addressed in this review.

2. DESIGN CRITERIA

The design criteria for a suitable RBR staging area should include the following:

1. Large overall area (50 m x 50 m = 2500 m^2) to accommodate new structure, storage of old bridge when removed, laydown area for contractor and maneuverability of SPMT's.
2. Travel route to bridge site moderate grades (below 1.5%).
3. Dimensions of site to exceed the size of the new bridge and include workspace on all sides of the new bridge. Bridges are in the order of (25-30 m) x 25 m so desirable lateral dimension is 50 m and minimum dimension must exceed width/span of new bridge.
4. Where no site is available on one side of the Queensway, both east and westbound bridges may be replaced on the same weekend using a larger staging area on one side of the Queensway.

3. STAGING AREA REVIEW PARAMETERS

The following assumptions were used in this preliminary examination of potential staging sites in the study area:

- Property ownership was not explicitly considered in the review. Municipal, private, federal and/or provincial lands were all deemed acceptable.
- The purchase of property for use as a temporary construction staging area was not considered in this review. This will be subject to property negotiations.
- The staging sites will require areas for the construction of the new structures and storage of the old structure and allow vehicle access/circulation.

- RBR staging areas are required on the north and south sides at each site (unless both bridges are replaced on the same weekend).
- Flat/minimal grades are preferred within the staging area and approaches to the replacement site. Some minor site preparation was considered acceptable.
- The extension of the staging area into adjacent travel lanes was considered feasible at locations where volumes were minimal or where multiple travel lanes are provided (unless both bridges are replaced on the same weekend).
- The proposed staging area should be in proximity to the replacement structure site.
- The site should readily accommodate construction vehicles, preferably on a designated truck route.

Off site staging areas which meet the guidelines are preferred. It is recognized that there are inherent challenges such as impacts on adjacent residents/land uses, the limited sites to construct a new structure/store the old structure, the need to relocate utilities, vegetation, trees and other landscape features and noise/dust issues. Although some challenges exist, the RBR process significantly reduces the amount of time required to close the road for use of traffic when compared to conventional reconstruction.

The availability of staging areas of the required size in an urban setting such as Central Ottawa is challenging – the preliminary staging sites typically consist of parks/sports fields, commercial/municipal parking areas and extended boulevards. The parks/sports fields identified in this review are located in the middle of established residential communities (i.e. Civic Hospital area). The use of these sites will require the removal of some or all of the existing functions; complete reinstatement will occur following the construction activities.

4. SITE REVIEW

Holland Avenue is a major collector roadway accommodating slightly less than 10,000 vehicles/day (i.e. 2009 AADT south of Highway 417). Holland Avenue comprises three lanes under the structure (1 SB and 2 NB lanes) and includes an on-road, northbound bicycle lane. The adjoining segments of Holland consist of 2 travel lanes and on-street parking lanes.

Using the parameters listed in the previous section, a preliminary assessment of possible RBR locations was undertaken. The results are summarized in subsequent tables. It is noted that the dimensions identified in this review were scaled from online mapping services and reflect the level of detail associated with those sources.

Table 1 provides a qualitative assessment of the various RBR sites based on ***Good, Fair*** and ***Poor*** criteria. The ratings are meant to quantify, in a broad manner, the potential of each site considering the factors listed above.

Table 1
Analysis of Potential RBR Staging Areas – Holland Avenue (Sites 3-050.1 and 3-050.2)

	Potential Site	***Discussion***	***RBR Potential***
North Side	***HO-01*** - School Parking lot east of Fisher Park school on west side of Holland	• Available area approx. 40 m (varies 30 m - 55 m) = 1200 – 2200 m^2 • Approx. 30 m to bridge site (via Holland) • Impact on school accessibility and functions (parking area also accommodates main entrance to school) • Impact on residences on Holland	• ***FAIR*** → *Site is less than the minimum required area of 2500* m^2 → *Within close proximity to bridge site* → *Impact on school accessibility/parking* → *Impact on nearby residences*
	HO-02 - Tennis courts in SW quadrant of Holland/ Byron intersection	• Available area approx. 40 m x 75 m = 3000 m^2 • Approx. 250 m to bridge site (via Byron/ Holland) • Impact on tennis court functions • Impact on residences on Byron • Meets maximum allowable grade of 1.5%	• ***FAIR*** → *Meets minimum area requirement of 2500* m^2 → *Reasonably close to the bridge site* → *Impacts recreational uses* → *Impact on nearby residences*
	HO-03A - School playground/park (Fisher Park Playground) north of Fisher Park on west side of Holland	• Available area approx. 100 m x 100 m = 10 000 m^2 • Approx. 300 m to bridge site (via Byron/Holland) • Direct access to Holland does not appear feasible because of existing residences • Route from staging area to bridge would require travel through tennis club • Impact on playground functions • Impact to residences on Holland/Harmer (noise, vibration, etc.) • Removal of vegetation/trees required • Construction vehicles travel through residential areas • Meets maximum allowable grade of 1.5%	• ***FAIR*** → *Far exceeds minimum required area of 2500* m^2 → *Reasonably close to bridge site* → *Impacts recreational uses* → *Impact on nearby residences* → *Relatively lengthy trip from staging area to bridge site* → *Construction vehicles must access site via residential roadways*
	HO-03B- School playground/park (Fisher Park Playground) travel through school property and use one residential property	• Available area approx. 100 m x 100m = 10 000 m^2 • Approx. 100 m to bridge site (via Fisher school parking lot) • Direct access to Holland does not appear feasible because of existing residences • Route from staging area to bridge would likely require travel through tennis club • Impact on playground functions • Impact to residences on Holland/Harmer (noise, vibration, etc.)	• ***GOOD*** → *Impacts recreational uses* → *Close to bridge site* → *Significantly shorter travel route than HO-03A* → *Minimal travelling required on residential roadways* → *Meets maximum allowable grade of 1.5%*

Subject: Assessment of Potential Staging Areas for Rapid Bridge Replacement Option – ***HOLLAND AVENUE***
Project: Preliminary Design and Environmental Assessment Study for the Rehabilitation/Replacement of Ottawa Queensway Mid-Town Bridges from Holland to O'Connor, GWP# 4075-11-00/BTE13-001
Date: September 2, 2014

		• Removal of vegetation/trees required • Construction vehicles travel through residential areas	
South Side	***HO-O4*** – use municipal ROW near intersection of Holland/Sherwood	• Available area approx. 40 m x (varies 20-40 m) = 800-1600 m^2 • Approx. 25 m from staging area to bridge site • Impact on residences on Holland Ave. • Construct new structure in south side intersection area (i.e. Holland/Sherwood) • Old structure to be dismantled in segments and stored off site (e.g. on Holland Avenue immediately north of Highway 417 or to the south in landscape area between hydro building and Highway 417)	• ***FAIR*** → *Does not meet minimum area requirement of 2500* m^2 → *Directly south of bridge site* → *Impact on nearby residences and local traffic* → *Site grades exceeds max allowable requirement of 1.5%*
	HO-05 - Central Experimental Farm lands south of Carling	• Available area approx. 100 m x 100 m = 10 000 m^2 • Approx. 750 m to bridge site (via Holland) • Access route on Holland Ave. would have significant impacts to utilities and mature trees • Gradient on Holland Ave. exceeds design criteria for SPMT	• ***FAIR*** • *Impact to traffic on Holland as well as residences living near travel route* • *Moderate distance from site to travel route* • *Exceeds max allowable grade of 1.5% in some locations*

5. COARSE SCREENING EVALUATION OF RBR SITES

The potential candidate RBR staging areas were assessed as part of a coarse screening analysis against three criteria (size, access route gradient and access route impacts) to assess if a site was feasible to carry forward. The conclusions of this assessment are presented in **Table 2** and **Table 3**.

Table 2
RBR Staging Area Coarse Screening Analysis
Bridge Site: Holland Avenue WB

Candidate RBR Staging Area	Achieve Minimum Area requirement (2500 m²) Yes/No	Route Access: Meet Gradient requirement <1.5% slope	Route Access: Level of Impact on Travel Route	Comments	Carry Forward Yes/No
HO-01 School Parking lot east of Fisher Park school on west side of Holland	No 40 m x (varies 30-55 m) = 1200-2200 m^2	Yes	Moderate impact on parking lot and nearby residences	-Impact on school accessibility/ parking -Impact on nearby residences	No
HO-02 Tennis courts in SW quadrant of Holland/Byron	Yes 75 m x 40 m = 3000 m^2	Yes	Travel route: Byron Avenue and Holland Avenue – High Impacts	Impacts on travel route to mature trees and utilities	No
HO-03A School playground park (Fisher Park playground) north of Fisher Park on west side of Holland	Yes 100 m x 100 m = 10 000 m^2	Yes	High	-Impacts to Byron Avenue, Holland Avenue, Fisher Park and Tennis courts in SW quadrant of Holland/Byron	No
HO-03B School playground park (Fisher Park playground) travel through school property and use one residential property	Yes 100 m x 100 m = 10 000 m^2	Yes	Moderate – one potential buyout	Impact to residential property (234 Holland Avenue)	Yes
Preliminary Recommendation: **HO-03B site will be carried forward**					

Table 3
RBR Staging Area Coarse Screening Analysis
Bridge Site: Holland Avenue EB

Candidate RBR Staging Area	Achieve Minimum Area requirement (2500 m²) Yes/No	Route Access: Meet Gradient requirement <1.5% slope	Route Access: Level of Impact on Travel Route	Comments	Carry Forward Yes/No
HO-04 Ottawa Hydro Substation/Municipal right-of-way	No 40 m x (varies 20-40 m) = 800-1600 m^2	No	High	The areas considered are behind the Ottawa Hydro substation and beside it in the area to the Queensway. The areas are considered too small.	No
HO-05 Central Experimental Farm lands south of Carling	Yes 100 m x 100 m = 10 000 m^2	No	Holland Avenue	The access route on Holland has significant impacts to utilities and mature trees. In addition the gradient on Holland Avenue exceeds the design criteria for the SPMT.	No
Preliminary Recommendation: **No staging area sites will be carried forward**					

Site HO-03B (see **Table 2**) is the only site that generally exhibits favorable staging characteristics (i.e. a combination of proximity to the site, route access characteristics, size of staging area, impacts on adjacent uses and ability to relocate the current use of the site).

6. PREFERRED RBR STAGING SITES

Based on this preliminary review, the preferred RBR staging sites recommended for consideration are presented in **Figure 2**. The evaluation of alternatives includes the following:

North Side

- **Site HO-03** is located in Fisher Park Playground. Following route **HO-03B** (as shown on **Figure 2**) is the preferred option. This site will likely require the buyout of one residential property; however, the travel route is significantly shorter and will result in less impact to nearby residential roadways, as compared with HO-03A.
- **Site HO-03** is large enough to accommodate both the north and south side structures.

South Side

- No sites are being carried forward for the south bridge structure. If the eastbound structure requires a staging area, it will require the use of the north side site **HO-03**.

7. TECHNICALLY PREFERRED OPTION

This technical memorandum on potential RBR staging areas has been used as input into the overall technical evaluation of bridge management alternatives. Based on the evaluation of alternatives, RBR is the technically preferred option for the Holland Avenue structures. The overall MATS (Multi-Attribute Tradeoff System) evaluation is described in a standalone Analysis and Evaluation Report. Based on the outcome of the evaluation, there is a need for a staging site for the replacement of the bridge. However, in consideration of the availability of funding, provincial priorities and the long term performance of the bridge replacement, the TESR (Transportation Environmental Study Report) will seek clearance for both rehabilitation and replacement approaches for the bridge management plan.

It is recommended to use site **HO-03** (as shown on **Figure 2**), which is located in Fisher Park, along with travel route **HO-03B**. The selection of this site and travel route will likely require the buyout of one residential property located at 234 Holland Avenue.

The Holland Avenue Eastbound and Westbound bridge structures will need to be replaced simultaneously on a long weekend (i.e. a 3-day weekend), since there is only one staging site available for both bridges. Appropriate site preparation will be required in advance of the replacements.

Figure 2
Location of Shortlisted RBR Staging Areas – Holland Avenue (Sites 3-050.1 and 3-050.2)

3 September 2014

100 Craig Henry Drive, Suite 103
Ottawa, Ontario, K2G-5W3

MEMORANDUM

TO:	File BTE13-001	**DATE:**	December 10, 2014
FROM:	Bytown Engineering	**PROJECT #:**	BTE13-001
PROJECT:	Preliminary Design and Environmental Assessment Study for the Rehabilitation/Replacement of Ottawa Queensway Mid-Town Bridges from Holland to O'Connor, GWP# 4075-11-00		
SUBJECT:	Preliminary Review of Staging Area Sites for Rapid Bridge Replacement Option/UPDATE 3 **Parkdale Avenue - Sites 3-051.1 and 3-051.2**		

1. INTRODUCTION

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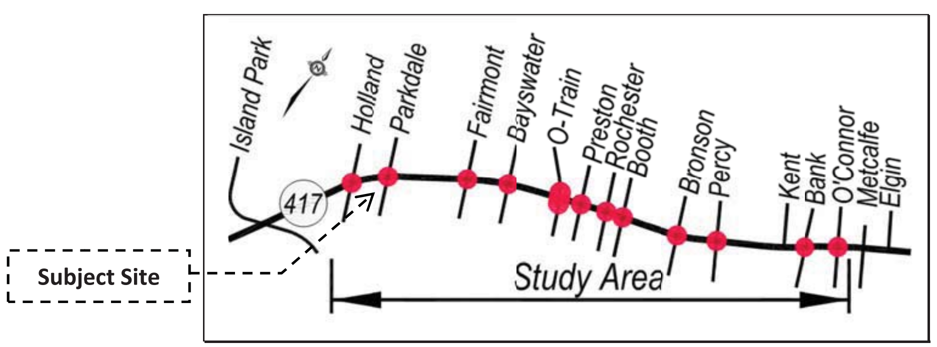
Figure 1: Study Area



Bridge replacement and rehabilitation options are being considered for all 23 structures under study. The rehabilitation options extend the service life of the bridge by making appropriate and targeted repairs; replacement is considered if a new bridge can be constructed as a cost effective alternative to repairing the existing bridge. The replacement approach considers different bridge types and construction methods. One replacement option includes a Rapid Bridge Replacement (RBR) which entails the removal of the existing structure and insertion of a new structure. This process has been used at other bridge sites on Highway 417 immediately west of the study area; MTO has recently employed the RBR process for structures at Carling Avenue (westbound) and Kirkwood Avenue. This approach requires the closure of the freeway (eastbound and westbound lanes) while the old structure is removed and the new bridge is placed.

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The MTO's Provincial Class EA is a planning and design procedure developed to ensure that all potential natural, social/cultural and economic environments as well as property and land use effects are considered in undertaking certain projects.

This document summarizes part of the analysis and evaluation process to define staging areas that could be used to construct replacement bridges using Accelerated Bridge Construction (ABC). The staging areas would provide an area to build new rigid frame bridges and a lay-down area for the contractor, and house the existing bridge temporarily after it is removed for it to be demolished.

This memo reviews candidate staging areas for each of the bridge sites and selects one as a preferred location based on the experience of the previous ABC projects completed by MTO on the Queensway. This will demonstrate that ABC is achievable and then allow for the temporary effects of creating a site and clearing a path from the site to the bridge, to be considered in the evaluation of alternatives. The subsequent evaluation of alternatives will be completed after Public Information Centre (PIC) No. 1, and will systematically analyze, evaluate and select the Technically Preferred Alternatives (TPA's) for the 23 bridge sites under study. This sequential methodology will include community and stakeholder input at all key milestones of the study including consideration of the temporary staging areas. The effects and mitigation as a result of the TPA may be modified during subsequent stages of public consultation and will be further defined at the detail design stage. This document will become a component of the Transportation Environmental Study Report (TESR). The use of temporary staging areas will be negotiated by the MTO Property Section, and the locations identified in this memorandum may be changed at the time of replacement if there are other more suitable sites that can be identified. At this point the identification of a staging area reflects the technical feasibility to implement an ABC project as a candidate alternative using Rapid Bridge Replacement (RBR) with heavy lift technology.

The staging areas for the Queensway Bridges in this study need to be large enough to accommodate the temporary structure where the new bridge is built and the 2 self-propelled modular transporters (SPMT's) that need to be assembled and disassembled. There is also a requirement for a construction lay-down area.

A key consideration for the use of RBR relates to the provision of a construction staging area where the new structure is constructed and prepared for insertion into the existing location (i.e. replaces the old structure). The sequencing of bridge replacement will be addressed following the structural reviews/investigations. This memorandum provides a preliminary assessment of possible RBR construction staging areas at the subject site. Both north side and south side locations are addressed in this review.

2. DESIGN CRITERIA

The design criteria for a suitable RBR staging area should include the following:

1. Large overall area (50 m x 50 m = 2500 m^2) to accommodate new structure, storage of old bridge when removed, lay-down area for contractor and maneuverability of SPMT's.
2. Moderate grades (below 1.5%) on travel route to bridge site.
3. Dimensions of site to exceed the size of the new bridge and include workspace on all sides of the new bridge. Bridges are in the order of (25-30 m) x 25 m so desirable lateral dimension is 50 m and minimum dimension must exceed width/span of new bridge.
4. Where no site is available on one side of the Queensway, both east and westbound bridges may be replaced on the same weekend using a larger staging area on one side of the Queensway.

3. STAGING AREA REVIEW PARAMETERS

The following assumptions were used in this preliminary examination of potential staging sites:

- Property ownership was not explicitly considered in the review. Municipal, private, federal and/or provincial lands were all deemed acceptable.
- The expropriation of property for use as a temporary construction staging area was not considered. Any use or acquisition would be subject to property negotiations.
- The staging sites will require areas for the construction of the new structures and storage of the old structures, and must allow vehicle access/circulation.
- RBR staging areas are required on the north and south sides at each site (unless both bridges are replaced on the same weekend).
- Flat/minimal grades are preferred within the staging area and on the approaches to the replacement site.

- Site preparation is required under all options.
- The extension of the staging area into adjacent travel lanes was considered feasible at locations where volumes were minimal and/or multiple travel lanes are provided (unless both bridges are replaced on the same weekend).
- The proposed staging area should be in close proximity to the replacement structure site.
- The site should readily accommodate construction vehicles, preferably on a designated truck route.

Off-site staging areas which meet the guidelines are preferred. It is recognized that there are inherent challenges such as impacts on adjacent residents/land uses, the limited sites available to construct a new structure/store the old structure; the need to relocate utilities; vegetation, trees and other landscape features; and noise/dust issues. Although some challenges exist, the RBR process significantly reduces the amount of time required to close the road to traffic when compared to conventional reconstruction.

4. SITE REVIEW

Parkdale Avenue is a north/south arterial roadway accommodating slightly less than 12,000 vehicles/day (i.e. 2013 AADT at Highway 417).

Using the parameters listed in the previous section, a preliminary assessment of possible RBR locations was undertaken. The results are summarized in subsequent tables. It is noted that the dimensions identified in this review were scaled from online mapping services and reflect the level of detail associated with those sources. The tables provide a qualitative rating of the various RBR sites based on ***Good, Fair*** and ***Poor*** criteria. The ratings are meant to quantify, in a broad manner, the potential of each site considering the factors listed above.

The availability of staging areas of the required size in an urban setting such as Central Ottawa is challenging – the preliminary staging sites typically consist of parks/sports fields, commercial/municipal parking areas and extended boulevards. The parks/sports fields identified in this review are located in the middle of established residential communities (i.e. Civic Hospital area). The use of these sites will require the removal of some or all of the existing functions; complete reinstatement will occur following the construction activities.

The parking area identified in this report as a possible staging site **(PA-03)** is associated with the Ottawa Hospital, Civic Campus. This surface parking area is currently being examined as a possible parking structure and may not be available in the near future. The site which contains recreational uses **(PA-02)** is situated in the middle of an established residential area and requires use of local roads for truck access. The use of any of these sites requires that users of these facilities must be relocated during the construction period.

Table 1
Analysis of Potential RBR Staging Areas – Parkdale Avenue (Sites 3-051.1 and 3-051.2)

	Location	*Discussion/Notes*	*RBR Potential*
North Side	***PA-05***– Parkdale N/S-W on-ramp area	• Available area approx. 65 m x 30 m = 1950 m^2 • Approx. 25 m from staging area to bridge site (via Parkdale) • Construct new structure and dismantle old structure within north on-ramp area and surrounding grassed area • Impact to residences on Parkdale	• ***FAIR*** → *Insufficient area due to narrow dimensions of site* → *Impact on nearby residences* → *Will likely require closure of both south side and/or north side ramps*
	PA-06 Parkdale E-N/S off-ramp area	• Available area approx. 130 m x 35 m = 4550 m^2 • Approx. 40 m from staging area to bridge site (via MacFarlane/Sherwood/Parkdale) • Impact to residences on MacFarlane/ Sherwood/Parkdale • Construct new structure and dismantle old structure within north on-ramp area • WB off-ramp to be relocated to south • Barrier and noise wall to be provided along north side of realigned WB off-ramp • Westmount Avenue to be relocated to north of noise wall/barrier	• ***FAIR*** → *Insufficient area due to narrow dimensions of site* → *Impact on nearby residences* → *Will likely require closure of both south side and/or north side ramps* → *New configuration of WB off-ramp removes existing boulevard/limits use of ramp area for staging*
	HO-03 Fisher Park (north of Fisher school)	• Available area approx. 100 m x 100 m = 10 000 m^2 • Approx. 500 m from staging area to bridge site (via Byron/Holland/Tyndall/Parkdale) • Impact to residences on Byron/Holland/Tyndall/ Parkdale • RBR construction vehicles must travel through residential areas • Access to site constrained	• ***FAIR*** → *Large, contiguous area* → *Impact on nearby residences* → *Moderate distance from the staging area to the bridge site that would impact local roadways*
South Side	**PA-01** Lawn Bowling Club/ Reid Park	• Available area approx. 160 m x (varies 80 – 130 m) • Approx. 420 m from staging area to bridge site (via MacFarlane/Sherwood/Parkdale) • Impact to residences on MacFarlane/Sherwood/ Parkdale • Site is less than 1.5% grade required to construct bridge structure	• ***FAIR*** → *Would result in loss of space for recreational activities* → *Large, contiguous area* → *Satisfies grade requirements* → *Impact on nearby residences*
	PA-02 Surface Parking Ottawa Civic Hospital Campus	• Available area approx. 50 m x 150 m = 7500 m^2 • Approx. 520 m from staging area to bridge site (via MacFarlane/Sherwood/Parkdale) • Impact to residences on MacFarlane/Hutchison/ Ruskin • Impact on hospital parking • RBR construction vehicles must travel through residential areas • Access to site constrained	• ***POOR*** → *Impacts recreational uses* → *Impact on nearby residences* → *Lengthy distance to bridge site* → *Construction access to staging area via residential roadways* → *May not be available due to potential parking structure*

	PA-03 Parkdale N/S-E off-ramp area (incl. closure of ramp)	• Available area approx. 110 m x (varies 15-25 m) = 1650 m^2 – 2750 m^2 • Approx. 25 m from staging area to bridge site (via Parkdale) • Closing off-ramp would impact local traffic	• ***FAIR*** → *Considered insufficient area due to the narrow dimensions of the site* → *Would require the closure of the ramp, which would impact motorists* → *Bridge site and staging area are within close proximity to each other*
	PA-04 Parkdale N/S-E on-ramp area (incl. closure of ramp)	• Available area approx. 150 m x (varies 15-25 m) = 2250 m^2 – 3750 m^2 • Approx. 25 m from staging area to bridge site (via Parkdale) • Site is not wide enough to be used as a staging area	• ***FAIR*** → *Considered insufficient area due to the narrow dimensions of the site* → *Would require the closure of the ramp, which would further impact motorists* → *Bridge site and staging area are within close proximity to each other* → *Site is located within close proximity to bridge structure*
	PA-07 Central Experimental Farm lands south of Carling	• Available area approx. 100 m x 100 m = 10 000 m^2 • Approx. 750 m from staging area to bridge site (via Parkdale) • Satisfies max. allowable grade of 1.5%	• ***POOR*** → *Lengthy travel route on Parkdale Ave to reach the bridge site* → *Site meets dimension requirements* → *Significant impacts to mature trees and utilities* → *Lengthy travel route on Parkdale to reach the bridge site* → *Significant impacts to mature trees and utilities*

5. COARSE SCREENING EVALUATION OF RBR SITES

The potential candidate RBR staging areas were assessed as part of a coarse screening analysis against three criteria (size, access route gradient and access route impacts) to assess if a site was feasible to carry forward. The conclusions of this assessment are presented in **Table 2** and **Table 3**.

Table 2
RBR Staging Area Coarse Screening Analysis
Bridge Site: Parkdale Avenue WB

Candidate RBR Staging Area	Achieve Minimum Area requirement (2500 m²) Yes/No	Route Access: Meet Gradient requirement <1.5% slope	Route Access: Level of Impact on Travel Route	Comments	Carry Forward Yes/No
PA-05 Using Parkdale N/S-W ramp area with closure of ramp	No 65 m x 30 m = 1950 m^2	No data	High - Requires closure of N/S-W Parkdale on-ramp	-Considered insufficient area due to narrow site dimensions -Constructability recommendation is that it could not work with the ramp operating through the site	No
PA-06 Using Parkdale E-N/S ramp area following removal of existing houses	Yes 130 m x 35 m = 4550 m^2	Yes	High – Requires closure of E-N/S Parkdale off-ramp and possible removal of select nearby residences	-Considered insufficient area due to narrow site dimensions -Constructability recommendation is that it could not work with the ramp operating through the site	No
HO-03 Fisher Park	Yes 100 x 100 m = 10 000 m^2	Yes	High	High impact on Tyndall Street (local street)	No
Preliminary Recommendation: **No sites being carried forward**					

Table 3
RBR Staging Area Coarse Screening Analysis
Bridge Site: Parkdale Avenue EB

Candidate RBR Staging Area	Achieve Minimum Area requirement (2500 m²) Yes/No	Route Access: Meet Gradient requirement <1.5% slope	Route Access: Level of Impact on Travel Route	Comments	Carry Forward Yes/No
PA-01 Lawn Bowling Club/ Reid Park	Yes (varies 80-130 m) x 160 m = 10 400 - 20 800 m^2	Yes	Medium (impact to local traffic on multiple streets in the area)	Narrow municipal right-of-way on Sherwood Dr & MacFarlane Ave	No
PA-02 Surface Parking Ottawa Hospital Campus	Yes 50 m x 150 m = 7500 m^2	Yes	520 m travel route on local streets via (via MacFarlane/Sherwood /Parkdale)	Access route impacts - High	No
PA-03 Parkdale W-N/S off-ramp area including closure of ramp	No (varies 15-25 m) x 110 m = 1650-2750 m^2	No Data	High – Closure of Parkdale W-N/S off-ramp	-Considered insufficient area due to narrow site dimensions	No
PA-04 Parkdale on-ramp area including closure of ramp	Yes 150 m x (varies 15-25 m) = 2250-3750 m^2	No Data	High – Closure of Parkdale N/S-E on-ramp	-Considered insufficient area due to narrow site dimensions	No
PA-07 Central Experimental Farm lands south of Carling	Yes 100 m x 100 m = 10 000 m^2	Yes	High	-Significant impacts to mature trees and utilities	No
Preliminary Recommendation: **No sites being carried forward**					

No staging area sites shown in **Table 2** or **Table 3** are being carried forward because none of these sites demonstrated the adequate design characteristics (i.e. a combination of proximity to the site, route access characteristics, size of staging area, impacts on adjacent uses and ability to relocate the current use of the site).

6. PREFERRED RBR STAGING SITES

Based on this preliminary review, the RBR staging sites considered are shown in **Figure 2**. The evaluation of alternatives resulted in the following:

North Side

- No sites are being carried forward.

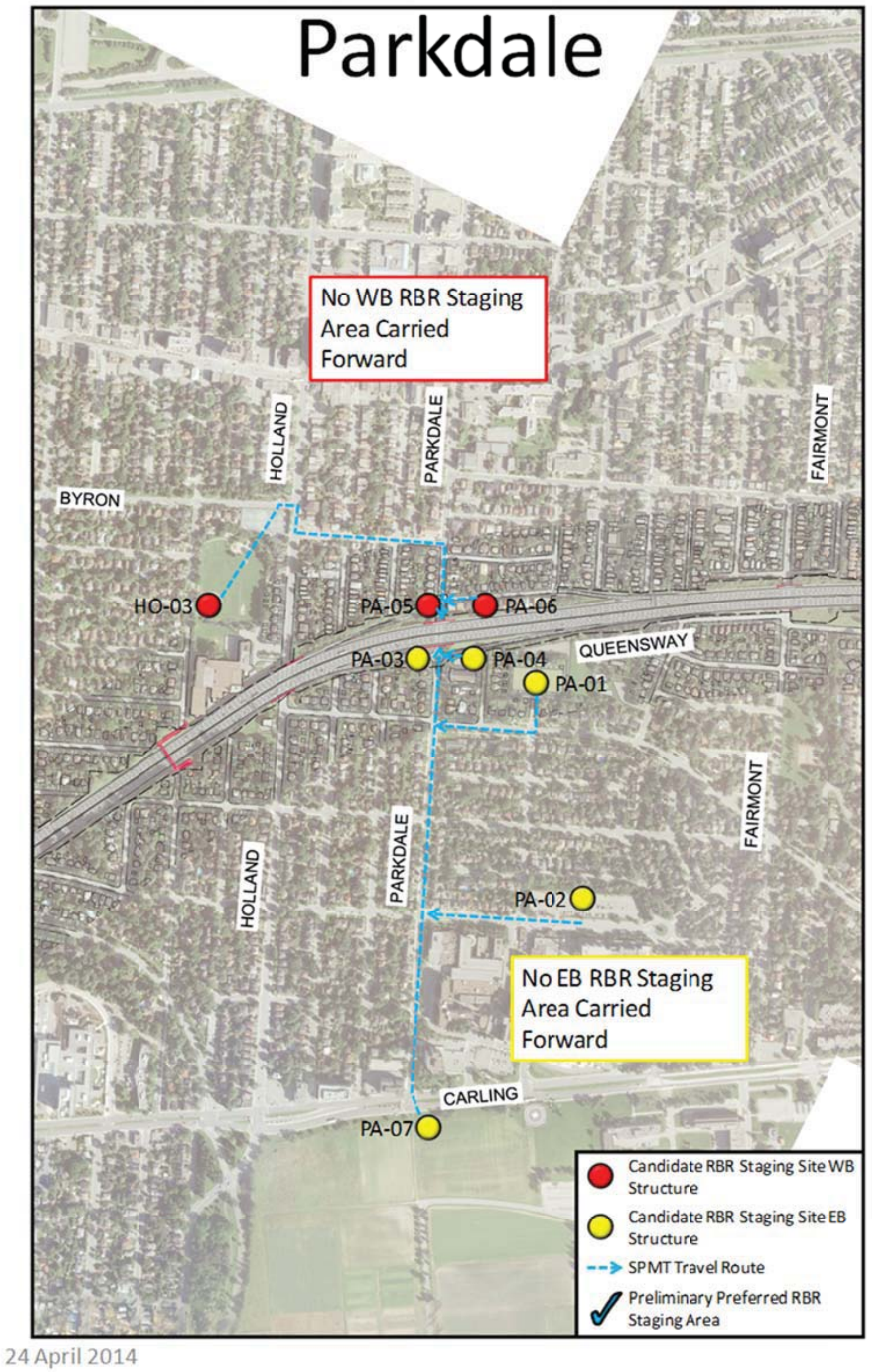
South Side

- No sites are being carried forward.

7. TECHNICALLY PREFERRED ALTERNATIVE

This technical memorandum on potential RBR staging areas has been used as input into the overall technical evaluation of bridge management alternatives. Based on the evaluation of alternatives, RBR is not the technically preferred option for the Parkdale Avenue structures. The overall MATS (Multi-Attribute Tradeoff System) evaluation is described in a standalone Analysis and Evaluation Report. Based on the outcome of the evaluation, there will not be a need for a staging site for the replacement of the bridge.

Figure 2
Location of Shortlisted RBR Staging Areas – Parkdale Avenue (Sites 3-051.1 and 3-051.2)



100 Craig Henry Drive, Suite 103
Ottawa, Ontario, K2G-5W3

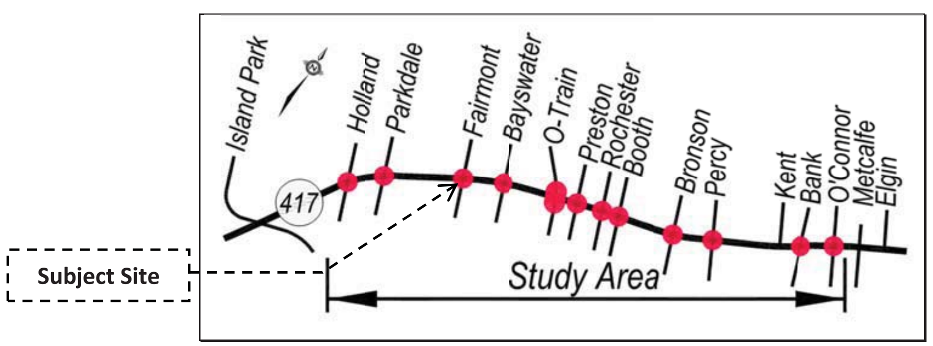
MEMORANDUM

TO:	File BTE13-001	**DATE:**	December 10, 2014
FROM:	Bytown Engineering	**PROJECT #:**	BTE13-001
PROJECT:	Preliminary Design and Environmental Assessment Study for the Rehabilitation/Replacement of Ottawa Queensway Mid-Town Bridges from Holland to O'Connor, GWP# 4075-11-00		
SUBJECT:	Preliminary Review of Staging Area Sites for Rapid Bridge Replacement Option/UPDATE 3 **Fairmont Avenue - Sites 3-052.1 and 3-052.2**		

1. INTRODUCTION

The Ontario Ministry of Transportation (MTO) will, over the next decade, undertake the rehabilitation or replacement of 23 structures on Highway 417 in the City of Ottawa. The structures are generally located within the central part of the City extending from Holland Avenue to O'Connor Street (see ***Figure 1***). The location considered in this review (i.e. Fairmont Avenue structure) is also highlighted.

Figure 1: Study Area



Bridge replacement and rehabilitation options are being considered for all 23 structures under study. The rehabilitation options extend the service life of the bridge by making appropriate and targeted repairs; replacement is considered if a new bridge can be constructed as a cost effective alternative to repairing the existing bridge. The replacement approach considers different bridge types and construction methods. One replacement option includes a Rapid Bridge Replacement (RBR) which entails the removal of the existing structure and insertion of a new structure. This process has been used at other bridge sites on Highway 417 immediately west of the study area; MTO has recently employed the RBR process for structures at Carling Avenue (westbound) and Kirkwood Avenue. This approach requires the closure of the freeway (eastbound and westbound lanes) while the old structure is removed and the new bridge is placed.

MTO has also tendered the first RBR for a rigid frame bridge in Ontario (i.e. Highway 401/Cornwall Centre Road). For a rigid frame bridge, the RBR process requires a duration that exceeds most recent deck replacements on Highway 417. For example, the Highway 401/Cornwall Centre Road pilot project allows 8 weeks for the removal and installation of a new rigid frame bridge.

A Group 'B' Environmental Assessment (EA) is being undertaken by the Ministry of Transportation for a bridge management plan for structural improvements (rehabilitation or replacements) to bridges on the Ottawa Queensway from Holland Avenue easterly to O'Connor Street. The project is being described as the Ottawa Queensway Mid-town bridges project.

The MTO's Provincial Class EA is a planning and design procedure developed to ensure that all potential natural, social/cultural and economic environments as well as property and land use effects are considered in undertaking certain projects.

This document summarizes part of the analysis and evaluation process to define staging areas that could be used to construct replacement bridges using Accelerated Bridge Construction (ABC). The staging areas would provide an area to build new rigid frame bridges and a lay-down area for the contractor, and house the existing bridge temporarily after it is removed for it to be demolished.

This memo reviews candidate staging areas for each of the bridge sites and selects one as a preferred location based on the experience of the previous ABC projects completed by MTO on the Queensway. This will demonstrate that ABC is achievable and then allow for the temporary effects of creating a site and clearing a path from the site to the bridge, to be considered in the evaluation of alternatives. The subsequent evaluation of alternatives will be completed after Public Information Centre (PIC) No. 1, and will systematically analyze, evaluate and select the Technically Preferred Alternatives (TPA's) for the 23 bridge sites under study. This sequential methodology will include community and stakeholder input at all key milestones of the study including consideration of the temporary staging areas. The effects and mitigation as a result of the TPA may be modified during subsequent stages of public consultation and will be further defined at the detail design stage. This document will become a component of the Transportation Environmental Study Report (TESR). The use of temporary staging areas will be negotiated by the MTO Property Section, and the locations identified in this memorandum may be changed at the time of replacement if there are other more suitable sites that can be identified. At this point the identification of a staging area reflects the technical feasibility to implement an ABC project as a candidate alternative using Rapid Bridge Replacement (RBR) with heavy lift technology.

The staging areas for the Queensway Bridges in this study need to be large enough to accommodate the temporary structure where the new bridge is built and the 2 self-propelled modular transporters (SPMT's) that need to be assembled and disassembled. There is also a requirement for a construction lay-down area.

A key consideration for the use of RBR relates to the provision of a construction staging area where the new structure is constructed and prepared for insertion into the existing location (i.e. replaces the old structure). The sequencing of bridge replacement will be addressed following the structural reviews/investigations. This memorandum provides a preliminary assessment of possible RBR construction staging areas at the subject site. Both north side and south side locations are addressed in this review.

2. DESIGN CRITERIA

The design criteria for a suitable RBR staging area should include the following:

1. Large overall area (50 m x 50 m = 2500 m^2) to accommodate new structure, storage of old bridge when removed, lay-down area for contractor and maneuverability of SPMT's.
2. Moderate grades (below 1.5%) on travel route to bridge site.
3. Dimensions of site to exceed the size of the new bridge and include workspace on all sides of the new bridge. Bridges are in the order of (25-30 m) x 25 m so desirable lateral dimension is 50 m and minimum dimension must exceed width/span of new bridge.
4. Where no site is available on one side of the Queensway, both east and westbound bridges may be replaced on the same weekend using a larger staging area on one side of the Queensway.

3. STAGING AREA REVIEW PARAMETERS

The following assumptions were used in this preliminary examination of potential staging sites:

- Property ownership was not explicitly considered in the review. Municipal, private, federal and/or provincial lands were all deemed acceptable.
- The expropriation of property for use as a temporary construction staging area was not considered. Any use or acquisition would be subject to property negotiations.
- The staging sites will require areas for the construction of the new structures and storage of the old structures, and must allow vehicle access/circulation.
- RBR staging areas are required on the north and south sides at each site (unless both bridges are replaced on the same weekend).
- Flat/minimal grades are preferred within the staging area and on the approaches to the replacement site.

Subject: Assessment of Potential Staging Areas for Rapid Bridge Replacement Option – ***FAIRMONT AVENUE***
Project: Preliminary Design and Environmental Assessment Study for the Rehabilitation/Replacement of Ottawa Queensway Mid-Town Bridges from Holland to O'Connor, GWP# 4075-11-00/BTE13-001
Date: December 10, 2014

- Site preparation is required under all options.
- The extension of the staging area into adjacent travel lanes was considered feasible at locations where volumes were minimal and/or multiple travel lanes are provided (unless both bridges are replaced on the same weekend).
- The proposed staging area should be in close proximity to the replacement structure site.
- The site should readily accommodate construction vehicles, preferably on a designated truck route.

Off-site staging areas which meet the guidelines are preferred. It is recognized that there are inherent challenges such as impacts on adjacent residents/land uses, the limited sites available to construct a new structure/store the old structure; the need to relocate utilities; vegetation, trees and other landscape features; and noise/dust issues. Although some challenges exist, the RBR process significantly reduces the amount of time required to close the road to traffic when compared to conventional reconstruction.

4. SITE REVIEW

Fairmont Avenue is a north/south local road accommodating approximately 3,600 vehicles/day (i.e. 2013 AADT at Highway 417). It comprises two lanes under the structure and beyond.

Using the parameters listed in the previous section, a preliminary assessment of possible RBR locations was undertaken. The results are summarized in subsequent tables. It is noted that the dimensions identified in this review were scaled from online mapping services and reflect the level of detail associated with those sources. ***Table 1*** provides a qualitative assessment of the various RBR sites based on ***Good, Fair*** and ***Poor*** criteria. The ratings are meant to quantify, in a broad manner, the potential of each site considering the factors listed above.

The availability of staging areas of the required size in an urban setting such as Central Ottawa is challenging – the preliminary staging sites typically consist of parks/sports fields, commercial/municipal parking areas and extended boulevards. The parks/sports fields identified in this review are located in the middle of established residential communities (i.e. Civic Hospital area). The use of these sites will require the removal of some or all of the existing functions; complete reinstatement will occur following the construction activities.

Table 1
Analysis of Potential RBR Staging Areas – Fairmont Avenue (Sites 3-052.1 and 3-052.2)

	Location	Discussion	RBR Potential
North Side	***FA-01*** – use municipal ROW /Edgar St west of Fairmont	• Available area approx. 23 m x 120m = 2760 m^2 • Less than 50 m from staging area to bridge site (via Edgar/ Fairmont) • Construct new structure in intersection area • Old structure to be dismantled in segments and stored on Fairmont/ Edgar Street or Young Street and/or boulevard area adjacent to Highway 417 or possibly in Fairmont Park • Impact to residences on Fairmont and Edgar	• ***FAIR*** → *Impact on nearby residences* → *Narrow site dimensions, but satisfies minimum area requirement of 2500 m^2*
	FA-04 - Hintonburg Park (near Duhamel Street)	• Available area approx. 85 m x 70 m = 5950 m^2 • Approx. 350 m from staging area to bridge structure (via Fairmont Ave) • Travel route from staging area to bridge structure is less than max. allowable grade of 1.5%	• ***FAIR*** → *Impact on nearby residences* → *Site satisfies dimension and area requirements* → *Travel route satisfies grade requirements*
	HO-03 - Fisher Park (north of Fisher School)	• Available area approx. 100 m x 100 m = 10 000 m^2 • Approx. 1300 m (1.3km) from staging area to bridge site (via Byron, Holland, Tyndall, Parkdale, Gladstone, Fairmont)	• ***FAIR*** → *Impact on nearby residences* → *Long/complex travel route*
South Side	***FA-02*** – Municipal / MTO ROW near NE corner of Fairmont/ Young	• Available area approx. 120 m x 25 m = 3000 m^2 • Approx. 50 m from staging area to bridge site (via Young/Fairmont) • Old structure to be dismantled in segments and stored on Fairmont or Young Street or boulevard area adjacent to Highway 417 or possibly in Fairmont Park • Impact to residences on Fairmont and Young • Grade adjustments required at boulevard area	• ***POOR*** → *Watermain runs directly underneath site* → *Impact on nearby residences/church* → *Would require extensive sheet piling along Queensway to create staging area site* → *Grade adjustments required*
	FA-03 - Fairmont Park Area	• Available area approx. 150 m x 70 m = 10 500 m^2 • Approx. 175 m from staging area to bridge site (via Fairmont) • Impact on playground functions • Impact to residences on Fairmont Ave • Removal of vegetation/trees required • Construction vehicles must travel through residential areas • Major preparation to access route to bridge site (i.e. via Fairmont Avenue)	• ***FAIR*** → *Impacts recreational uses* → *Impact on nearby residences* → *Construction vehicles access staging area via residential roadways*

5. COARSE SCREENING EVALUATION OF RBR STAGING SITES

The potential candidate RBR staging areas were assessed as part of a coarse screening analysis against three criteria (size, access route gradient and access route impacts) to assess if a site was feasible to carry forward. The conclusions of this assessment are presented in **Table 2** and **Table 3**.

Table 2
RBR Staging Area Coarse Screening Analysis
Bridge Site: Fairmont Avenue WB

Candidate RBR Staging Area	Achieve Minimum Area requirement (2500 m^2) Yes/No	Route Access: Meet Gradient requirement <1.5% slope	Route Access: Level of Impact on Travel Route	Comments	Carry Forward Yes/No
FA-01 Municipal right-of-way /Edgar Street west of Fairmont	Yes 23 m x 120 m = 2760 m^2	Yes	Low	Site is too narrow to be used as a staging area	No
FA-04 Hintonburg Park Duhamel Street	Yes 85 m x 70 m = 5950 m^2	Yes	Fairmont Avenue - High	Fairmont Avenue has impacts to mature trees and utilities	No
H0-03 School playground park (Fisher Park playground) north of Fisher Park on west side of Holland (using a Holland Ave site)	Yes 100 m x 100 m = 10 000 m^2	Yes	Very High – Impacts on Byron, Holland, Tyndall, Parkdale, Gladstone, and Fairmont	High impact on Tyndall Street (local street)	No
Preliminary Recommendation: **No sites will be carried forward**					

Table 3
RBR Staging Area Coarse Screening Analysis
Bridge Site: Fairmont Avenue EB

Candidate RBR Staging Area	Achieve Minimum Area requirement ($2500\ m^2$) Yes/No	Route Access: Meet Gradient requirement <1.5% slope	Route Access: Level of Impact on Travel Route	Comments	Carry Forward Yes/No
FA-02 – Municipal / MTO ROW near NE corner of Fairmont/ Young	Yes (120 m x 25 m = $3000\ m^2$)	No	Low	-Irregular shaped site will require extensive sheet piling along Queensway to create staging area site. -Large watermain located within site boundaries	No
FA-03 Fairmont Park Area	Yes 195 m x (varies 75-90 m) = $14625\text{-}17550\ m^2$	Yes	High	Narrow road right-of-way on Fairmont south of Kinnear Street	No
Preliminary recommendation: **No sites will be carried forward**					

None of the sites shown in **Table 2** or **Table 3** adequately meet the criteria for the north or south Fairmont Avenue Queensway bridge structure replacements. A variety of criteria were considered including: proximity to the site route access characteristics, size of staging area, impacts on adjacent uses and ability to relocate the current use of the site.

6. PREFERRED RBR STAGING SITES

Based on this preliminary review, the RBR staging sites considered are shown in **Figure 2**. The evaluation of alternatives resulted in the following:

North Side

- No sites are being carried forward.

South Side

- No sites are being carried forward.

7. TECHNICALLY PREFERRED ALTERNATIVE

This technical memorandum on potential RBR staging areas has been used as input into the overall technical evaluation of bridge management alternatives. Based on the evaluation of alternatives, RBR is not the technically preferred option for the Fairmont Avenue bridge structure. The overall MATS (Multi-Attribute Tradeoff System) evaluation is described in a standalone Analysis and Evaluation Report. Based on the outcome of the evaluation, there will not be a need for a staging site for the replacement of the bridge.

Figure 2
Location of Shortlisted RBR Staging Areas – Fairmont Avenue (Sites 3-052.1 and 3-052.2)

29 April 2014

100 Craig Henry Drive, Suite 103
Ottawa, Ontario, K2G-5W3

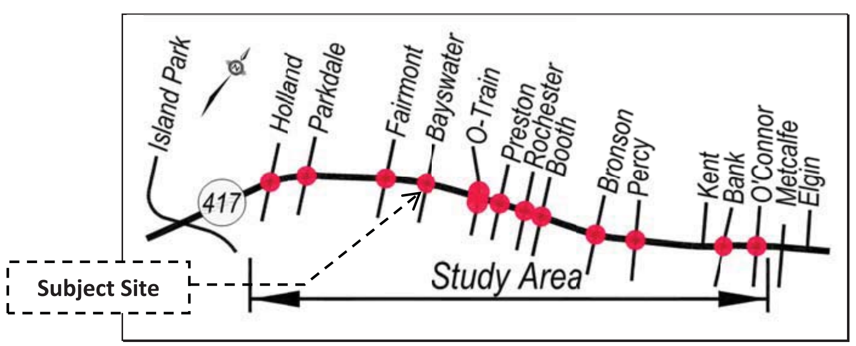
MEMORANDUM

TO:	File BTE13-001	**DATE:**	December 10, 2014
FROM:	Bytown Engineering	**PROJECT #:**	BTE13-001
PROJECT:	Preliminary Design and Environmental Assessment Study for the Rehabilitation/Replacement of Ottawa Queensway Mid-Town Bridges from Holland to O'Connor, GWP# 4075-11-00		
SUBJECT:	Preliminary Review of Staging Area Sites for Rapid Bridge Replacement Option/UPDATE 3 **Bayswater Avenue - Sites 3-053.1 and 3-053.2**		

1. INTRODUCTION

The Ontario Ministry of Transportation (MTO) will, over the next decade, undertake the rehabilitation or replacement of 23 structures on Highway 417 in the City of Ottawa. The structures are generally located within the central part of the City extending from Holland Avenue to O'Connor Street (see ***Figure 1***). The location considered in this review (i.e. Bayswater Avenue structure) is also highlighted.

Figure 1: Study Area



Bridge replacement and rehabilitation options are being considered for all 23 structures under study. The rehabilitation options extend the service life of the bridge by making appropriate and targeted repairs; replacement is considered if a new bridge can be constructed as a cost effective alternative to repairing the existing bridge. The replacement approach considers different bridge types and construction methods. One replacement option includes a Rapid Bridge Replacement (RBR) which entails the removal of the existing structure and insertion of a new structure**.** This process has been used at other bridge sites on Highway 417 immediately west of the study area; MTO has recently employed the RBR process for structures at Carling Avenue (westbound) and Kirkwood Avenue. This approach requires the closure of the freeway (eastbound and westbound lanes) while the old structure is removed and the new bridge is placed.

MTO has also tendered the first RBR for a rigid frame bridge in Ontario (i.e. Highway 401/Cornwall Centre Road). For a rigid frame bridge, the RBR process requires a duration that exceeds most recent deck replacements on Highway 417. For example, the Highway 401/Cornwall Centre Road pilot project allows 8 weeks for the removal and installation of a new rigid frame bridge.

A Group 'B' Environmental Assessment (EA) is being undertaken by the Ministry of Transportation for a bridge management plan for structural improvements (rehabilitation or replacements) to bridges on the Ottawa Queensway from Holland Avenue easterly to O'Connor Street. The project is being described as the Ottawa Queensway Mid-town bridges project.

The MTO's Provincial Class EA is a planning and design procedure developed to ensure that all potential natural, social/cultural and economic environments as well as property and land use effects are considered in undertaking certain projects.

This document summarizes part of the analysis and evaluation process to define staging areas that could be used to construct replacement bridges using Accelerated Bridge Construction (ABC). The staging areas would provide an area to build new rigid frame bridges and a lay-down area for the contractor, and house the existing bridge temporarily after it is removed for it to be demolished.

This memo reviews candidate staging areas for each of the bridge sites and selects one as a preferred location based on the experience of the previous ABC projects completed by MTO on the Queensway. This will demonstrate that ABC is achievable and then allow for the temporary effects of creating a site and clearing a path from the site to the bridge, to be considered in the evaluation of alternatives. The subsequent evaluation of alternatives will be completed after Public Information Centre (PIC) No. 1, and will systematically analyze, evaluate and select the Technically Preferred Alternatives (TPA's) for the 23 bridge sites under study. This sequential methodology will include community and stakeholder input at all key milestones of the study including consideration of the temporary staging areas. The effects and mitigation as a result of the TPA may be modified during subsequent stages of public consultation and will be further defined at the detail design stage. This document will become a component of the Transportation Environmental Study Report (TESR). The use of temporary staging areas will be negotiated by the MTO Property Section, and the locations identified in this memorandum may be changed at the time of replacement if there are other more suitable sites that can be identified. At this point the identification of a staging area reflects the technical feasibility to implement an ABC project as a candidate alternative using Rapid Bridge Replacement (RBR) with heavy lift technology.

The staging areas for the Queensway Bridges in this study need to be large enough to accommodate the temporary structure where the new bridge is built and the 2 self-propelled modular transporters (SPMT's) that need to be assembled and disassembled. There is also a requirement for a construction lay-down area.

A key consideration for the use of RBR relates to the provision of a construction staging area where the new structure is constructed and prepared for insertion into the existing location (i.e. replaces the old structure). The sequencing of bridge replacement will be addressed following the structural reviews/investigations. This memorandum provides a preliminary assessment of possible RBR construction staging areas at the subject site. Both north side and south side locations are addressed in this review.

2. DESIGN CRITERIA

The design criteria for a suitable RBR staging area should include the following:

1. Large overall area (50 m x 50 m = 2500 m^2) to accommodate new structure, storage of old bridge when removed, lay-down area for contractor and maneuverability of SPMT's.
2. Moderate grades (below 1.5%) on travel route to bridge site.
3. Dimensions of site to exceed the size of the new bridge and include workspace on all sides of the new bridge. Bridges are in the order of (25-30 m) x 25 m so desirable lateral dimension is 50 m and minimum dimension must exceed width/span of new bridge.
4. Where no site is available on one side of the Queensway, both east and westbound bridges may be replaced on the same weekend using a larger staging area on one side of the Queensway.

3. STAGING AREA REVIEW PARAMETERS

The following assumptions were used in this preliminary examination of potential staging sites:

- Property ownership was not explicitly considered in the review. Municipal, private, federal and/or provincial lands were all deemed acceptable.
- The expropriation of property for use as a temporary construction staging area was not considered. Any use or acquisition would be subject to property negotiations.
- The staging sites will require areas for the construction of the new structures and storage of the old structures, and must allow vehicle access/circulation.
- RBR staging areas are required on the north and south sides at each site (unless both bridges are replaced on the same weekend).
- Flat/minimal grades are preferred within the staging area and on the approaches to the replacement site.

Subject: Assessment of Potential Staging Areas for Rapid Bridge Replacement Option – ***BAYSWATER AVENUE***
Project: Preliminary Design and Environmental Assessment Study for the Rehabilitation/Replacement of Ottawa Queensway Mid-Town Bridges from Holland to O'Connor, GWP# 4075-11-00/BTE13-001
Date: December 10, 2014

- Site preparation is required under all options.
- The extension of the staging area into adjacent travel lanes was considered feasible at locations where volumes were minimal and/or multiple travel lanes are provided (unless both bridges are replaced on the same weekend).
- The proposed staging area should be in close proximity to the replacement structure site.
- The site should readily accommodate construction vehicles, preferably on a designated truck route.

Off-site staging areas which meet the guidelines are preferred. It is recognized that there are inherent challenges such as impacts on adjacent residents/land uses, the limited sites available to construct a new structure/store the old structure; the need to relocate utilities; vegetation, trees and other landscape features; and noise/dust issues. Although some challenges exist, the RBR process significantly reduces the amount of time required to close the road to traffic when compared to conventional reconstruction.

4. SITE REVIEW

Bayswater Avenue is a north/south local roadway accommodating slightly less than 2,000 vehicles/day (i.e. 2013 AADT north of Highway 417). It comprises two lanes under the structure and beyond.

The availability of staging areas of the required size in an urban setting such as Central Ottawa is challenging – the preliminary staging sites typically consist of parks/sports fields, commercial/municipal parking areas and extended boulevards. The use of these sites will require the removal of some or all of the existing functions; complete reinstatement will occur following the construction activities.

Using the parameters listed in the previous section, a preliminary assessment of possible RBR locations was undertaken. The results are summarized in subsequent tables. It is noted that the dimensions identified in this review were scaled from online mapping services and reflect the level of detail associated with those sources. ***Table 1*** provides a qualitative assessment of the various RBR sites based on ***Good, Fair*** and ***Poor*** criteria. The ratings are meant to quantify, in a broad manner, the potential of each site considering the factors listed above.

Table 1
Analysis of Potential RBR Staging Areas – Bayswater Avenue (Sites 3-053.1 and 3-053.2)

	Location	Discussion	RBR Potential
North Side	***BA-01*** – use municipal ROW	• Available area approx. 45 m x 75 m = 3375 m^2 • Staging area located adjacent to bridge site (within 30 m) • Residential buyouts required to increase work zone to acceptable size • Construct new structure in roadway • Old structure to be dismantled in segments and stored on Bayswater south of Highway 417 • Impact to residences on Bayswater and Young	• ***POOR*** → *Impact on nearby residences* → *Residential buyouts required* → *Constrained work zone*
	BA-05 – Tom Brown Arena	• Available area approx. (varies 130-210 m) x (varies 95-180 m) = 12350-37800 m^2 • Irregularly shaped lot, but meets both area and dimension requirements • Approx. 850 m from staging area to bridge structure (via Bayview/Bayswater) • Impacts to residences on Bayview Road and Bayswater Avenue • Max. allowable grade of 1.5% exists along travel route	• ***FAIR*** → *Meets area and dimension requirements* → *Relatively long travel route from staging area to bridge structure* → *Major impacts to residences along Bayswater during bridge removal/replacement*
South Side	***BA-02*** – use municipal ROW	• Available area approx. 55 m x 35 m = 1925 m^2 • Staging area located within 30 m of bridge site (via Bayswater) • Construct new structure in roadway • Old structure to be dismantled in segments and stored on Bayswater north of Highway 417 • Impact to residences on Bayswater and Young	• ***POOR*** → *Does not meet area or dimension requirements* → *Impact on nearby residences* → *Constrained work zone*
	BA-03 – Parking/ landscaped area immediately north of Heritage Academy School on east side of Bayswater	• Available area approx. 100 m x (varies 25 – 70 m) = 2500 m^2 – 7000 m^2 • Approx. 200 m from staging area to bridge site (via Bayswater) • Relatively direct route to structure • Impact on school parking function • Impact to adjacent residences on Bayswater • Removal of vegetation/trees required • Minor grade change on approach to structure • Max allowable grade of 1.5% exists along travel route	• ***FAIR*** → *Impact on school functions* → *Impact on nearby residences* → *Moderate distance from staging area to bridge site* → *Construction vehicles access staging area via residential roadways*
	BA-04 – Parking area immediately east of church on east side of Bayswater at Young	• Available area approx. 35 m x 40 m = 1400 m^2 • Approx. 200 m from staging area to bridge site (via Breezehill/Young/Bayswater) • Impact on church parking function • Impact to residences on Breezehill and Young • Transport of new bridge requires 2 right turn movements • Minor grade change on north approach to structure	• ***POOR*** → *Size/dimensions of site do not meet requirement* → *Impact on church functions* → *Impact on nearby residences* → *Moderate distance from staging area to bridge site* → *Construction vehicles*

			access staging area via residential roadways
	FA-02 – MTO and municipal right-of-way (Fairmont site)	• Available area approx. 120 m x 25 m = 3000 m^2 • Approx. 120 m from staging area to bridge site (via Young/Bayswater) • High impact to utilities, mature trees and retaining walls on front yards • Irregular shaped site will require extensive sheet piling along Queensway to create staging area site • Max. allowable grade of 1.5% exists along travel route	• ***POOR*** → *Major utility impacts* → *Tree removal and extensive re-landscaping would be required* → *Impact on nearby residences* → *Moderate distance from staging area to bridge site* → *Grade requirements satisfied*

5. COARSE SCREENING EVALUATION OF RBR SITES

The potential candidate RBR staging areas were assessed as part of a coarse screening analysis against three criteria (size, access route gradient and access route impacts) to assess if a site was feasible to carry forward. The conclusions of this assessment are presented in **Table 2** and **Table 3**.

Table 2
RBR Staging Area Coarse Screening Analysis
Bridge Site: Bayswater Avenue WB

Candidate RBR Staging Area	Achieve Minimum Area requirement (2500 m²) Yes/No	Route Access: Meet Gradient requirement <1.5% slope	Route Access: Level of Impact on Travel Route	Comments	Carry Forward Yes/No
BA-01 Municipal right-of-way widening to west side of street	Yes 45 m x 75 m = 3150 m^2	Yes	Low	Requires residential buyouts	No
BA-05 Tom Brown Arena	Yes (varies 130-210 m) x (varies 95-180 m) = 12350-37800 m^2	Yes	High	Travel route has high impact using narrow municipal right-of-way	No
Preliminary Recommendation: **No sites available to carry forward**					

Table 3
RBR Staging Area Coarse Screening Analysis
Bridge Site: Bayswater Avenue EB

Candidate RBR Staging Area	Achieve Minimum Area requirement (2500 m²) Yes/No	Route Access: Meet Gradient requirement <1.5% slope	Route Access: Level of Impact on Travel Route	Comments	Carry Forward Yes/No
BA-02 Municipal right-of-way	No 55 x 35 m = 1925 m^2	Yes	Low	Travel impact on route is low	No
BA-03 Parking/ landscaped area north of Heritage Academy School	Yes 100 m x (varies 25-70m) = 2500-7000 m^2	Yes	High	The local street cross section is narrow and route would have high impacts to mature trees and heritage church	No
BA-04 Parking area east of church on east side of Bayswater	No 35 m x 45 m = 1575 m^2	Yes	Moderate	Impact on church parking lot and nearby residences along the travel route	No
FA-02 MTO and municipal right-of-way (Fairmont Site)	Yes (120 m x 25 m = 3000 m²)	No	High - impact to utilities, mature trees and retaining walls on front yards	Irregular shaped site will require extensive sheet piling along Queensway to create staging area site.	No
Preliminary Recommendation: **No sites available to carry forward**					

None of the bridge structure sites shown in **Table 2** or **Table 3** meet the criteria for a desirable staging area site (i.e. a combination of proximity to the site, route access characteristics, size of staging area, impacts on adjacent uses and ability to relocate the current use of the site).

6. PREFERRED RBR STAGING SITES

Based on this preliminary review, the RBR staging sites considered are shown in **Figure 2**. The evaluation of alternatives resulted in the following:

North Side

- No sites are being carried forward.

South Side

- No sites are being carried forward.

7. TECHNICALLY PREFERRED ALTERNATIVE

This technical memorandum on potential RBR staging areas has been used as input into the overall technical evaluation of bridge management alternatives. Based on the evaluation of alternatives, RBR is not the technically preferred option for the Bayswater Avenue structure. The overall MATS (Multi-Attribute Tradeoff System) evaluation is described in a standalone Analysis and Evaluation Report. Based on the outcome of the evaluation, there will not be a need for a staging site for the replacement of the bridge.

Subject: Assessment of Potential Staging Areas for Rapid Bridge Replacement Option – ***BAYSWATER AVENUE***
Project: Preliminary Design and Environmental Assessment Study for the Rehabilitation/Replacement of Ottawa Queensway Mid-Town Bridges from Holland to O'Connor, GWP# 4075-11-00/BTE13-001
Date: December 10, 2014

Figure 2
Location of Shortlisted RBR Staging Areas – Bayswater Avenue (Sites 3-053.1 and 3-053.2)

24 April 2014

100 Craig Henry Drive, Suite 103
Ottawa, Ontario, K2G-5W3

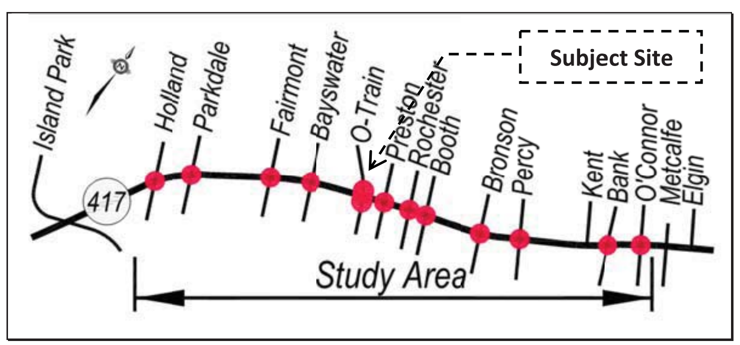
MEMORANDUM

TO:	File BTE13-001	**DATE:**	September 2, 2014
FROM:	Bytown Engineering	**PROJECT #:**	BTE13-001
PROJECT:	Preliminary Design and Environmental Assessment Study for the Rehabilitation/Replacement of Ottawa Queensway Mid-Town Bridges from Holland to O'Connor, GWP# 4075-11-00		
SUBJECT:	Preliminary Review of Staging Area Sites for Rapid Bridge Replacement Option/**UPDATE 4 O-Train - Sites 3-054.1 and 3-054.2**		

1. INTRODUCTION

The Ontario Ministry of Transportation (MTO) will, over the next decade, undertake the rehabilitation or replacement of 23 structures on Highway 417 in the City of Ottawa. The structures are generally located within the central part of the City extending from Holland Avenue to O'Connor Street (see ***Figure 1***). The location considered in this review (i.e. O-Train structure) is also highlighted.

Figure 1: Study Area



Bridge replacement and rehabilitation options are being considered for all 23 structures under study. The rehabilitation options extend the service life of the bridge by making appropriate and targeted repairs; replacement is considered if a new bridge can be constructed as a cost effective alternative to repairing the existing bridge. However, rehabilitation approaches are not being considered for the CPR/O-Train structures. One replacement option considered at the CPR/O-Train site involves the construction of the new bridge superstructure adjacent to the bridge and a jack and slide insertion into place. This approach requires the closure of the freeway (eastbound and westbound lanes) while the old structure is removed and the new bridge is placed. A staging area is required for all of the O-Train bridge replacement options.

A key consideration for the use of jack and slide construction relates to the provision of a construction staging area adjacent to the new structure. This memorandum provides a preliminary assessment of possible construction staging areas at the subject site.

2. STAGING AREA REVIEW PARAMETERS

The following assumptions were used in this preliminary examination of potential staging sites:

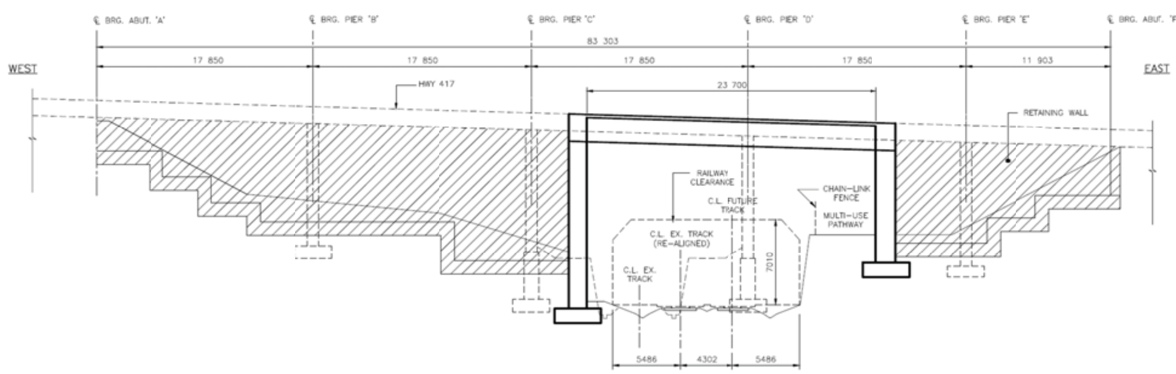
- Property ownership was not explicitly considered in the review. Municipal, private, and federal (NCC) lands will be required at the O-Train site.
- The purchase of property for use as a temporary construction staging area has been considered for the EBL staging area as the property would have conflicts with both the staging area and the new bridge.
- The staging sites will require areas for the construction of the new structures but not storage of the old structure. The rapid demolition of the existing bridges can be accomplished by a combination of trucking portions of the existing deck and beams and dropping the superstructure directly below (the O-Train operation would be protected); disposal can then occur after the new bridge is slid into place.
- Staging areas are required on the north and south sides at each site (unless both bridges are slid from one side).
- Flat/minimal grades are preferred within the staging area and on the approaches to the replacement site.
- Site preparation is required under all options including the construction of temporary track protection over the O-Train.
- The proposed staging area should be adjacent to the replacement structure site to allow the jack and slide technology being considered by the Structural Team.
- For this site, the existing rail tracks would remain intact (i.e. there would be no adjustment in grade).
- The O-Train would remain operational, to the greatest extent possible, during construction activities with a planned weekend closure.
- The new structure would provide sufficient room for the planned double tracking of the O Train.
- Two options to accommodate the existing multi-use pathway were explored:
  - One option included a multi-use pathway within the structure (per the current arrangement)
  - A second option redirects pedestrian and cyclists to the local road network.

At this juncture, two bridge replacement alternatives are being explored that utilize the jack and slide technology for the rapid bridge replacement. These include a single span and 3-span alternatives to replace the existing 5-span 86 m long structure.

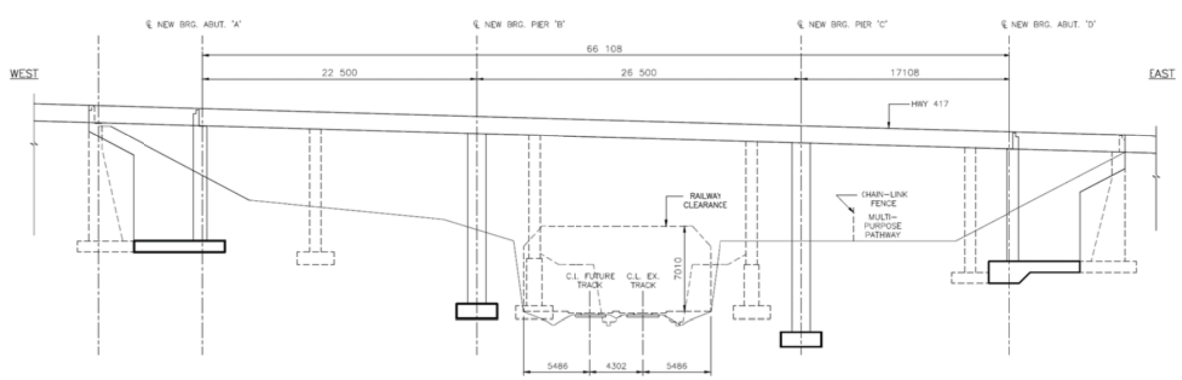
3. SITE REVIEW

The two O-Train sites represent the largest structures under review. Each existing structure consists of five spans totalling approximately 86.0 m (length) x 31.0 m (width). Following guidance from structural staff, this discussion of staging sites has assumed that the single structure will be replaced by either a single span bridge jack and slide option (Alternative H) or a 3-span jack and slide option (Alternative I). Each is shown below. For the O Train site, the planned RBR approach for the new deck will be to prefabricate it on temporary platforms alongside the existing bridge, and slide into place after the existing bridge is removed. A single span bridge can be slid in one stage. For a 3-span bridge, it is presumed that the new decks will have to slide in 3 stages while Highway 417 is closed.

Alternative H: Single Span Jack and Slide Alternative



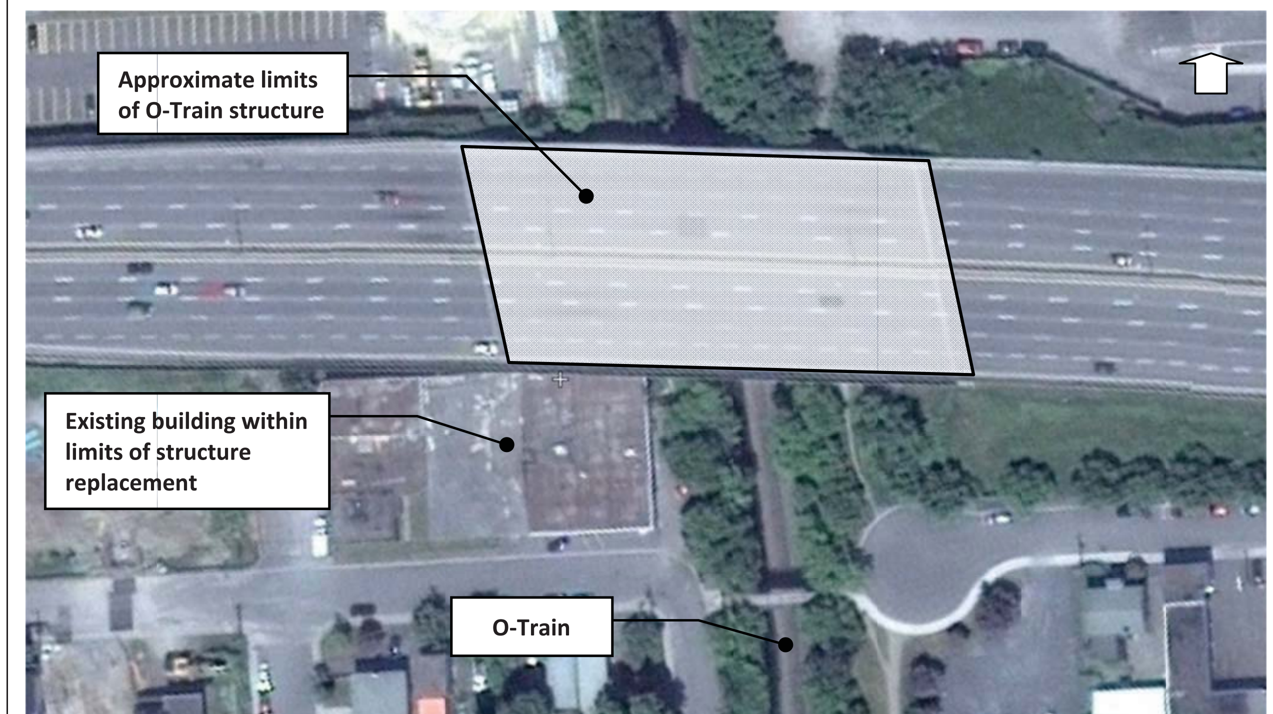
Alternative I: Three Span Jack and Slide Alternative



The limits of the existing bridge and the features of the area are illustrated in ***Figure 2***.

Subject: Assessment of Potential Staging Areas for Rapid Bridge Replacement Option – ***O-TRAIN SITE***
Project: Preliminary Design and Environmental Assessment Study for the Rehabilitation/Replacement of Ottawa Queensway Mid-Town Bridges from Holland to O'Connor, GWP# 4075-11-00/BTE13-001
Date: September 2, 2014

Figure 2
O-Train Site Characteristics

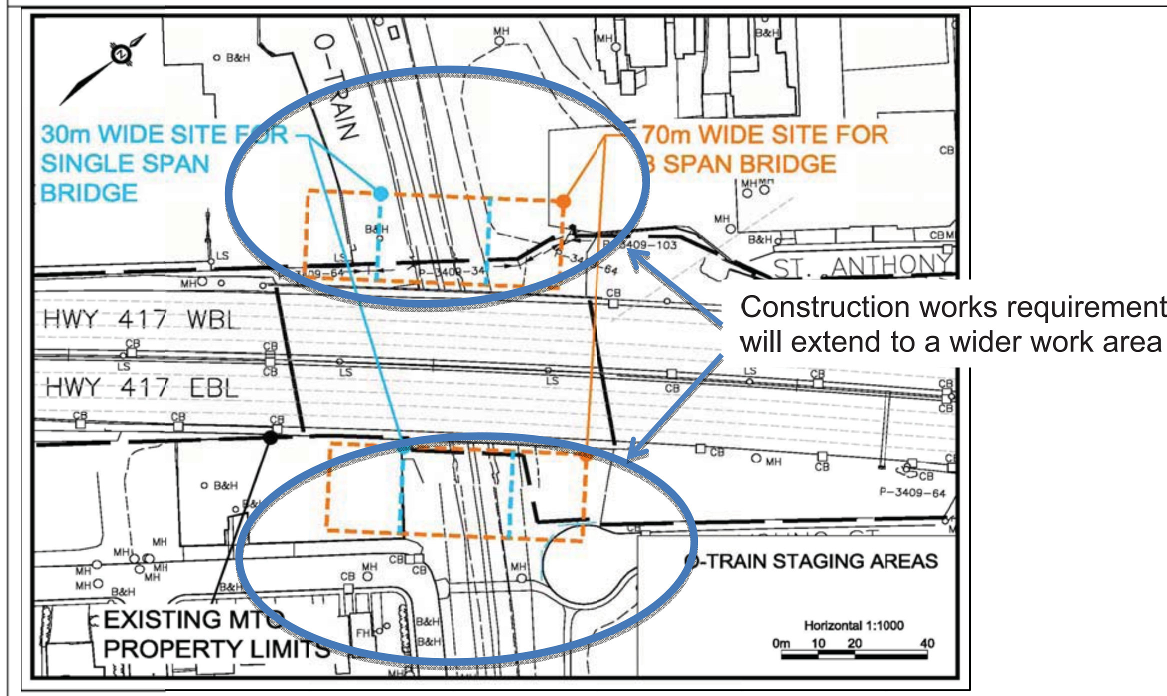


The figure indicates that an existing building on the south side of Highway 417 and west of the O-Train extends well into the limits of the O-Train structure. It is also evident that any replacement options will be greatly affected by the presence of this industrial property.

Figure 3 shows the work zone that will be required for the north and south bridge structures.

Figure 3

Construction Work Zones



Subject: Assessment of Potential Staging Areas for Rapid Bridge Replacement Option – ***O-TRAIN SITE***
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Date: September 2, 2014

4. TECHNICAL REVIEW OF JACK AND SLIDE SITES

The selection of appropriate Jack and Slide Access Alternative staging areas for the O-Train site is limited or impacted by the following:

- Presence of the rail track.
- The need to maintain rail service during construction.
- Configuration of the existing structure.
- The presence of an existing building to the southwest of the structure.
- Accessibility constraints including the need to employ local roadways to access the sites.
- The need to provide a site that ensures ease and efficiency for construction activities.

In general terms, a new bridge is built on temporary supports (i.e. over the O-Train) parallel to the existing structure on Highway 417. Once construction is complete, the road is closed and the existing bridge structure is demolished or removed. The new bridge is positioned into place and tied into the east and west approaches. In terms of accessibility to the north and south sides of the O-Train structure, there are a number of potential options available.

Table 1 and **Table 2** present a discussion and preliminary evaluation of the north side and south side access alternatives to reach the staging areas.

Table 1
Preferred Access Routes to O-Train Jack and Slide Staging Area (North Side)

Option	Discussion	RBR Potential
OT-01 – use abandoned roadway/pathway on west side of O-Train tracks; enter/exit via Gladstone	• Existing gravel pathway - improvement to route required for truck access • Improvements can remain for possible use as multi use pathway (if feasible) • Two-way travel requires control of vehicles	• ***GOOD*** → *Limited impacts* → *Unused facility*
OT-02 – use existing multiuse pathway on east side of tracks; enter/exit via Gladstone	• Existing gravel pathway - improvement to route required for truck access • Improvements can remain for use as multi use pathway • Impacts to activities on pathway • Two-way travel requires control of vehicles	• ***GOOD*** → *Impacts to activities on pathway*
OT-03 – use abandoned roadway/pathway on west side of tracks to enter site; and use existing multiuse pathway on east side of tracks to exit site; enter/exit via Gladstone	• Existing gravel pathway - improvement to route required for truck access • Improvements can remain for possible use as multi use pathways • Impacts to activities on existing pathway • One direction of travel per road – no control of vehicles	• ***FAIR*** → *Impacts to activities on pathway* → *Facilitates construction activities*

Table 1
Preferred Access Routes to O-Train Jack and Slide Staging Area (North Side)

Option	***Discussion***	***RBR Potential***
OT-04 – access through City of Ottawa Traffic Operations parking area (enter/exit via Loretta/ Gladstone)	• Requires travel through City parking area and potential conflicts with manoeuvring vehicles • Requires travel on Loretta – impact to abutting residences • Relatively direct route to RBR site	• ***FAIR*** → *Impact on parking supply* → *Noise and vibration impacts to Traffic Control facilities and residences on Loretta*
OT-05 – enter/exit via St. Anthony Street (and attached parking lot)	• Requires travel through parking area and potential conflicts with manoeuvring vehicles • Requires removal of on-street parking on St. Anthony and in surface parking area to west • RBR access roadway must cross multi use pathway on east side of O-Train • Most direct route to RBR site	• ***FAIR*** → *Impact on parking supply* → *Direct access to Preston Street (truck route)*
OT-06– enter/exit via Louisa Street and new access road along multi-use pathway	• Requires travel on local residential road • Likely requires removal of on-street parking on north side of Louisa • RBR access roadway uses part of multi use pathway on east side of O-Train	• ***POOR*** → *Impact on on-street parking supply* → *Impact to adjacent residences*

The preferred travel routes (i.e. **OT-01** and **OT-02**) for trucks and other construction vehicles on the north side of the O-Train Queensway bridge structure are highlighted in **Table 1**.

Table 2
Preferred Access Routes to O-Train Jack and Slide Staging Area (South Side)

OT-07 – use Young Street (east of O-Train tracks)	• Local road • Most direct route to City truck route (i.e. Preston Street) • Will likely require removal of on-street parking	• ***GOOD*** → *Impacts to greater number of residences* → *Most direct route to site*
OT-08 – use Beech and Railways Streets	• Both Railway Street and Beech Street are local roads • Signalized intersection at Beech/Preston • Will likely require removal of on-street parking on both roadways • Two-way travel requires control of vehicles	• ***FAIR*** → *Impacts to greater number of residences* → *Indirect route to site*
OT-09 – use Young Street (west of O-Train tracks)	• Young Street is a local roadway • Will likely require the removal of on-street parking • Use Gladstone/Bayswater/Young Street to access construction area • Signalized intersection at Gladstone and Bayswater	• ***Poor*** → *Impacts to residences on Bayswater & Young*

The preferred travel route (i.e. **OT-07**) for trucks and other construction vehicles on the south side of the O-Train Queensway bridge structure are highlighted in **Table 2**.

Figure 3 illustrates the access routes considered in **Table 1** and **Table 2**.

As stated, there is an existing building on the south side of Highway 417 and west of the O-Train which extends well into the limits of the O-Train structure. It is also evident that any replacement/RBR options will be greatly affected by the presence of this commercial facility. The ***Jack and Slide*** option will require the removal of all or part the aforementioned commercial building on Young Street (i.e. to the south and west of the subject structure). The remaining areas that abut the O-Train structure do not impose any major impediments to the ***Jack and Slide*** option.

5. TECHNICALLY PREFERRED ALTERNATIVE

This technical memorandum on potential construction access routes and staging areas has been used as input into the overall technical evaluation of bridge management alternatives. Based on the evaluation of alternatives, 3-Span ***Jack and Slide*** is the technically preferred option for the CPR/O-Train structure. The overall MATS (Multi-Attribute Tradeoff System) evaluation is described in a standalone Analysis and Evaluation Report. Based on the outcome of the evaluation, there is a need for a staging site for the replacement of the bridge.

Figure 3
Preferred Access Routes - O-Train Jack and Slide Option (North and South Sides)

100 Craig Henry Drive, Suite 103
Ottawa, Ontario, K2G-5W3

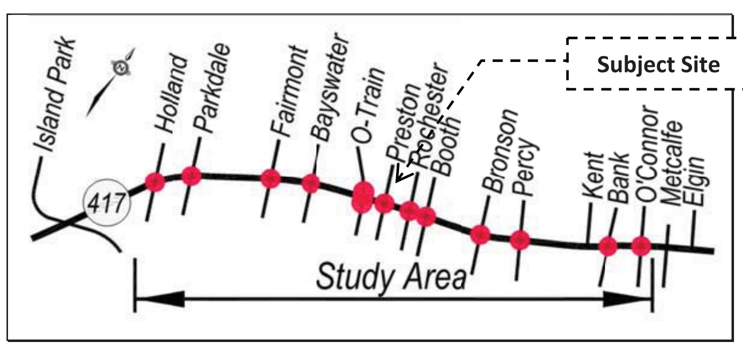
MEMORANDUM

TO:	File BTE13-001	**DATE:**	September 2, 2014
FROM:	Bytown Engineering	**PROJECT #:**	BTE13-001
PROJECT:	Preliminary Design and Environmental Assessment Study for the Rehabilitation/Replacement of Ottawa Queensway Mid-Town Bridges from Holland to O'Connor, GWP# 4075-11-00		
SUBJECT:	Preliminary Review of Staging Area Sites for Rapid Bridge Replacement Option/**UPDATE 2 Preston Street - Sites 3-055.1 and 3-055.2**		

1. INTRODUCTION

The Ontario Ministry of Transportation (MTO) will, over the next decade, undertake the rehabilitation or replacement of 23 structures on Highway 417 in the City of Ottawa. The structures are generally located within the central part of the City extending from Holland Avenue to O'Connor Street (see ***Figure 1***). The location considered in this review (i.e. Preston Street structure) is also highlighted.

Figure 1: Study Area



Bridge replacement and rehabilitation options are being considered for all 23 structures under study. The rehabilitation options extend the service life of the bridge by making appropriate and targeted repairs; replacement is considered if a new bridge can be constructed as a cost effective alternative to repairing the existing bridge. The replacement approach considers different bridge types and construction methods. One replacement option includes a Rapid Bridge Replacement (RBR) which entails the removal of the existing structure and insertion of a new structure. This process has been used at other bridge sites on Highway 417 immediately west of the study area; MTO has recently employed the RBR process for structures at Carling Avenue (westbound) and Kirkwood Avenue. This approach requires the closure of the freeway (eastbound and westbound lanes) while the old structure is removed and the new bridge is placed.

MTO has also tendered the first RBR for a rigid frame bridge in Ontario (i.e. Highway 401/Cornwall Centre Road). For a rigid frame bridge, the RBR process requires a duration that exceeds most recent deck replacements on Highway 417. For example, the Highway 401/Cornwall Centre Road pilot project allows 8 weeks for the removal and installation of a new rigid frame bridge.

A Group 'B' Environmental Assessment (EA) is being undertaken by the Ministry of Transportation for a bridge management plan for structural improvements (rehabilitation or replacements) to bridges on the Ottawa Queensway from Holland Avenue easterly to O'Connor Street. The project is being described as the Ottawa Queensway Mid-town bridges project.

The MTO's Provincial Class EA is a planning and design procedure developed to ensure that all potential natural, social/cultural and economic environments as well as property and land use effects are considered in undertaking certain projects.

This document summarizes part of the analysis and evaluation process to define staging areas that could be used to construct replacement bridges using Accelerated Bridge Construction (ABC). The staging areas would provide an area to build new rigid frame bridges and a lay-down area for the contractor, and house the existing bridge temporarily after it is removed for it to be demolished.

This memo reviews candidate staging areas for each of the bridge sites and selects one as a preferred location based on the experience of the previous ABC projects completed by MTO on the Queensway. This will demonstrate that ABC is achievable and then allow for the temporary effects of creating a site and clearing a path from the site to the bridge, to be considered in the evaluation of alternatives. The subsequent evaluation of alternatives will be completed after Public Information Centre (PIC) No. 1, and will systematically analyze, evaluate and select the Technically Preferred Alternatives (TPA's) for the 23 bridge sites under study. This sequential methodology will include community and stakeholder input at all key milestones of the study including consideration of the temporary staging areas. The effects and mitigation as a result of the TPA may be modified during subsequent stages of public consultation and will be further defined at the detail design stage. This document will become a component of the Transportation Environmental Study Report (TESR). The use of temporary staging areas will be negotiated by the MTO Property Section, and the locations identified in this memorandum may be changed at the time of replacement if there are other more suitable sites that can be identified. At this point the identification of a staging area reflects the technical feasibility to implement an ABC project as a candidate alternative using Rapid Bridge Replacement (RBR) with heavy lift technology.

The staging areas for the Queensway Bridges in this study need to be large enough to accommodate the temporary structure where the new bridge is built and the 2 self-propelled modular transporters (SPMT's) that need to be assembled and disassembled. There is also a requirement for a construction lay-down area.

A key consideration for the use of RBR relates to the provision of a construction staging area where the new structure is constructed and prepared for insertion into the existing location (i.e. replaces the old structure). The sequencing of bridge replacement will be addressed following the structural reviews/investigations. This memorandum provides a preliminary assessment of possible RBR construction staging areas at the subject site. Both north side and south side locations are addressed in this review.

2. DESIGN CRITERIA

The design criteria for a suitable RBR staging area should include the following:

1. Large overall area (50 m x 50 m = 2500 m^2) to accommodate new structure, storage of old bridge when removed, lay-down area for contractor and maneuverability of SPMT's.
2. Moderate grades (below 1.5%) on travel route to bridge site.
3. Dimensions of site to exceed the size of the new bridge and include workspace on all sides of the new bridge. Bridges are in the order of (25-30 m) x 25 m so desirable lateral dimension is 50 m and minimum dimension must exceed width/span of new bridge.
4. Where no site is available on one side of the Queensway, both east and westbound bridges may be replaced on the same weekend using a larger staging area on one side of the Queensway.

3. STAGING AREA REVIEW PARAMETERS

The following assumptions were used in this preliminary examination of potential staging sites:

- Property ownership was not explicitly considered in the review. Municipal, private, federal and/or provincial lands were all deemed acceptable.
- The expropriation of property for use as a temporary construction staging area was not considered. Any use or acquisition would be subject to property negotiations.
- The staging sites will require areas for the construction of the new structures and storage of the old structures, and must allow vehicle access/circulation.
- RBR staging areas are required on the north and south sides at each site (unless both bridges are replaced on the same weekend).
- Flat/minimal grades are preferred within the staging area and on the approaches to the replacement site.

Subject: Assessment of Potential Staging Areas for Rapid Bridge Replacement Option – ***PRESTON STREET***
Project: Preliminary Design and Environmental Assessment Study for the Rehabilitation/Replacement of Ottawa Queensway Mid-Town Bridges from Holland to O'Connor, GWP# 4075-11-00/BTE13-001
Date: September 2, 2014

- Site preparation is required under all options.
- The extension of the staging area into adjacent travel lanes was considered feasible at locations where volumes were minimal and/or multiple travel lanes are provided (unless both bridges are replaced on the same weekend).
- The proposed staging area should be in close proximity to the replacement structure site.
- The site should readily accommodate construction vehicles, preferably on a designated truck route.

Off-site staging areas which meet the guidelines are preferred. It is recognized that there are inherent challenges such as impacts on adjacent residents/land uses, the limited sites available to construct a new structure/store the old structure; the need to relocate utilities; vegetation, trees and other landscape features; and noise/dust issues. Although some challenges exist, the RBR process significantly reduces the amount of time required to close the road to traffic when compared to conventional reconstruction.

4. SITE REVIEW

Each Preston Street structure (i.e. EB and WB sites) is approximately 21.0 m (length) x 19.0 m (width). This underpass structure is located within an established commercial area; there is no access to Highway 417 at this location.

The availability of staging areas of the required size in an urban setting such as Central Ottawa is challenging – the preliminary staging sites typically consist of parks/sports fields, commercial/municipal parking areas and extended boulevards. The use of these sites will require the removal of some or all of the existing functions; complete reinstatement will occur following the construction activities.

Using the parameters listed in the previous section, a preliminary assessment of possible RBR locations was undertaken. The results are summarized in subsequent tables. It is noted that the dimensions identified in this review were scaled from online mapping services and reflect the level of detail associated with those sources. ***Table 1*** provides a qualitative assessment of the various RBR sites based on ***Good, Fair*** and ***Poor*** criteria. The ratings are meant to quantify, in a broad manner, the potential of each site considering the factors listed above

.

Table 1
Analysis of Potential RBR Staging Areas – Preston Street (Sites 3-055.1 and 3-055.2)

	Location	*Discussion*	*RBR Potential*
North Side	***PR-01*** - School playing field on east side of Preston St.	• Available area approx. 65 m x 120m = 7800 m^2 • Approx. 100 m to bridge site (via Preston) • Impact on playing field functions • Impact on retail uses on south side of Preston St. • Preston is a designated truck route • Max. grade of 1.5% is satisfied along travel route	• ***GOOD*** → *Large, contiguous area near bridge site* → *Impact on recreational and school functions* → *Uses designated truck route*
	PR-02 - Surface parking area on St. Anthony St. between Highway 417 and school playground	• Available area approx. 65 m x 45 m = 2925 m^2 • Approx. 25 m to bridge site (via Preston) • Impact on commercial parking functions • Preston is a designated truck route • No abutting residences/commercial uses • Max. grade of 1.5% is satisfied along travel route	• ***GOOD*** → *Impact on municipal parking functions* → *Extension into adjacent school parking area or playing field may be possible, if required*
South Side	***PR-03*** - Surface parking area east of Preston St. between Beech and Aberdeen	• Available area approx. 65 m x 165 m = 10725 m^2 • Approx. 300 m to bridge site (via Beech/Preston) • Impact on commercial parking functions • Preston is a designated truck route • Max. grade of 1.5% is satisfied along travel route	• ***GOOD*** → *Large contiguous area* → *Preparation of route to bridge site is required*
	PR-04 –Municipal ROW (east side of Preston)	• Available area approx. 120 m x (varies 25-45 m) = 3000 m^2 - 5400 m^2 (via Preston) • Impact on commercial parking functions • Preston is a designated truck route • Max. grade of 1.5% is satisfied along travel route	• ***FAIR*** → *Large overall area, but narrow width is less than desirable in some locations* → *Moderate distance to bridge site* → *Preparation of route to bridge site is required* → *Major rehabilitation of Preston Street recently undertaken*
	PR-05 –EV Tremblay Park at Beech Street and Champagne Street	• Available area approx. 65 m x 85 m = 5525 m^2 • Approx. 475 m to bridge site (via Beech/Preston) • Impact on residences and commercial parking functions • Preston is a designated truck route • Max. grade of 1.5% is satisfied along travel route	• ***FAIR*** → *Large contiguous area* → *Moderate distance to bridge site* → *Preparation of route to bridge site is required* → *Major rehabilitation of Preston Street recently undertaken*
	PR-06 –NCC park lands south of Carling Avenue	• Available area approx. 170 m x (varies by 80 -120 m) = 13 600 m^2 – 20 400 m^2 • Approx. 650 m to bridge site (via Preston) • Parkdale cross section too narrow north of Aberdeen street with existing buildings • Impact on businesses and residences along Preston • Preston is a designated truck route • Max. grade of 1.5% is satisfied along travel route	• ***FAIR*** → *Large contiguous area* → *Moderate distance to bridge site* → *Preparation of route to bridge site is required* → *Major rehabilitation of Preston Street recently undertaken*

Subject: Assessment of Potential Staging Areas for Rapid Bridge Replacement Option – ***PRESTON STREET***
Project: Preliminary Design and Environmental Assessment Study for the Rehabilitation/Replacement of Ottawa Queensway Mid-Town Bridges from Holland to O'Connor, GWP# 4075-11-00/BTE13-001
Date: September 2, 2014

5. COARSE SCREENING EVALUATION OF RBR SITES

The potential candidate RBR staging areas were assessed as part of a coarse screening analysis against three criteria (size, access route gradient and access route impacts) to assess if a site was feasible to carry forward. The conclusions of this assessment are presented in **Table 2** and **Table 3**.

Table 2
RBR Staging Area Coarse Screening Analysis
Bridge Site: Preston Street WB

Candidate RBR Staging Area	**Achieve Minimum Area requirement (2500 m²) Yes/No**	**Route Access: Meet Gradient requirement <1.5% slope**	**Route Access: Level of Impact on Travel Route**	**Comments**	**Carry Forward Yes/No**
PR-01 School playing field on east side of Preston Street	Yes 65 m x 120 m = 7800 m^2	Yes	Medium	Uses designated truck route	Yes
PR-02 Municipal parking lot on Anthony Street between Highway 417 and school playing field	Yes 45 m x 65 m = 2925 m^2	Yes	Low	May need to be used in combination with PR-01, since the dimension on one side is than the desired 50m	Yes
Preliminary Recommendation: **Sites PR-01 and PR-02 are being carried forward**					

Table 3
RBR Staging Area Coarse Screening Analysis
Bridge Site: Preston Street EB

Candidate RBR Staging Area	Achieve Minimum Area requirement (2500 m²) Yes/No	Route Access: Meet Gradient requirement <1.5% slope	Route Access: Level of Impact on Travel Route	Comments	Carry Forward Yes/No
PR-03-Surface Parking Lot east of Preston Street between Beech and Aberdeen	Yes 65 m x 165 m = 10725 m^2	Yes	Moderate	loss of commercial parking	Yes
PR-04 Municipal right-of-way (east side of Preston Street)	Yes 120 m x (varies 25-45 m) = 3000-5400 m^2	Yes	Moderate	loss of commercial parking	No (Preference for larger size provided by PR-03)
PR-05 EV Tremblay Park at Beech Street and Champagne	Yes 65 m x 85 m = 5525 m^2	Yes	High	Beech Street right-of-way narrow with high impacts	No
PR-06 NCC park lands south of Carling Avenue	Yes (varies 80-120 m) x 170 m = 13600-20400 m^2	Yes	High	Parkdale cross section too narrow north of Aberdeen Street with existing buildings	No
Preliminary Recommendation: **Site PR-03 is being carried forward**					

Sites **PR-01**, **PR-02** in **Table 2** and site **PR-03** in **Table 3** generally exhibit more favorable staging characteristics (i.e. a combination of proximity to the site, size of staging area, impacts on adjacent uses and ability to relocate the current use of the site).

Subject: Assessment of Potential Staging Areas for Rapid Bridge Replacement Option – ***PRESTON STREET***
Project: Preliminary Design and Environmental Assessment Study for the Rehabilitation/Replacement of Ottawa Queensway Mid-Town Bridges from Holland to O'Connor, GWP# 4075-11-00/BTE13-001
Date: September 2, 2014

6. PREFERRED RBR STAGING SITES

Based on this preliminary review, the preferred RBR staging sites recommended for consideration are presented in **Figure 2**. The evaluation of alternatives includes the following:

North Side

- **Site PR-01** is currently a playing field located on the southeast corner of Gladstone Avenue and Preston Street. The site features a large contiguous area that easily meets the size and dimensional requirements necessary to carry out all aspects of the rapid bridge north Queensway bridge structure at Preston Street. The staging area is located within close proximity to the bridge structure, and the travel route does not have any grades exceeding 1.5%, which is the steepest slope that the SPMT is capable of handling. There are no abutting residences or commercial uses that would be impacted – with the possible exception of the loss of short term public parking. Using this playing field as a staging area, however, would mean the loss of recreational space for the Adult High School and the surrounding community.
- **Site PR-02** is a municipal parking lot on Anthony Street between Highway 417 and the school playing field. The site is located immediately north of the bridge site, making it an ideal location for the SPMT assembly. Impact to businesses on Preston Street will be limited because of the close proximity of the staging area to the bridge structure site. The site meets the size requirement of 2500 m^2; however, because the dimensions are slightly less than the desirable 50 m, Site **PR-02** may need to be used in combination with the other preferred site, **PR-01** (as described above).

South Side

- **Site PR-03** is currently a surface parking lot located east of Preston Street between Aberdeen Street and Beech Street. The site has a large contiguous area that far exceeds the minimum required size of 2500 m^2. The travel route from the staging are to the bridge structure meets the maximum allowable grade that the SPMT is able to travel on, which is 1.5%. The travel route for the SPMT will have little or no effect on residential properties, since properties in this area are primarily zoned for commercial use.

Appropriate site preparation will be required at each selected location.

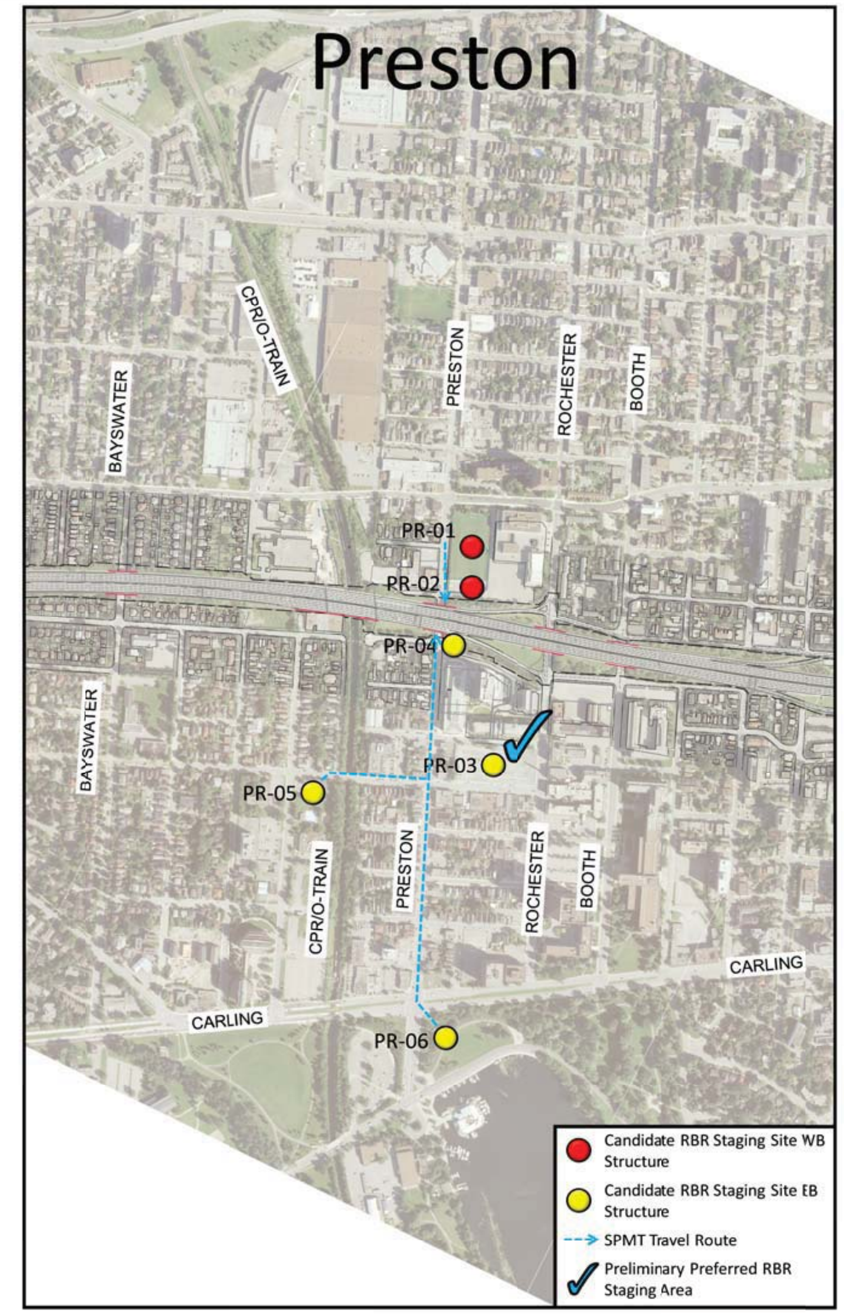
7. TECHNICALLY PREFERRED ALTERNATIVE

This technical memorandum on potential RBR staging areas has been used as input into the overall technical evaluation of bridge management alternatives. Based on the evaluation of alternatives, RBR is the technically preferred option for the Preston Street bridge structures. The overall MATS (Multi-Attribute Tradeoff System) evaluation is described in a standalone Analysis and Evaluation Report. Based on the outcome of the evaluation, there is a need for a staging site for the replacement of the bridge. However, in consideration of the availability of funding, provincial priorities and the long term performance of the bridge replacement, the TESR (Transportation Environmental Study Report) will seek clearance for both rehabilitation and replacement approaches for the bridge management plan.

The preferred staging site is **PR-03** (see **Figure 2**). This site is currently a surface parking lot located east of Preston Street between Aberdeen Street and Beech Street. The site has a large contiguous area that far exceeds the minimum required size of 2500 m^2. The travel route from the staging area to the bridge structure is within the maximum allowable grade that the SPMT is able to travel on, which is 1.5%. The travel route for the SPMT will have little or no effect on residential properties, since properties in this area are primarily zoned for commercial use.

Since there is only one RBR staging site being carried forward for the Eastbound and Westbound bridges, both structures will need to be replaced simultaneously on a long weekend (i.e. a 3-day weekend). Appropriate site preparation will be required in advance of the bridge structure replacements.

Figure 2
Location of Shortlisted RBR Staging Areas – Preston Street (Sites 3-055.1 and 3-055.2)



2 September 2014

100 Craig Henry Drive, Suite 103
Ottawa, Ontario, K2G-5W3

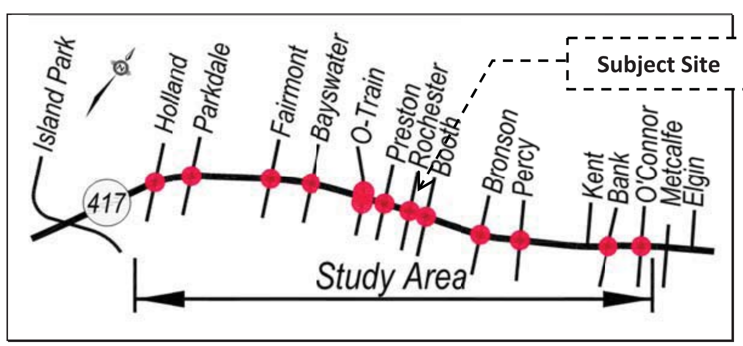
MEMORANDUM

TO:	File BTE13-001	**DATE:**	September 2, 2014
FROM:	Bytown Engineering	**PROJECT #:**	BTE13-001
PROJECT:	Preliminary Design and Environmental Assessment Study for the Rehabilitation/Replacement of Ottawa Queensway Mid-Town Bridges from Holland to O'Connor, GWP# 4075-11-00		
SUBJECT:	Preliminary Review of Staging Area Sites for Rapid Bridge Replacement Option/**UPDATE 3 Rochester Street - Sites 3-056.1 and 3-056.2**		

1. INTRODUCTION

The Ontario Ministry of Transportation (MTO) will, over the next decade, undertake the rehabilitation or replacement of 23 structures on Highway 417 in the City of Ottawa. The structures are generally located within the central part of the City extending from Holland Avenue to O'Connor Street (see ***Figure 1***). The location considered in this review (i.e. Rochester Street structure) is also highlighted.

Figure 1: Study Area



Bridge replacement and rehabilitation options are being considered for all 23 structures under study. The rehabilitation options extend the service life of the bridge by making appropriate and targeted repairs; replacement is considered if a new bridge can be constructed as a cost effective alternative to repairing the existing bridge. The replacement approach considers different bridge types and construction methods. One replacement option includes a Rapid Bridge Replacement (RBR) which entails the removal of the existing structure and insertion of a new structure**.** This process has been used at other bridge sites on Highway 417 immediately west of the study area; MTO has recently employed the RBR process for structures at Carling Avenue (westbound) and Kirkwood Avenue. This approach requires the closure of the freeway (eastbound and westbound lanes) while the old structure is removed and the new bridge is placed.

MTO has also tendered the first RBR for a rigid frame bridge in Ontario (i.e. Highway 401/Cornwall Centre Road). For a rigid frame bridge, the RBR process requires a duration that exceeds most recent deck replacements on Highway 417. For example, the Highway 401/Cornwall Centre Road pilot project allows 8 weeks for the removal and installation of a new rigid frame bridge.

A Group 'B' Environmental Assessment (EA) is being undertaken by the Ministry of Transportation for a bridge management plan for structural improvements (rehabilitation or replacements) to bridges on the Ottawa Queensway from Holland Avenue easterly to O'Connor Street. The project is being described as the Ottawa Queensway Mid-town bridges project.

The MTO's Provincial Class EA is a planning and design procedure developed to ensure that all potential natural, social/cultural and economic environments as well as property and land use effects are considered in undertaking certain projects.

This document summarizes part of the analysis and evaluation process to define staging areas that could be used to construct replacement bridges using Accelerated Bridge Construction (ABC). The staging areas would provide an area to build new rigid frame bridges and a lay-down area for the contractor, and house the existing bridge temporarily after it is removed for it to be demolished.

This memo reviews candidate staging areas for each of the bridge sites and selects one as a preferred location based on the experience of the previous ABC projects completed by MTO on the Queensway. This will demonstrate that ABC is achievable and then allow for the temporary effects of creating a site and clearing a path from the site to the bridge, to be considered in the evaluation of alternatives. The subsequent evaluation of alternatives will be completed after Public Information Centre (PIC) No. 1, and will systematically analyze, evaluate and select the Technically Preferred Alternatives (TPA's) for the 23 bridge sites under study. This sequential methodology will include community and stakeholder input at all key milestones of the study including consideration of the temporary staging areas. The effects and mitigation as a result of the TPA may be modified during subsequent stages of public consultation and will be further defined at the detail design stage. This document will become a component of the Transportation Environmental Study Report (TESR). The use of temporary staging areas will be negotiated by the MTO Property Section, and the locations identified in this memorandum may be changed at the time of replacement if there are other more suitable sites that can be identified. At this point the identification of a staging area reflects the technical feasibility to implement an ABC project as a candidate alternative using Rapid Bridge Replacement (RBR) with heavy lift technology.

The staging areas for the Queensway Bridges in this study need to be large enough to accommodate the temporary structure where the new bridge is built and the 2 self-propelled modular transporters (SPMT's) that need to be assembled and disassembled. There is also a requirement for a construction lay-down area.

A key consideration for the use of RBR relates to the provision of a construction staging area where the new structure is constructed and prepared for insertion into the existing location (i.e. replaces the old structure). The sequencing of bridge replacement will be addressed following the structural reviews/investigations. This memorandum provides a preliminary assessment of possible RBR construction staging areas at the subject site. Both north side and south side locations are addressed in this review.

2. DESIGN CRITERIA

The design criteria for a suitable RBR staging area should include the following:

1. Large overall area (50 m x 50 m = 2500 m^2) to accommodate new structure, storage of old bridge when removed, lay-down area for contractor and maneuverability of SPMT's.
2. Moderate grades (below 1.5%) on travel route to bridge site.
3. Dimensions of site to exceed the size of the new bridge and include workspace on all sides of the new bridge. Bridges are in the order of (25-30 m) x 25 m so desirable lateral dimension is 50 m and minimum dimension must exceed width/span of new bridge.
4. Where no site is available on one side of the Queensway, both east and westbound bridges may be replaced on the same weekend using a larger staging area on one side of the Queensway.

3. STAGING AREA REVIEW PARAMETERS

The following assumptions were used in this preliminary examination of potential staging sites:

- Property ownership was not explicitly considered in the review. Municipal, private, federal and/or provincial lands were all deemed acceptable.
- The expropriation of property for use as a temporary construction staging area was not considered. Any use or acquisition would be subject to property negotiations.
- The staging sites will require areas for the construction of the new structures and storage of the old structures, and must allow vehicle access/circulation.
- RBR staging areas are required on the north and south sides at each site (unless both bridges are replaced on the same weekend).
- Flat/minimal grades are preferred within the staging area and on the approaches to the replacement site.

Subject: Assessment of Potential Staging Areas for Rapid Bridge Replacement Option – ***ROCHESTER STREET***
Project: Preliminary Design and Environmental Assessment Study for the Rehabilitation/Replacement of Ottawa Queensway Mid-Town Bridges from Holland to O'Connor, GWP# 4075-11-00/BTE13-001
Date: September 2, 2014

- Site preparation is required under all options.
- The extension of the staging area into adjacent travel lanes was considered feasible at locations where volumes were minimal and/or multiple travel lanes are provided (unless both bridges are replaced on the same weekend).
- The proposed staging area should be in close proximity to the replacement structure site.
- The site should readily accommodate construction vehicles, preferably on a designated truck route.

Off-site staging areas which meet the guidelines are preferred. It is recognized that there are inherent challenges such as impacts on adjacent residents/land uses, the limited sites available to construct a new structure/store the old structure; the need to relocate utilities; vegetation, trees and other landscape features; and noise/dust issues. Although some challenges exist, the RBR process significantly reduces the amount of time required to close the road to traffic when compared to conventional reconstruction.

4. SITE REVIEW

Rochester Street is a north/south major collector roadway accommodating approximately 6,500 vehicles/day (i.e. 2012 AADT south of Highway 417). It comprises four travel lanes under the structure (2 in each direction).

The Rochester Street structure is located approximately 120 m east of the Booth Street structure (i.e. Sites **3-055.1 and 3-055.2**). Given the proximity of these structures and the presence of available and nearby south side staging areas, the concurrent replacement of both sites appears feasible.

The availability of staging areas of the required size in an urban setting such as Central Ottawa is challenging – the preliminary staging sites typically consist of parks/sports fields, commercial/municipal parking areas and extended boulevards. The use of these sites will require the removal of some or all of the existing functions; complete reinstatement will occur following the construction activities.

Using the parameters listed in the previous section, a preliminary assessment of possible RBR locations was undertaken. The results are summarized in subsequent tables. It is noted that the dimensions identified in this review were scaled from online mapping services and reflect the level of detail associated with those sources. ***Table 1*** provides a qualitative assessment of the various RBR sites based on ***Good, Fair*** and ***Poor*** criteria. The ratings are meant to quantify, in a broad manner, the potential of each site considering the factors listed above.

Table 1
Analysis of Potential RBR Staging Areas – Rochester Street (Sites 3-056.1 and 3-056.2)

	Location	*Discussion*	*RBR Potential*
North Side	***RO-01*** - School parking area/west side of Rochester Street	• Available area approx. 60 m x 60 m + 15 m x 30 m = 4050 m^2 • Approx. 60 m from staging area to bridge site (via Rochester) • Impact on school parking supply/accessibility • Impact on residences on Rochester Street • Grade concerns (parking area lower than roadway)	• ***GOOD*** → *Grade difference in potential staging area and route to bridge site* → *Site dimensions are suitable*
	RO-02 – Municipal ROW	• Available 15 m x 20 m = 300 m^2 • Impact on residences on Rochester and Raymond • Construct new structure in south side intersection area (i.e. Rochester/Raymond/WB on-ramp) • Old structure to be dismantled in segments and stored off site (e.g. on Rochester or on-ramp or parking areas to the south of Highway 417)	• ***FAIR*** → *Site area and dimensions are significantly less than required* → *Impact on commercial uses on Preston and Young* → *Access to properties on Young may be impacted*
	PR-01 - School playing field on east side of Preston Street	• Available area approx. 65 m x 120 m = 7800 m^2 • Approx. 450 m from staging area to bridge site (via Preston/Gladstone/Rochester) • Rochester Street is a designated as a City truck route	• ***GOOD*** → *Grade difference in potential staging area and route to bridge site* → *Site dimensions are suitable* → *Preference is RO-01, which is located closer the bridge site*
South Side	***RO-03*** - Federal government (Natural Resources Canada) parking facility south of Orangeville St. between Rochester and Booth	• Available area approx. 100m x 30 m + 30 m x 35 m + 25 m x 30 m = 4800 m^2 • Approx. 60 m from staging area to bridge site • Rochester/Booth Streets are designated truck routes • Impact on parking supply at federal buildings • May require lane "borrow" from Orangeville Street • Potentially combine RBR staging areas for Rochester and Booth Street bridge sites	• ***GOOD*** → *Large area near bridge site* → *Impact on parking functions* → *Federal approval required*
	RO-04 - NCC lands south of Carling Ave	• Available area approx. 150 m x 70 m = 10 500 m^2 • Approx. 600 m from staging area to bridge site (via Rochester) • Rochester Street is designated as a City truck route	• ***FAIR*** → *National tourist area* → *Moderate travel route distance* → *Federal approval required*
	PR-03 Surface Parking Lot east of Preston Street between Beech and Aberdeen	• Available area approx. 65 m x 165 m = 10 725 m^2 • Approx. 225 m from staging area to bridge site (via Rochester) • Rochester Street is designated as a City truck route	• ***GOOD*** → *Large contiguous area near bridge site* → *Loss of commercial parking*

5. COARSE SCREENING EVALUATION OF RBR SITE

The potential candidate RBR staging areas were assessed as part of a coarse screening analysis against three criteria (size, access route gradient and access route impacts) to assess if a site was feasible to carry forward. The conclusions of this assessment are presented in **Table 2** and **Table 3**.

Table 2
RBR Staging Area Coarse Screening Analysis
Bridge Site: Rochester Street WB

Candidate RBR Staging Area	**Achieve Minimum Area requirement (2500 m²) Yes/No**	**Route Access: Meet Gradient requirement <1.5% slope**	**Route Access: Level of Impact on Travel Route**	**Comments**	**Carry Forward Yes/No**
RO-01 Adult High School parking lot	Yes (60 m x 60 m) + (15 m x 30 m) = 4050 m^2	Yes	Low	Impacts to Adult High School parking lot	Yes
RO-02 municipal right-of-way	No 15 m x 20 m = 300 m^2	Yes	Low	Minimal impacts to nearby roadways and residences, but does not meet area requirements	No
PR-01 School playing field on east side of Preston Street (Preston Street site)	Yes 65 m x 120 m = 7800 m^2	Yes	Medium	Impacts to playing field, Gladstone Avenue and Rochester Street	Yes (preference is the Adult High School which is closer to the site)
Preliminary Recommendation: **Sites RO-01 and PR-01 are being carried forward**					

Table 3
RBR Staging Area Coarse Screening Analysis
Bridge Site: Rochester Street EB

Candidate RBR Staging Area	Achieve Minimum Area requirement (2500 m²) Yes/No	Route Access: Meet Gradient requirement <1.5% slope	Route Access: Level of Impact on Travel Route	Comments	Carry Forward Yes/No
RO-03 Federal government Natural Resources Canada parking facility	Yes (closing Elizabeth municipal street to be part of staging area) (100 m x 30 m) + (30 m x 35 m) + (25 m x 30 m) = 4800 m^2	Yes	Moderate	Requires use of street and negotiated use with federal authority	Yes
PR-03 Surface Parking Lot east of Preston Street between Beech and Aberdeen	Yes 65 m x 165 m = 10725 m^2	Yes	Moderate	loss of commercial parking	Yes
R0-04 NCC lands south of Carling Avenue	Yes 150m x 70 m = 10500 m^2	Yes	Moderate	National tourist area in National Capital Area	No (preference for RO-03)
Preliminary Recommendation: **Sites RO-03 or PR-03 are being carried forward**					

Sites **RO-01** and **PR-01** in **Table 2**, and sites **RO-03** and **PR-03** in **Table 3** generally exhibit more favorable staging characteristics (i.e. a combination of proximity to the site route access characteristics, size of staging area, impacts on adjacent uses and ability to relocate the current use of the site).

6. PREFERRED RBR STAGING SITES

Based on this preliminary review, the preferred RBR staging sites recommended for consideration are presented in **Figure 2**. The evaluation of alternatives includes the following:

North Side

- **Site RO-01** is currently a parking facility that is being used for the Adult High School. It is the most preferred option for the Rochester Avenue north bridge structure replacement, since the proposed travel route is shorter and less complex, compared to the travel route for Site **PR-01**. The shorter route will ensure that there is minimal impact to commuters and nearby residences when the existing bridge structure is being replaced and the new bridge is being driven into place. In addition, the travel route is relatively flat, and does not have any slopes that exceed 1.5%.
- **Site PR-01** is currently a grassed playing field located at the southeast corner of Gladstone Avenue and Preston Street. The site far exceeds the required dimensions and area that are required for the staging area. The travel route to the bridge site is approximately 450 m, and will result in impacts to residences and businesses on Preston Street, Gladstone Avenue and Rochester Street. Using this site as a staging area will mean the loss of a well-used recreational facility for the Adult High School and surrounding community. Slopes along the travel route are relatively flat, with the exception of the section on Gladstone Avenue from Preston Street to Rochester Street, which may pose a problem for the SPMT, since it exceeds 1.5%. It should be noted that Site **RO-01** is more preferred site for the north bridge structure Queensway staging area replacement.

South Side

- **Site RO-03** is currently a parking facility associated with Natural Resources Canada (i.e. south side of Orangeville Street)**.** This site is adequately sized and located within close proximity to the subject structure. There are no abutting residences or commercial uses that would be impacted – with the possible exception of the loss of parking (to be temporarily replaced elsewhere, if required). The possible use of some or all of the Orangeville Street right-of-way also appears feasible. This site can be used for both construction of the new structure and storage of the dismantled structure.
- **Site PR-03** is currently a surface parking lot located east of Preston Street between Aberdeen Street and Beech Street. The site has a large contiguous area that far exceeds the minimum required size of 2500 m^2. One section of the travel route on Rochester Street (between Aberdeen Street and the Rochester N/S-E Queensway off-ramp), however, appears to exceed the maximum grade of 1.5% that

can be handled by the SPMT. The travel route for the SPMT will have little effect on residences, since most properties in this area are zoned for commercial use.

Appropriate site preparation will be required at each selected location.

7. TECHNICALLY PREFERRED ALTERNATIVE

This technical memorandum on potential RBR staging areas has been used as input into the overall technical evaluation of bridge management alternatives. Based on the evaluation of alternatives, RBR is the technically preferred option for the Rochester Street bridge structures. The overall MATS (Multi-Attribute Tradeoff System) evaluation is described in a standalone Analysis and Evaluation Report. Based on the outcome of the evaluation, there is a need for a staging site for the replacement of the bridge. However, in consideration of the availability of funding, provincial priorities and the long term performance of the bridge replacement, the TESR (Transportation Environmental Study Report) will seek clearance for both rehabilitation and replacement approaches for the bridge management plan.

The preferred staging site is **PR-03** (see **Figure 2**). This site is currently a surface parking lot located east of Preston Street between Aberdeen Street and Beech Street. The site has a large contiguous area that far exceeds the minimum required size of 2500 m^2. The travel route from the staging area to the bridge structure is within the maximum allowable grade that the SPMT is able to travel on, which is 1.5%. The travel route for the SPMT will have little or no effect on residential properties, since properties in this area are primarily zoned for commercial use.

Since there is only one RBR staging site being carried forward for the Eastbound and Westbound bridges, both structures will need to be replaced simultaneously on a long weekend (i.e. a 3-day weekend). Appropriate site preparation will be required in advance of the bridge structure replacements.

Figure 2
Location of Shortlisted RBR Staging Areas – Rochester Street (Sites 3-056.1 and 3-056.2)

! September 2014

100 Craig Henry Drive, Suite 103
Ottawa, Ontario, K2G-5W3

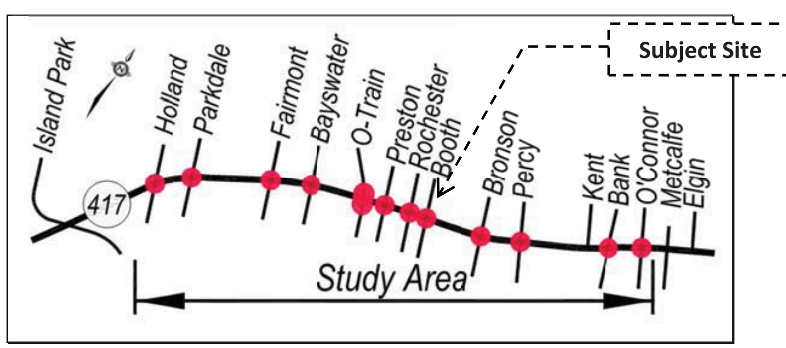
MEMORANDUM

TO:	File BTE13-001	**DATE:**	December 10, 2014
FROM:	Bytown Engineering	**PROJECT #:**	BTE13-001
PROJECT:	Preliminary Design and Environmental Assessment Study for the Rehabilitation/Replacement of Ottawa Queensway Mid-Town Bridges from Holland to O'Connor, GWP# 4075-11-00		
SUBJECT:	Preliminary Review of Staging Area Sites for Rapid Bridge Replacement Option/**UPDATE 3 Booth Street - Sites 3-057.1 and 3-057.2**		

1. INTRODUCTION

The Ontario Ministry of Transportation (MTO) will, over the next decade, undertake the rehabilitation or replacement of 23 structures on Highway 417 in the City of Ottawa. The structures are generally located within the central part of the City extending from Holland Avenue to O'Connor Street (see ***Figure 1***). The location considered in this review (i.e. Booth Street structure) is also highlighted.

Figure 1: Study Area



Bridge replacement and rehabilitation options are being considered for all 23 structures under study. The rehabilitation options extend the service life of the bridge by making appropriate and targeted repairs; replacement is considered if a new bridge can be constructed as a cost effective alternative to repairing the existing bridge. The replacement approach considers different bridge types and construction methods. One replacement option includes a Rapid Bridge Replacement (RBR) which entails the removal of the existing structure and insertion of a new structure**.** This process has been used at other bridge sites on Highway 417 immediately west of the study area; MTO has recently employed the RBR process for structures at Carling Avenue (westbound) and Kirkwood Avenue. This approach requires the closure of the freeway (eastbound and westbound lanes) while the old structure is removed and the new bridge is placed.

MTO has also tendered the first RBR for a rigid frame bridge in Ontario (i.e. Highway 401/Cornwall Centre Road). For a rigid frame bridge, the RBR process requires a duration that exceeds most recent deck replacements on Highway 417. For example, the Highway 401/Cornwall Centre Road pilot project allows 8 weeks for the removal and installation of a new rigid frame bridge.

A Group 'B' Environmental Assessment (EA) is being undertaken by the Ministry of Transportation for a bridge management plan for structural improvements (rehabilitation or replacements) to bridges on the Ottawa Queensway from Holland Avenue easterly to O'Connor Street. The project is being described as the Ottawa Queensway Mid-town bridges project.

The MTO's Provincial Class EA is a planning and design procedure developed to ensure that all potential natural, social/cultural and economic environments as well as property and land use effects are considered in undertaking certain projects.

This document summarizes part of the analysis and evaluation process to define staging areas that could be used to construct replacement bridges using Accelerated Bridge Construction (ABC). The staging areas would provide an area to build new rigid frame bridges and a lay-down area for the contractor, and house the existing bridge temporarily after it is removed for it to be demolished.

This memo reviews candidate staging areas for each of the bridge sites and selects one as a preferred location based on the experience of the previous ABC projects completed by MTO on the Queensway. This will demonstrate that ABC is achievable and then allow for the temporary effects of creating a site and clearing a path from the site to the bridge, to be considered in the evaluation of alternatives. The subsequent evaluation of alternatives will be completed after Public Information Centre (PIC) No. 1, and will systematically analyze, evaluate and select the Technically Preferred Alternatives (TPA's) for the 23 bridge sites under study. This sequential methodology will include community and stakeholder input at all key milestones of the study including consideration of the temporary staging areas. The effects and mitigation as a result of the TPA may be modified during subsequent stages of public consultation and will be further defined at the detail design stage. This document will become a component of the Transportation Environmental Study Report (TESR). The use of temporary staging areas will be negotiated by the MTO Property Section, and the locations identified in this memorandum may be changed at the time of replacement if there are other more suitable sites that can be identified. At this point the identification of a staging area reflects the technical feasibility to implement an ABC project as a candidate alternative using Rapid Bridge Replacement (RBR) with heavy lift technology.

The staging areas for the Queensway Bridges in this study need to be large enough to accommodate the temporary structure where the new bridge is built and the 2 self-propelled modular transporters (SPMT's) that need to be assembled and disassembled. There is also a requirement for a construction lay-down area.

A key consideration for the use of RBR relates to the provision of a construction staging area where the new structure is constructed and prepared for insertion into the existing location (i.e. replaces the old structure). The sequencing of bridge replacement will be addressed following the structural reviews/investigations. This memorandum provides a preliminary assessment of possible RBR construction staging areas at the subject site. Both north side and south side locations are addressed in this review.

2. DESIGN CRITERIA

The design criteria for a suitable RBR staging area should include the following:

1. Large overall area (50 m x 50 m = 2500 m^2) to accommodate new structure, storage of old bridge when removed, lay-down area for contractor and maneuverability of SPMT's.
2. Moderate grades (below 1.5%) on travel route to bridge site.
3. Dimensions of site to exceed the size of the new bridge and include workspace on all sides of the new bridge. Bridges are in the order of (25-30 m) x 25 m so desirable lateral dimension is 50 m and minimum dimension must exceed width/span of new bridge.
4. Where no site is available on one side of the Queensway, both east and westbound bridges may be replaced on the same weekend using a larger staging area on one side of the Queensway.

3. STAGING AREA REVIEW PARAMETERS

The following assumptions were used in this preliminary examination of potential staging sites:

- Property ownership was not explicitly considered in the review. Municipal, private, federal and/or provincial lands were all deemed acceptable.
- The expropriation of property for use as a temporary construction staging area was not considered. Any use or acquisition would be subject to property negotiations.
- The staging sites will require areas for the construction of the new structures and storage of the old structures, and must allow vehicle access/circulation.
- RBR staging areas are required on the north and south sides at each site (unless both bridges are replaced on the same weekend).
- Flat/minimal grades are preferred within the staging area and on the approaches to the replacement site.

- Site preparation is required under all options.
- The extension of the staging area into adjacent travel lanes was considered feasible at locations where volumes were minimal and/or multiple travel lanes are provided (unless both bridges are replaced on the same weekend).
- The proposed staging area should be in close proximity to the replacement structure site.
- The site should readily accommodate construction vehicles, preferably on a designated truck route.

Off-site staging areas which meet the guidelines are preferred. It is recognized that there are inherent challenges such as impacts on adjacent residents/land uses, the limited sites available to construct a new structure/store the old structure; the need to relocate utilities; vegetation, trees and other landscape features; and noise/dust issues. Although some challenges exist, the RBR process significantly reduces the amount of time required to close the road to traffic when compared to conventional reconstruction.

4. SITE REVIEW

Booth Street is a north/south major collector roadway accommodating approximately 7,700 vehicles/day (i.e. 2012 AADT south of Highway 417). It comprises four travel lanes under the structure (2 in each direction).

The Booth Street structure is located approximately 120 m east of the Rochester Street structure (i.e. Sites 3-056.1 and 3-056.2). Given the proximity of these structures and the presence of available and nearby south side staging areas, the concurrent replacement of both sites appears feasible.

The availability of staging areas of the required size in an urban setting such as Central Ottawa is challenging – the preliminary staging sites typically consist of parks/sports fields, commercial/municipal parking areas and extended boulevards. The use of these sites will require the removal of some or all of the existing functions; complete reinstatement will occur following the construction activities.

Using the parameters listed in the previous section, a preliminary assessment of possible RBR locations was undertaken. The results are summarized in subsequent tables. It is noted that the dimensions identified in this review were scaled from online mapping services and reflect the level of detail associated with those sources. ***Table 1*** provides a qualitative assessment of the various RBR sites based on ***Good, Fair*** and ***Poor*** criteria. The ratings are meant to quantify, in a broad manner, the potential of each site considering the factors listed above.

Table 1
Analysis of Potential RBR Staging Areas – Booth Street (Sites 3-057.1 and 3-057.2)

	Location	Discussion	RBR Potential
North Side	***BO-01*** –Booth/ Raymond Street Municipal ROW	→ Available area approx. 35 m x 15 m = 525 m^2 → Approx. 25 m from staging area to bridge site (via Booth) → Impact on residences on Booth and Raymond → Construct new structure in north side intersection area (i.e. Booth/Raymond with possible extension into surface parking area in NE quadrant) → Old structure to be dismantled in segments and stored in above surface parking area or federal parking areas to the south of Highway 417)	***POOR*** → *Site area and dimensions less than requirements* → *Impact to residences on Booth and Raymond* → *Lot size is less than 2500 m^2*
	RO-01 – Adult high school parking lot	→ Available area approx. 60 m x 60 m + 15 m x 30 m = 4050 m^2 → Approx. 200 m from staging area to bridge site (Rochester/Raymond/Booth) → Dimensions are within acceptable range, as shown on drawings	***GOOD*** → *Site exceeds area and dimension requirements* → *Impact to residences on Rochester/Booth/ Raymond/* → *Landscaping work is required to create adequate grades for the SPMT to travel across*
South Side	***RO-03*** - Federal government (Natural Resources Canada) parking facility south of Orangeville St. between Rochester and Booth	→ Available area approx. 100 m x 30 m + 30 m x 35 m + 25 m x 30 m = 4080 m^2 → Approx. 50 m from staging area to bridge site (via Orangeville/Booth) → Rochester and Booth are designated truck routes → Impact on parking supply at federal buildings → Lane "borrow" possible from Orangeville St. → Potentially combine RBR staging areas for Rochester and Booth Street bridge sites (this site is preferred because of central location between two bridge sites and slightly larger size)	***GOOD*** → *Large contiguous area near bridge site* → *Impact on parking functions* → *Federal approval required*
	BO-02 - Federal government (Natural Resources Canada) parking facility south of Orangeville St. between Booth and Lebreton Streets	→ Available area approx. 25 m x 90 m = 2250 m^2 → Approx. 50 m from staging area to bridge site (via Orangeville/Booth) → Rochester and Booth are designated truck routes → Impact on parking supply at federal buildings → Lane "borrow" possible from Orangeville St. → Potentially combine RBR staging areas for Rochester and Booth Street bridge sites	***FAIR*** → *Irregular shaped lot* → *Does not meet minimum dimension or area requirements* → *Impact on parking functions* → *Federal approval required to use this facility*
	PR-03 Surface Parking Lot east of Preston Street between Beech and Aberdeen	→ Available area approx. 65 m x 165 m = 10 725 m^2 → Approx. 325 m from staging area to bridge site (via Rochester/Orangeville/Booth) → Rochester Street is designated as a City truck route	***GOOD*** → *Large contiguous area near bridge site* → *Loss of commercial parking* → *Requires use of street*

			and negotiated use of federal lands
	BO-03 Federal lands at corner of Booth and Carling (north side)	→ Available area approx. 85 m x (varies 55-75 m) = 4675 m^2– 6375 m^2 → Approx. 550 m from staging area to bridge site (via Booth) → Moderate pinch point at 552 Booth Street → Travel route meets grade requirements → Businesses and federal government offices on Booth Street will be affected	***GOOD*** → *Meets area and dimension requirements* → *Moderate distance from staging area to bridge site* → *Requires use of street and negotiated use of federal lands*
	RO-04 NCC lands south of Carling Avenue	→ Available area approx. 150 m x 70 m = 10 500 m^2 → Approx. 600m from staging area to bridge site (via Booth) → National tourist site → Will be difficult to get federal approval to use site as a construction staging area → Moderate distance from bridge site	***POOR*** → *National tourist site in National Capital* → *Large contiguous area near bridge site* → *Moderate distance from bridge site and staging area* → *Federal approval required*

5. COARSE SCREENING EVALUATION OF RBR SITES

The potential candidate RBR staging areas were assessed as part of a coarse screening analysis against three criteria (size, access route gradient and access route impacts) to assess if a site was feasible to carry forward. The conclusions of this assessment are presented in **Table 2** and **Table 3**.

Table 2
RBR Staging Area Coarse Screening Analysis
Bridge Site: Booth Street WB

Candidate RBR Staging Area	Achieve Minimum Area requirement (2500 m²) Yes/No	Route Access: Meet Gradient requirement <1.5% slope	Route Access: Level of Impact on Travel Route	Comments	Carry Forward Yes/No
BO-01 Municipal right-of-way	No 35 m x 15 m = 525 m^2	Yes	Low	Minimal impacts to Booth Street within close proximity to site	No
RO-01 Adult High School parking lot	Yes (60 m x 60 m) + (30 m x 15 m) = 4050 m^2	Yes	Moderate	Requires widening Raymond Street between Rochester and Booth that will include temporary sheet piling of Queensway embankment.	Yes
Preliminary Recommendation: **Site RO-01 is being carried forward**					

Table 3
RBR Staging Area Coarse Screening Analysis
Bridge Site: Booth Street EB

Candidate RBR Staging Area	Achieve Minimum Area requirement (2500 m²) Yes/No	Route Access: Meet Gradient requirement <1.5% slope	Route Access: Level of Impact on Travel Route	Comments	Carry Forward Yes/No
BO-02 Federal government (Natural Resources Canada) parking facility south of Orangeville Street between Booth and Lebreton Streets	Yes 90 m x 25 m = 2250 m^2	Yes	Low	Irregular shaped lot	No (See RO-03 as larger site)
RO-03 Federal government Natural Resources Canada parking facility	Yes (Closing Elizabeth municipal street to be part of staging area) (100 m x 30 m) + (30 m x 35 m) + (25 m x 30 m) = 4080 m^2	Yes	Moderate	Requires use of street and negotiated use with federal authority	Yes
PR-03 Surface Parking Lot east of Preston Street between Beech and Aberdeen	Yes 65 m x 165 m = 10725 m^2	Yes	Moderate	Loss of commercial parking	Yes
BO-03 Federal lands corner of Booth and Carling (north side)	Yes 85 m x (varies 55-75 m) = 4675-6375 m^2	Yes	Moderate Pinch point at 552 Booth Street	Open site with no road closure	Yes
BO-04 NCC lands south of Carling Avenue	Yes 150 m x 70 m = 10500 m^2	Yes	High	National tourist area in National Capital Area and impact to mature trees	No (preference for RO-03)
Preliminary Recommendation: **Sites RO-03, PR-03 and BO-03 are being carried forward**					

The sites highlighted in **Table 1** (i.e. **RO-01**) and **Table 2** (i.e. **RO-03**, **PR-03** and **BO-03**) generally exhibit more favorable staging characteristics (i.e. a combination of proximity to the site, size of staging area, impacts on adjacent uses and ability to relocate the current use of the site).

6. PREFERRED RBR STAGING SITES

Based on this preliminary review, the preferred RBR staging sites recommended for consideration are presented in **Figure 2**. The evaluation of alternatives includes the following:

North Side

- **Site RO-01** is located at the northwest corner of Rochester Street and Raymond Street. The features a large, contiguous area that exceeds the dimensions and area requirements that are needed to assemble the SPMT, store/dismantle the existing bridge structure and build the new bridge structure. It is also reasonably close to the north Booth Street Queensway bridge structure. The site would have to be re-graded to ensure that the elevations of the parking facility match the elevations on Rochester Street. The travel route will likely impact residences fronting on Rochester Street and Raymond Street. The Adult high school parking supply will be adversely affected, and parking will have to be redistributed to other parking lots or unused land in the surrounding area.

South Side

- **Site RO-03** is located parking facility associated with Natural Resources Canada (i.e. south side of Orangeville Street)**.** This site is adequately sized and in proximity to the subject structure. There are no abutting residences or commercial uses that would be impacted – with the possible exception of the loss of parking (to be temporarily replaced elsewhere, if required). The possible use of some or all of the Orangeville Street ROW also appears feasible. This site can be used for both construction of the new structure and storage of the dismantled structure.
- **Site PR-03** is currently a surface parking lot located east of Preston Street between Aberdeen Street and Beech Street. The site has a large contiguous area that far exceeds the minimum required size of 2500 m^2. The travel route is approximately 325 m, and the SPMT will travel north along Booth Street, east along Orangeville Street and finally north along Booth Street. One section of the travel route on Rochester Street (between Aberdeen Street and the Rochester N/S-E Queensway off-ramp), however, appears to exceed the maximum grade of 1.5% that can be handled by the SPMT. There are expected to be little or no direct effects to residences on Rochester Street or Orangeville Street when the new bridge structure is being driven into place, since most properties in this area are zoned for commercial use.
- **Site BO-03** consists of the Federal Lands located at the northeast corner of Carling Avenue and Booth Street. The land exceeds the minimum area and dimensions required for the Booth Street south

Queensway bridge structure, and meets the grade requirements that are needed to operate the SPMT. It might be difficult, however, to obtain approval from the federal government to use the land as a staging area, since it would be mean that businesses and federal government workers on Booth Street would be affected. In addition, there is a pinch point at 552 Booth Street that might make it challenging for the bridge structure to use this route.

Appropriate site preparation will be required at each selected location.

7. TECHNICALLY PREFERRED ALTERNATIVE

This technical memorandum on potential RBR staging areas has been used as input into the overall technical evaluation of bridge management alternatives. Based on the evaluation of alternatives, RBR is the technically preferred option for the Booth Street bridge structures. The overall MATS (Multi-Attribute Tradeoff System) evaluation is described in a standalone Analysis and Evaluation Report. Based on the outcome of the evaluation, there is a need for a staging site for the replacement of the bridge. However, in consideration of the availability of funding, provincial priorities and the long term performance of the bridge replacement, the TESR (Transportation Environmental Study Report) will seek clearance for both rehabilitation and replacement approaches for the bridge management plan.

The preferred staging site is **PR-03** (see **Figure 2**). This site is currently a surface parking lot located east of Preston Street between Aberdeen Street and Beech Street. The site has a large contiguous area that far exceeds the minimum required size of 2500 m^2. The travel route from the staging area to the bridge structure is within the maximum allowable grade that the SPMT is able to travel on, which is 1.5%. The travel route for the SPMT will have little or no effect on residential properties, since properties in this area are primarily zoned for commercial use.

Since there is only one RBR staging site being carried forward for the Eastbound and Westbound bridges, both structures will need to be replaced simultaneously on a long weekend (i.e. a 3-day weekend). Appropriate site preparation will be required in advance of the bridge structure replacements.

Figure 2
Location of Shortlisted RBR Staging Areas – Booth Street (Sites 3-057.1 and 3-057.2)

100 Craig Henry Drive, Suite 103
Ottawa, Ontario, K2G-5W3

MEMORANDUM

TO:	File BTE13-001	**DATE:**	September 2, 2014
FROM:	Bytown Engineering	**PROJECT #:**	BTE13-001
PROJECT:	Preliminary Design and Environmental Assessment Study for the Rehabilitation/Replacement of Ottawa Queensway Mid-Town Bridges from Holland to O'Connor, GWP# 4075-11-00		
SUBJECT:	Preliminary Review of Staging Area Sites for Rapid Bridge Replacement Option/**UPDATE 3 Bronson Avenue - Sites 3-060.1 and 3-060.2**		

1. INTRODUCTION

The Ontario Ministry of Transportation (MTO) will, over the next decade, undertake the rehabilitation or replacement of 23 structures on Highway 417 in the City of Ottawa. The structures are generally located within the central part of the City extending from Holland Avenue to O'Connor Street (see ***Figure 1***). The location considered in this review (i.e. Bronson Avenue structure) is also highlighted.

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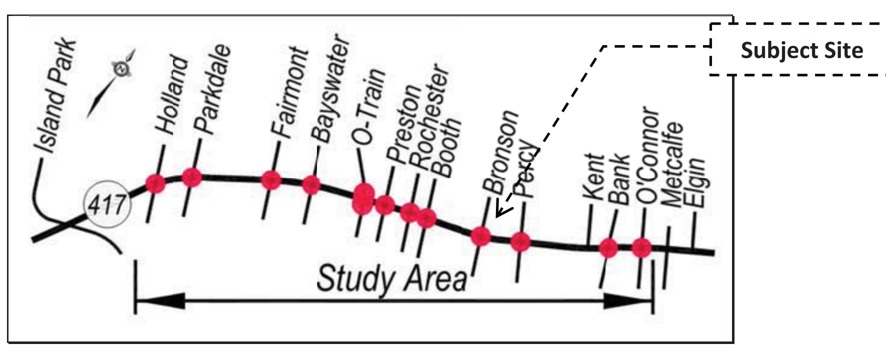

Bridge replacement and rehabilitation options are being considered for all 23 structures under study. The rehabilitation options extend the service life of the bridge by making appropriate and targeted repairs; replacement is considered if a new bridge can be constructed as a cost effective alternative to repairing the existing bridge. The replacement approach considers different bridge types and construction methods. One replacement option includes a Rapid Bridge Replacement (RBR) which entails the removal of the existing structure and insertion of a new structure**.** This process has been used at other bridge sites on Highway 417 immediately west of the study area; MTO has recently employed the RBR process for structures at Carling Avenue (westbound) and Kirkwood Avenue. This approach requires the closure of the freeway (eastbound and westbound lanes) while the old structure is removed and the new bridge is placed.

MTO has also tendered the first RBR for a rigid frame bridge in Ontario (i.e. Highway 401/Cornwall Centre Road). For a rigid frame bridge, the RBR process requires a duration that exceeds most recent deck replacements on Highway 417. For example, the Highway 401/Cornwall Centre Road pilot project allows 8 weeks for the removal and installation of a new rigid frame bridge.

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This document summarizes part of the analysis and evaluation process to define staging areas that could be used to construct replacement bridges using Accelerated Bridge Construction (ABC). The staging areas would provide an area to build new rigid frame bridges and a lay-down area for the contractor, and house the existing bridge temporarily after it is removed for it to be demolished.

This memo reviews candidate staging areas for each of the bridge sites and selects one as a preferred location based on the experience of the previous ABC projects completed by MTO on the Queensway. This will demonstrate that ABC is achievable and then allow for the temporary effects of creating a site and clearing a path from the site to the bridge, to be considered in the evaluation of alternatives. The subsequent evaluation of alternatives will be completed after Public Information Centre (PIC) No. 1, and will systematically analyze, evaluate and select the Technically Preferred Alternatives (TPA's) for the 23 bridge sites under study. This sequential methodology will include community and stakeholder input at all key milestones of the study including consideration of the temporary staging areas. The effects and mitigation as a result of the TPA may be modified during subsequent stages of public consultation and will be further defined at the detail design stage. This document will become a component of the Transportation Environmental Study Report (TESR). The use of temporary staging areas will be negotiated by the MTO Property Section, and the locations identified in this memorandum may be changed at the time of replacement if there are other more suitable sites that can be identified. At this point the identification of a staging area reflects the technical feasibility to implement an ABC project as a candidate alternative using Rapid Bridge Replacement (RBR) with heavy lift technology.

The staging areas for the Queensway Bridges in this study need to be large enough to accommodate the temporary structure where the new bridge is built and the 2 self-propelled modular transporters (SPMT's) that need to be assembled and disassembled. There is also a requirement for a construction lay-down area.

A key consideration for the use of RBR relates to the provision of a construction staging area where the new structure is constructed and prepared for insertion into the existing location (i.e. replaces the old structure). The sequencing of bridge replacement will be addressed following the structural reviews/investigations. This memorandum provides a preliminary assessment of possible RBR construction staging areas at the subject site. Both north side and south side locations are addressed in this review.

2. DESIGN CRITERIA

The design criteria for a suitable RBR staging area should include the following:

1. Large overall area (50 m x 50 m = 2500 m^2) to accommodate new structure, storage of old bridge when removed, lay-down area for contractor and maneuverability of SPMT's.
2. Moderate grades (below 1.5%) on travel route to bridge site.
3. Dimensions of site to exceed the size of the new bridge and include workspace on all sides of the new bridge. Bridges are in the order of (25-30 m) x 25 m so desirable lateral dimension is 50 m and minimum dimension must exceed width/span of new bridge.
4. Where no site is available on one side of the Queensway, both east and westbound bridges may be replaced on the same weekend using a larger staging area on one side of the Queensway.

3. STAGING AREA REVIEW PARAMETERS

The following assumptions were used in this preliminary examination of potential staging sites:

- Property ownership was not explicitly considered in the review. Municipal, private, federal and/or provincial lands were all deemed acceptable.
- The expropriation of property for use as a temporary construction staging area was not considered. Any use or acquisition would be subject to property negotiations.
- The staging sites will require areas for the construction of the new structures and storage of the old structures, and must allow vehicle access/circulation.
- RBR staging areas are required on the north and south sides at each site (unless both bridges are replaced on the same weekend).
- Flat/minimal grades are preferred within the staging area and on the approaches to the replacement site.

Subject: Assessment of Potential Staging Areas for Rapid Bridge Replacement Option – ***BRONSON AVENUE***
Project: Preliminary Design and Environmental Assessment Study for the Rehabilitation/Replacement of Ottawa Queensway Mid-Town Bridges from Holland to O'Connor, GWP# 4075-11-00/BTE13-001
Date: September 2, 2014

- Site preparation is required under all options.
- The extension of the staging area into adjacent travel lanes was considered feasible at locations where volumes were minimal and/or multiple travel lanes are provided (unless both bridges are replaced on the same weekend).
- The proposed staging area should be in close proximity to the replacement structure site.
- The site should readily accommodate construction vehicles, preferably on a designated truck route.

Off-site staging areas which meet the guidelines are preferred. It is recognized that there are inherent challenges such as impacts on adjacent residents/land uses, the limited sites available to construct a new structure/store the old structure; the need to relocate utilities; vegetation, trees and other landscape features; and noise/dust issues. Although some challenges exist, the RBR process significantly reduces the amount of time required to close the road to traffic when compared to conventional reconstruction.

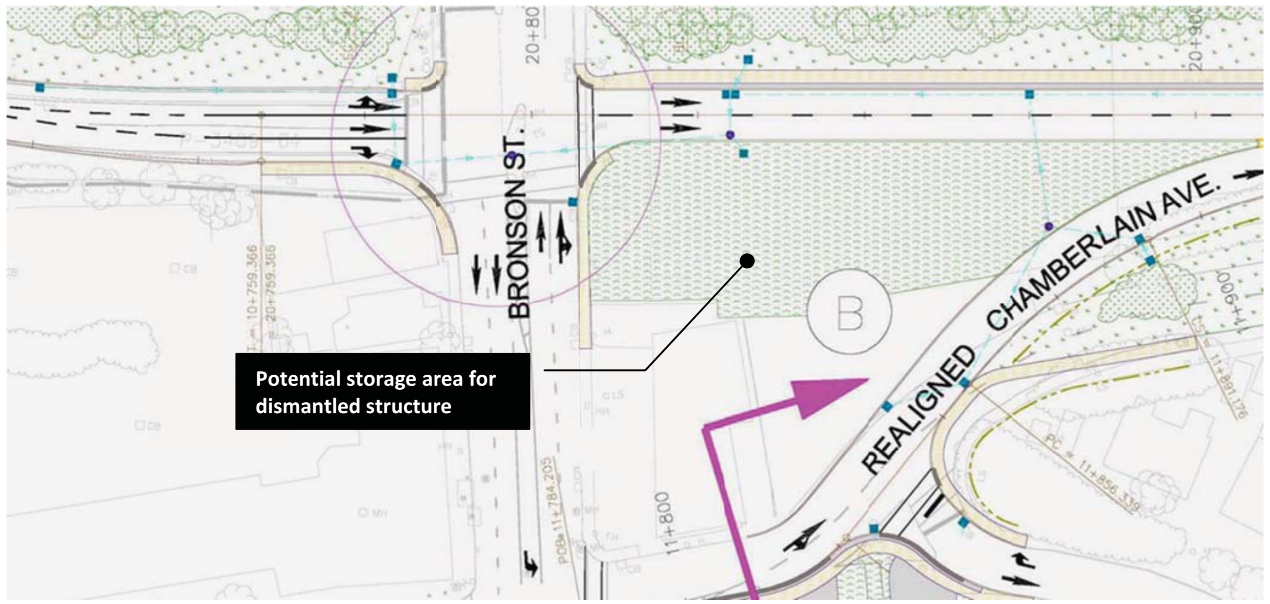
4. SITE REVIEW

Bronson Avenue is a key north/south arterial roadway which accommodates significant traffic volumes (approximately 30,000 vehicles/day at Highway 417); the roadway also accommodates transit service and is a designated truck route. Direct access to/from the west and from the east on Highway 417 is provided at this location; access to eastbound Highway 417 occurs further east near O'Connor Street (i.e. via Isabella/Chamberlain). MTO has identified changes to the south side ramps and ramp terminal and Bronson Avenue. The key modifications include:

- Demolition of the building located in the southeast quadrant;
- Construction of a new surface roadway directly opposite the eastbound off-ramp (i.e. new Chamberlain Avenue). This 2-lane roadway would operate in an eastbound direction;
- Widening of the eastbound off-ramp to 3 lanes at the approach to Bronson;
- Changes to the configuration of the Bronson/Raymond-Catherine Street intersection;
- The provision of noise barriers generally adjacent to the eastbound off-ramp; and
- Realignment of existing Chamberlain Avenue.

Figure 2 illustrates the proposed configuration.

Figure 2
Planned Reconfiguration of South Ramp terminal – Bronson Avenue



Source: McCormick Rankin, 2012

Subject: Assessment of Potential Staging Areas for Rapid Bridge Replacement Option – ***BRONSON AVENUE***
Project: Preliminary Design and Environmental Assessment Study for the Rehabilitation/Replacement of Ottawa Queensway Mid-Town Bridges from Holland to O'Connor, GWP# 4075-11-00/BTE13-001
Date: September 2, 2014

Using the parameters listed in the previous section, a preliminary assessment of possible RBR locations was undertaken. The results are summarized in subsequent tables. It is noted that the dimensions identified in this review were scaled from online mapping services and reflect the level of detail associated with those sources. ***Table 1*** provides a qualitative rating of the various RBR sites based on ***Good, Fair*** and ***Poor*** criteria. The ratings are meant to quantify, in a broad manner, the potential of each site considering the factors listed above.

Table 1
Assessment of Potential RBR Staging Areas – Bronson Avenue (Sites 3-060.1 and 3-060.2)

	Location	*Discussion*	*RBR Potential*
North Side	***BR-01*** - Parking area at storage facility east of Bronson between Catherine and Highway 417	• Available area approx. 55 m x (varies from 20 -25 m) = 1100 m^2 – 1375 m^2 • Approx. 75 m from staging area to bridge structure (via Catherine/Bronson) • Impact on parking supply at storage facility • Opportunity for lane "borrow" from Catherine • Alternate site required for dismantled structure (possibly site BR-02)	• ***FAIR*** → *Site dimensions are inadequate, and would need to be used in combination with another site*
	BR-02 – Boulevard area west of Bronson between Catherine and Highway 417	• Available area approx. 25 m x 65 m = 1625 m^2 • Useable area reduced by grade between ramp and Highway 417 • West limits of boulevard have more favourable grades • Opportunity for lane "borrow" from Catherine	• ***FAIR*** → *Does not meet minimum area requirements or dimensions* → *Significant grades in boulevard area*
	BR-05 McNabb Park at southeast corner of Gladstone and Bronson	• Available area approx. 75 m x 50 m = 3750 m^2 • Approx. 400 m from staging area to bridge structure (via Bronson) • Bronson Avenue is narrow, and has several pinch points in this between Gladstone and Catherine • Utilities along Bronson may be affected at pinch points	• ***FAIR*** → *Will result in the loss of recreational space for the community for 2 years* → *Bronson has pinch points with buildings too narrow to transport new bride from McLeod to Arlington Ave. Lateral width <20 m* → *Utilities at pinch points will need to be relocated*
South Side	***BR-03*** - Parking area at commercial office development west of Bronson and south of Highway 417 EB off-ramp	• Available area approx. 60 m x (varies 40-55 m) = 2600 m^2 – 3575 m^2 • Approx. 120 m from staging area to bridge site (via Highway 417 EB off ramp/Bronson Ave.) • Impact on parking supply at commercial buildings • Impact to residences on Cambridge and Plymouth • Construction-related impacts on adjacent commercial buildings (noise, vibration, etc.)	• ***FAIR*** → *Area exceed minimum requirements for staging site* → *Impact on parking functions* → *Truck access*

		• Truck access may be problematic (narrow local streets) • Route to bridge site via EB off-ramp (temporary closure required) • Storage of dismantled structure at alternate location – possibly in remnant area south of new road in SE quadrant (see ***Figure 2***)	*circuitous/possibly requires travel on residential road* → *Modifications to EB off-ramp boulevard to accommodate movement of new structure to site*
	BR-04 – Glebe Collegiate Institute playing field at the southeast corner of Bronson and Carling	• Available area approx. 160 m x 65 m = 10 400 m^2 • Approx. 475 m from staging area to bridge site (via Chamberlain/Bronson) • Impact to residences and businesses on Bronson that will result from the road closure	• ***FAIR*** → *Impact on school playing field* → *Moderate trip from bridge site to staging area* → *Impact to residences and businesses on Bronson*
	PE-06 - Grassed area between Chamberlain and the Queensway including the former School Board building site	• Available area approx. 120 m x (varies 40-80 m) = 4800 – 9600 m^2 • Approx. 100 m from staging area to bridge site (via Chamberlain/Bronson) • Minimal impact on traffic during the weekend of the RBR, as compared to the other options	• ***GOOD*** → *Meets size requirements* → *Adjacent to the bridge site* → *Results in minimal affects on traffic, in comparison to other options*

Subject: Assessment of Potential Staging Areas for Rapid Bridge Replacement Option – ***BRONSON AVENUE***
Project: Preliminary Design and Environmental Assessment Study for the Rehabilitation/Replacement of Ottawa Queensway Mid-Town Bridges from Holland to O'Connor, GWP# 4075-11-00/BTE13-001
Date: September 2, 2014

5. COARSE SCREENING EVALUATION OF RBR SITES

The potential candidate RBR staging areas were assessed as part of a coarse screening analysis against three criteria (size, access route gradient and access route impacts) to assess if a site was feasible to carry forward. The conclusions of this assessment are presented in **Table 2** and **Table 3**.

Table 2
RBR Staging Area Coarse Screening Analysis
Bridge Site: Bronson Avenue WB

Candidate RBR Staging Area	**Achieve Minimum Area requirement (2500 m²) Yes/No**	**Route Access: Meet Gradient requirement <1.5% slope**	**Route Access: Level of Impact on Travel Route**	**Comments**	**Carry Forward Yes/No**
BR-01 Parking area at storage facility east of Bronson Avenue between Catherine and Highway 417	No 55 m x (varies 20-25 m) = 1100-1375 m²	Yes	Low	Minimal impact on travel route, but area requirement is not met	No
BR-02 MTO right-of-way west of Bronson on-ramp including parking lot between Raymond and Highway 417	No (size of site 25 m x 65 m = 1625 m²)	Yes	Low	Minimal impact on travel route, but area requirement is not met	No
BR-05 McNabb Park at southeast corner of Gladstone and Bronson	Yes 75 m x 50 m = 3750 m² (This only includes part of McNabb Park. It could be expanded if necessary.)	Yes	High	Bronson Avenue has pinch points with buildings too narrow to transport new bridge from McLeod to Arlington Avenue. Lateral width less than 20 m.	No
Preliminary Recommendation: **No sites are being carried forward**					

Table 3
RBR Staging Area Coarse Screening Analysis
Bridge Site: Bronson Avenue EB

Candidate RBR Staging Area	Achieve Minimum Area requirement (2500 m²) Yes/No	Route Access: Meet Gradient requirement <1.5% slope	Route Access: Level of Impact on Travel Route	Comments	Carry Forward Yes/No
BR-03 Parking area at commercial office development west of Bronson and south of Highway 417	Yes 65 m x (varies 40-55 m) = 2600-3575 m²	Yes	High	High impacts along travel route with property impacts to businesses	No
BR-04 Glebe Collegiate at the southeast corner of Bronson and Carling	Yes 160 m x 65 m = 10400 m²	Yes	Moderate	Use PE-06 RBR site	No
PE-06 – Grassed area between Chamberlain and Queensway including the former School Board building site	Yes 120 m x (varies (40-80 m) = 4800-9600 m²	Yes	Low	80 m x 45 m site irregular and will be available when former school board building removed	Yes
Preliminary Recommendation : **Carry forward PE-06 as preferred staging area**					

There are no sites being carried forward for the replacement of the Bronson Avenue Queensway north bridge structure (see **Table 2**). Site **PE-06** (shown in **Table 3**) generally exhibits the most favorable staging characteristics for the replacement of the south bridge structure (i.e. a combination of proximity to the site, route access characteristics, size of staging area, impacts on adjacent uses and ability to relocate the current use of the site).

Subject: Assessment of Potential Staging Areas for Rapid Bridge Replacement Option – ***BRONSON AVENUE***
Project: Preliminary Design and Environmental Assessment Study for the Rehabilitation/Replacement of Ottawa Queensway Mid-Town Bridges from Holland to O'Connor, GWP# 4075-11-00/BTE13-001
Date: September 2, 2014

6. PREFERRED RBR STAGING SITES

Based on this preliminary review, the preferred RBR staging sites recommended for consideration are presented in **Figure 3**. The evaluation of alternatives includes the following:

North Side

- No sites are being carried forward. If the westbound bridge structure RBR alternatives require a staging area, it will require the use of the south side site PE-06.

South Side

- **Site PE-06** covers the MTO/municipal ROW north of Chamberlain Avenue (between Bronson Avenue and Percy Street), and includes the former School Board building site. As described other preparation may be required. It is noted that the westerly area of this site generally exhibits flatter grades (along Highway 417) when compared to the easterly portion of the site. This site is ideal for the south Bronson Avenue Queensway bridge structure staging area because of its close proximity to the site. As well, the site consists of a large, contiguous area that easily meets the dimensions required for an adequate staging area site. Effects on residences will be minimal, as this portion of Bronson Avenue is exclusively commercial. This site could be used to stage the construction for both the north and south side bridges; however, a long weekend would be required to complete both bridges.

As stated, appropriate site preparation will be required at any selected RBR staging locations.

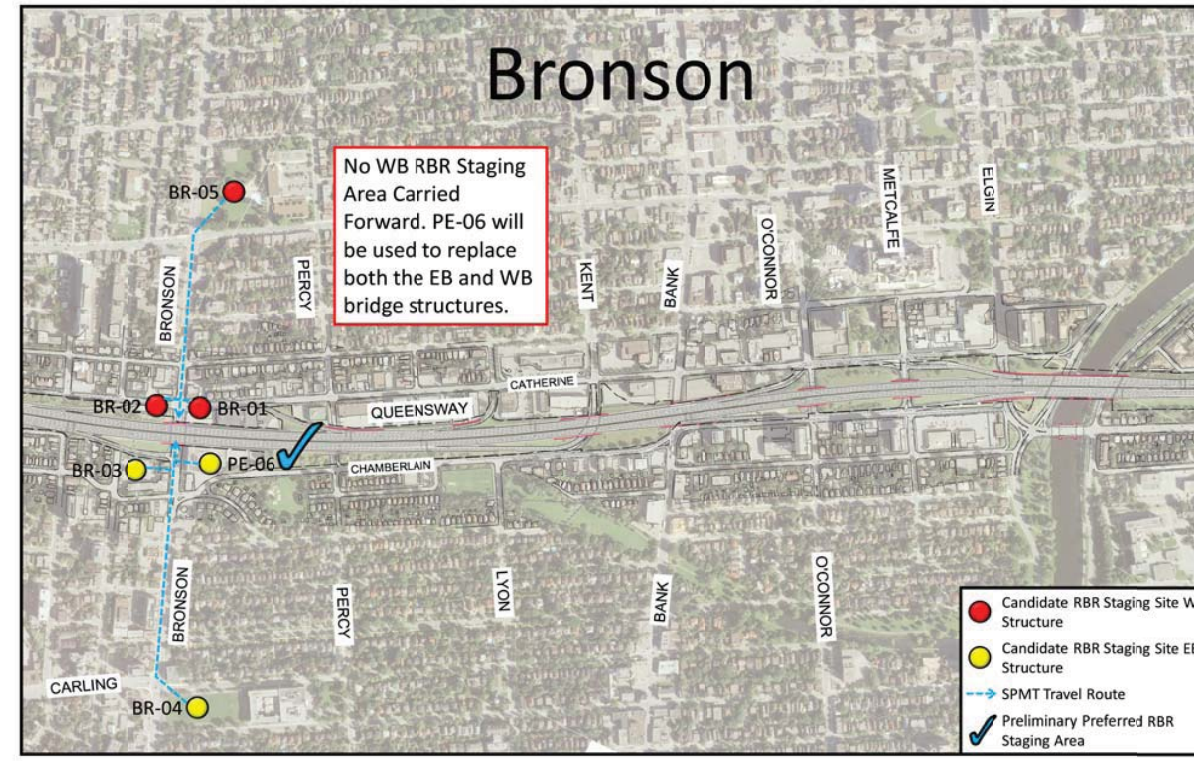
7. TECHNICALLY PREFERRED ALTERNATIVE

This technical memorandum on potential RBR staging areas has been used as input into the overall technical evaluation of bridge management alternatives. Based on the evaluation of alternatives, RBR is the technically preferred option for the Bronson Avenue structures. The overall MATS (Multi-Attribute Tradeoff System) evaluation is described in a standalone Analysis and Evaluation Report. Based on the outcome of the evaluation, there is a need for a staging site for the replacement of the bridge. However, in consideration of the availability of funding, provincial priorities and the long term performance of the bridge replacement, the TESR (Transportation Environmental Study Report) will seek clearance for both rehabilitation and replacement approaches for the bridge management plan.

The preferred staging site is **PE-06** (see **Figure 2**). Site **PE-06** covers the MTO/municipal ROW north of Chamberlain Avenue (between Bronson Avenue and Percy Street), and includes the former School Board building site. It is noted that the westerly area of this site generally exhibits flatter grades (along Highway 417) when compared to the easterly portion of the site. This site is ideal for the south Bronson Avenue Queensway bridge structure staging area because of its close proximity to the site. As well, the site consists of a large, contiguous area that easily meets the dimensions required for an adequate staging area. Effects on residences will be minimal, as this portion of Bronson Avenue is exclusively commercial.

Since there is only one RBR staging site being carried forward for the Eastbound and Westbound bridges, both structures will need to be replaced simultaneously on a long weekend (i.e. a 3-day weekend). Appropriate site preparation will be required in advance of the bridge structure replacements.

Figure 3
Location of Shortlisted RBR Staging Areas – Bronson Avenue (Sites 3-060.1 and 3-060.2)



2 September 2014

100 Craig Henry Drive, Suite 103
Ottawa, Ontario, K2G-5W3

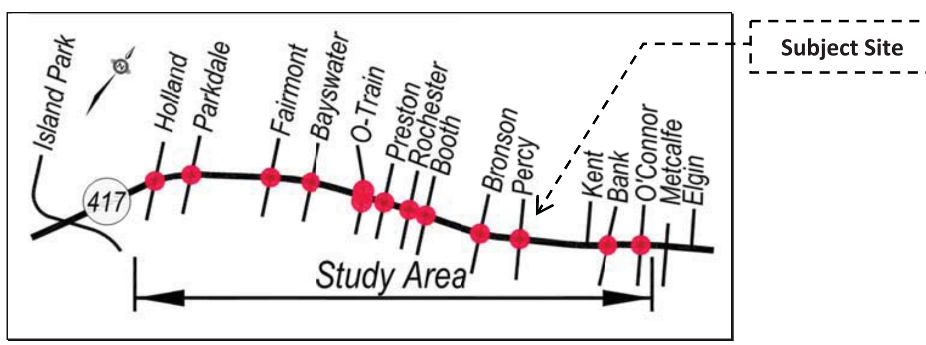
MEMORANDUM

TO:	File BTE13-001	**DATE:**	September 2, 2014
FROM:	Bytown Engineering	**PROJECT #:**	BTE13-001
PROJECT:	Preliminary Design and Environmental Assessment Study for the Rehabilitation/Replacement of Ottawa Queensway Mid-Town Bridges from Holland to O'Connor, GWP# 4075-11-00		
SUBJECT:	Preliminary Review of Staging Area Sites for Rapid Bridge Replacement Option/**UPDATE 3 Percy Street - Sites 3-061.1 and 3-061.2**		

1. INTRODUCTION

The Ontario Ministry of Transportation (MTO) will, over the next decade, undertake the rehabilitation or replacement of 23 structures on Highway 417 in the City of Ottawa. The structures are generally located within the central part of the City extending from Holland Avenue to O'Connor Street (see ***Figure 1***). The location considered in this review (i.e. Percy Street structure) is also highlighted.

Figure 1: Study Area



Bridge replacement and rehabilitation options are being considered for all 23 structures under study. The rehabilitation options extend the service life of the bridge by making appropriate and targeted repairs; replacement is considered if a new bridge can be constructed as a cost effective alternative to repairing the existing bridge. The replacement approach considers different bridge types and construction methods. One replacement option includes a Rapid Bridge Replacement (RBR) which entails the removal of the existing structure and insertion of a new structure**.** This process has been used at other bridge sites on Highway 417 immediately west of the study area; MTO has recently employed the RBR process for structures at Carling Avenue (westbound) and Kirkwood Avenue. This approach requires the closure of the freeway (eastbound and westbound lanes) while the old structure is removed and the new bridge is placed.

MTO has also tendered the first RBR for a rigid frame bridge in Ontario (i.e. Highway 401/Cornwall Centre Road). For a rigid frame bridge, the RBR process requires a duration that exceeds most recent deck replacements on Highway 417. For example, the Highway 401/Cornwall Centre Road pilot project allows 8 weeks for the removal and installation of a new rigid frame bridge.

A Group 'B' Environmental Assessment (EA) is being undertaken by the Ministry of Transportation for a bridge management plan for structural improvements (rehabilitation or replacements) to bridges on the Ottawa Queensway from Holland Avenue easterly to O'Connor Street. The project is being described as the Ottawa Queensway Mid-town bridges project.

The MTO's Provincial Class EA is a planning and design procedure developed to ensure that all potential natural, social/cultural and economic environments as well as property and land use effects are considered in undertaking certain projects.

This document summarizes part of the analysis and evaluation process to define staging areas that could be used to construct replacement bridges using Accelerated Bridge Construction (ABC). The staging areas would provide an area to build new rigid frame bridges and a lay-down area for the contractor, and house the existing bridge temporarily after it is removed for it to be demolished.

This memo reviews candidate staging areas for each of the bridge sites and selects one as a preferred location based on the experience of the previous ABC projects completed by MTO on the Queensway. This will demonstrate that ABC is achievable and then allow for the temporary effects of creating a site and clearing a path from the site to the bridge, to be considered in the evaluation of alternatives. The subsequent evaluation of alternatives will be completed after Public Information Centre (PIC) No. 1, and will systematically analyze, evaluate and select the Technically Preferred Alternatives (TPA's) for the 23 bridge sites under study. This sequential methodology will include community and stakeholder input at all key milestones of the study including consideration of the temporary staging areas. The effects and mitigation as a result of the TPA may be modified during subsequent stages of public consultation and will be further defined at the detail design stage. This document will become a component of the Transportation Environmental Study Report (TESR). The use of temporary staging areas will be negotiated by the MTO Property Section, and the locations identified in this memorandum may be changed at the time of replacement if there are other more suitable sites that can be identified. At this point the identification of a staging area reflects the technical feasibility to implement an ABC project as a candidate alternative using Rapid Bridge Replacement (RBR) with heavy lift technology.

The staging areas for the Queensway Bridges in this study need to be large enough to accommodate the temporary structure where the new bridge is built and the 2 self-propelled modular transporters (SPMT's) that need to be assembled and disassembled. There is also a requirement for a construction lay-down area.

A key consideration for the use of RBR relates to the provision of a construction staging area where the new structure is constructed and prepared for insertion into the existing location (i.e. replaces the old structure). The sequencing of bridge replacement will be addressed following the structural reviews/investigations. This memorandum provides a preliminary assessment of possible RBR construction staging areas at the subject site. Both north side and south side locations are addressed in this review.

2. DESIGN CRITERIA

The design criteria for a suitable RBR staging area should include the following:

1. Large overall area (50 m x 50 m = 2500 m^2) to accommodate new structure, storage of old bridge when removed, lay-down area for contractor and maneuverability of SPMT's.
2. Moderate grades (below 1.5%) on travel route to bridge site.
3. Dimensions of site to exceed the size of the new bridge and include workspace on all sides of the new bridge. Bridges are in the order of (25-30 m) x 25 m so desirable lateral dimension is 50 m and minimum dimension must exceed width/span of new bridge.
4. Where no site is available on one side of the Queensway, both east and westbound bridges may be replaced on the same weekend using a larger staging area on one side of the Queensway.

3. STAGING AREA REVIEW PARAMETERS

The following assumptions were used in this preliminary examination of potential staging sites:

- Property ownership was not explicitly considered in the review. Municipal, private, federal and/or provincial lands were all deemed acceptable.
- The expropriation of property for use as a temporary construction staging area was not considered. Any use or acquisition would be subject to property negotiations.
- The staging sites will require areas for the construction of the new structures and storage of the old structures, and must allow vehicle access/circulation.
- RBR staging areas are required on the north and south sides at each site (unless both bridges are replaced on the same weekend).
- Flat/minimal grades are preferred within the staging area and on the approaches to the replacement site.

- Site preparation is required under all options.
- The extension of the staging area into adjacent travel lanes was considered feasible at locations where volumes were minimal and/or multiple travel lanes are provided (unless both bridges are replaced on the same weekend).
- The proposed staging area should be in close proximity to the replacement structure site.
- The site should readily accommodate construction vehicles, preferably on a designated truck route.

Off-site staging areas which meet the guidelines are preferred. It is recognized that there are inherent challenges such as impacts on adjacent residents/land uses, the limited sites available to construct a new structure/store the old structure; the need to relocate utilities; vegetation, trees and other landscape features; and noise/dust issues. Although some challenges exist, the RBR process significantly reduces the amount of time required to close the road to traffic when compared to conventional reconstruction.

4. SITE REVIEW

Percy Street is a north/south local road which accommodates minimal traffic demands (1,500 AADT in 2013). It functions as a one-way, southbound facility, and includes a separate, dedicated bicycle lane under Highway 417. Signalized intersections are located at both Catherine Street and Chamberlain Avenue. Percy Street does not accommodate transit services and is not a designated truck route. In addition, there is no direct access to/from Highway 417 at this location.

The availability of staging areas of the required size in an urban setting such as Central Ottawa is challenging. Potential opportunities for staging sites typically consist of parks/sports fields, commercial/municipal parking areas and extended boulevards. The use of these facilities for RBR sites requires the removal of some or all of the existing functions; complete reinstatement will occur following the construction activities. In addition, RBR staging areas within the municipal ROW (i.e. the north and/or south approaches to the structure) are considered where viable alternative sites do not exist and where roadway features satisfy the requirements.

Using the parameters listed in the previous section, a preliminary assessment of possible RBR locations was undertaken. The results are summarized in subsequent tables. It is noted that the dimensions identified in this review were scaled from online mapping services and reflect the level of detail associated with those sources. ***Table 1*** provides a qualitative rating of the various RBR sites based on ***Good, Fair*** and ***Poor*** criteria. The ratings are meant to quantify, in a broad manner, the potential of each site considering the factors listed above.

Table 1
Analysis of Potential RBR Staging Areas – Percy Street (Sites 3-061.1 and 3-061.2)

	Location	Discussion	RBR Potential
North Side	***PE-01*** – Surface parking area at private development on Catherine east of Percy	• Available area approx. 80 m x 50 m = 4000 m^2 • Approx. 260 m from staging area to bridge site (via Catherine/Percy) • Impact on parking facility • Catherine is a designated truck route • Approximately 250 m from bridge site (via Catherine) • Catherine (i.e. route to bridge site) does not have available width to accommodate structure; possible pinch point at 370 Catherine Street	• ***POOR*** → *Size acceptable* → *Moderate distance to bridge site* → *Corridor insufficient for transport*
	PE-02 – Municipal ROW at Percy and Chamberlain	• Available area approx. 15 m x 65 m = 975 m^2 • Approx. 60 m from staging area to bridge structure (via Percy) • Constrained corridor; adjacent buildings abut sidewalk • Impacts to access/loading areas for commercial property to west and City works yard to east • Possible use of portion of City works yard for staging area	• ***FAIR*** → *Impacts on adjacent businesses* → *Traffic impacts on both Catherine and Percy*
	BR-05 – McNabb Park at southeast corner of Gladstone and Bronson	• Available area approx. 75 m x 50 m = 3750 m^2 • Approx. 650 m from staging area to bridge site (via Bronson/Catherine/Percy) • Constrained corridor- adjacent buildings abut sidewalk • Impacts to access/loading areas for commercial property to west and City works yard to east • Possible use of portion of City works yard for staging area	• ***FAIR*** → *Impacts on adjacent businesses* → *Impacts on Centretown recreational space*
South Side	***PE-03*** – Glebe Memorial Park (west of Percy)	• Available area approx. 100 m x 50 m = 5000 m^2 • Approx. 150 m from staging area to bridge site (via Chamberlain/Percy) • Located within residential area • Chamberlain is a designated truck route • May require removal of vegetation/trees	• ***GOOD*** → *Short term impact to traffic on Chamberlain during the weekend of the bridge replacement* → *Loss of recreational space for Glebe Community*
	PE-04 – Tennis Courts at Glendale/ Chamberlain	• Available area approx. 50 m x 30 m = 1750 m^2 • Approx. 200 m from staging area to bridge site (via Chamberlain/Percy) • Located within residential area • Chamberlain is a designated truck route • May require removal of vegetation/trees and field house • Impact to residences on Percy/Glendale • Approximately 150 m from bridge site (via Chamberlain)	• ***FAIR*** → *Impact on recreational uses* → *Impact on nearby residences*
	PE-05 - Tennis courts immediately north of Glendale	• Available area approx. 75 m x 35 m = 3375 m^2 • Approximately 310 m from bridge site (via Chamberlain/ Percy) • Requires temporary use of tennis courts • Located within mature residential area • Chamberlain is a designated truck route	• ***FAIR*** → *Impact on recreational uses and nearby residences*

Subject: Assessment of Potential Staging Areas for Rapid Bridge Replacement Option – ***PERCY STREET***
Project: Preliminary Design and Environmental Assessment Study for the Rehabilitation/Replacement of Ottawa Queensway Mid-Town Bridges from Holland to O'Connor, GWP# 4075-11-00/BTE13-001
Date: September 2, 2014

	PE-06 – Grassed ROW between Chamberlain and Queensway (just west of Percy)	• Available area approx. 120 m x (varies 40-80 m) = 4800 m^2 – 9600 m^2 • Approx. 260 m from staging area to bridge site (via Chamberlain/Percy) • Impacts to traffic on Chamberlain/Percy • Located on MTO property approx 50m west of Percy St (between Chamberlain and Queensway) • Sufficient space to store and dismantle components of old structure and construct new structure • Grade adjustments and landscaping will be required prior to land being used as a staging area • Chamberlain is a designated truck route	• ***GOOD*** → *Minimal impact on nearby residences* → *Size acceptable*

5. COARSE SCREENING EVALUATION OF RBR SITES

The potential candidate RBR staging areas were assessed as part of a coarse screening analysis against three criteria (size, access route gradient and access route impacts) to assess if a site was feasible to carry forward. The conclusions of this assessment are presented in **Table 2** and **Table 3**.

Table 2
RBR Staging Area Coarse Screening Analysis
Bridge Site: Percy Street WB

Candidate RBR Staging Area	Achieve Minimum Area requirement (2500 m²) Yes/No	Route Access: Meet Gradient requirement <1.5% slope	Route Access: Level of Impact on Travel Route	Comments	Carry Forward Yes/No
PE-01 Surface parking lot at private development on Catherine Street east of Percy	Yes 80 m x 50 m = 4000 m^2	Yes	High	Catherine Street roadway too narrow between existing buildings. Pinch point at 383 Catherine Street - 18 m face to face opening.	No
PE-02 Municipal right-of-way	No 15 m x 65 m = 975 m^2	Yes	Low	Minimal impact on travel route, but site does not meet size requirements	No
BR-05 –McNabb Park at southeast corner of Gladstone and Bronson	Yes 75 m x 50 m = 3750 m^2 (This only includes part of McNabb Park. It could be expanded if necessary.)	Yes	High	Percy Street has pinch points with buildings too narrow to transport new bridge. Travel route using Bronson to Catherine also has a pinch point at 458 Catherine which is too narrow to transport new bridge.	No
Preliminary Recommendation: **No site is available on north side of Queensway. However, carry forward PE-03 and PE-06 (i.e. preferred Percy EB staging area), should both the EB and WB structures be replaced on the same weekend**.					

Table 3
RBR Staging Area Coarse Screening Analysis
Bridge Site: Percy Street EB

Candidate RBR Staging Area	Achieve Minimum Area requirement (2500 m²) Yes/No	Route Access: Meet Gradient requirement <1.5% slope	Route Access: Level of Impact on Travel Route	Comments	Carry Forward Yes/No
PE-03 Playground/ park west of Percy (Chamberlain Park) between Glendale and Lyon	Yes 100 m x 50 m = 5000 m^2	Yes	Low	Travel route across Chamberlain. Preferred site would be PE-06 site from Kent Street RBR project	Yes
PE-04 Tennis courts immediately north of Glendale	No 50 m x 35 m = 1750 m^2	Yes	Low - Potential impacts to truck traffic on Chamberlain	Not available for RBR site but could be candidate SPMT assembly area	No
PE-05 Playing field/park south of Chamberlain/west of Percy	Yes 75 m x 45 m = 3375 m^2	Yes	High	Utility impact	No
PE-06 Grassed area between Chamberlain and Queensway including the former School Board building site	Yes 120 m x (varies 40-80 m) = 4800-9600 m^2	Yes	Low - Potential impacts to truck traffic on Chamberlain	Site meets area, gradient and impact requirements	Yes
Preliminary Recommendation: **Carry Forward sites PE-03 and PE-06**					

None of the sites analyzed for the replacement of the north Percy Street Queensway bridge structure (see **Table 2**) adequately met the criteria (i.e. a combination of proximity to the site, route access characteristics, size of staging area, impacts on adjacent uses and ability to relocate the current use of the site). For the south bridge structure, the highlighted sites (i.e. **PE-03** and **PE-06**) shown in **Table 3** generally exhibit more favourable staging characteristics. As noted in Table 2, if both the north and south bridge structures are replaced on the same weekend, then **PE-03** and **PE-06** should also be carried forward for this scenario as well.

6. PREFERRED RBR STAGING SITES

Based on this preliminary review, the preferred RBR staging sites recommended for consideration are presented in **Figure 2**. The evaluation of alternatives includes the following:

North Side

- No sites are being carried forward. If westbound structure RBR alternatives require a staging area, it will require the use of the south sites PE-03 or PE-06.

South Side

- **Site PE-03** is located in Glebe Memorial Park, which is south of Chamberlain Avenue (between Bronson Avenue and Percy Street). The site easily meets the size criteria of 2500 m^2, and is located reasonably close to the Percy Street Queensway south bridge structure site. In order for it to be used as a staging area, the park will need to be re-landscaped, meaning the removal of mature trees, bushes and re-grading the area to ensure that all grades on the site are 1.5% or less.
- **Site PE-06** covers the MTO/municipal right-of-way north of Chamberlain Avenue (between Bronson Avenue and Percy Street), and includes the former School Board building site. It is noted that the westerly area of this site generally exhibits flatter grades (along Highway 417) when compared to the easterly portion of the site. The travel route length is moderate (approx. 310m); however, the grade requirement of 1.5% for the SPMT is met, and there would be a minimal effect on residences, since Chamberlain Avenue has very few front-facing residential properties. Chamberlain Avenue, however, is a City-designated truck route. Trucks that typically make use of this route will likely need to be detoured to a nearby east/west arterial road during the rapid bridge replacement.

As stated, appropriate site preparation will be required at each selected location.

7. TECHNICALLY PREFERRED ALTERNATIVE

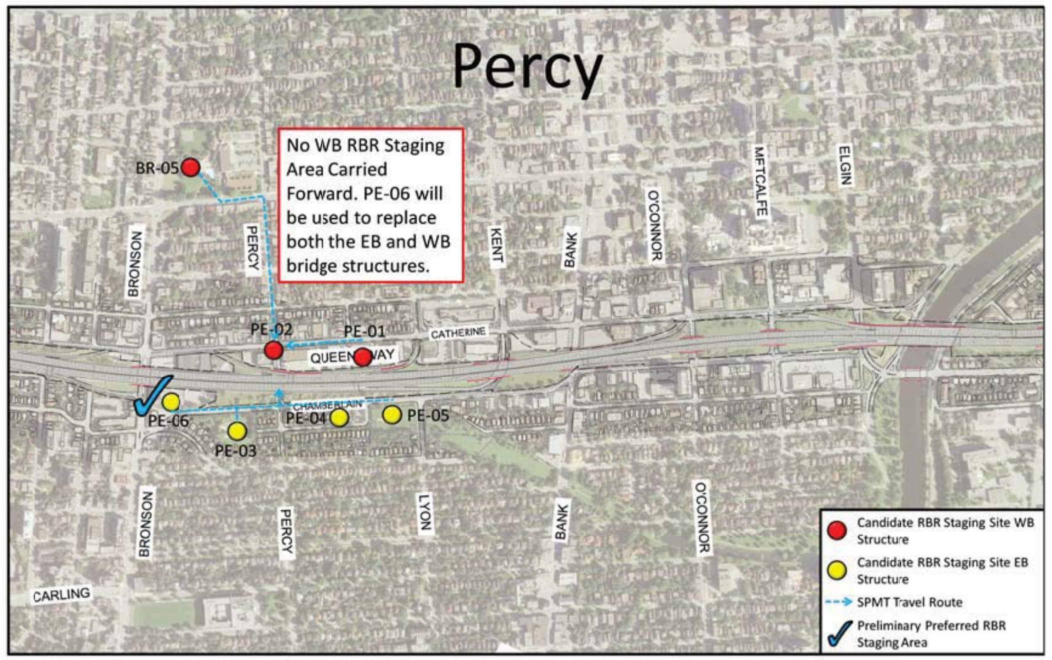
This technical memorandum on potential RBR staging areas has been used as input into the overall technical evaluation of bridge management alternatives. Based on the evaluation of alternatives, RBR is the technically preferred option for the Percy Street structures. The overall MATS (Multi-Attribute Tradeoff System) evaluation is described in a standalone Analysis and Evaluation Report. Based on the outcome of the evaluation, there is a need for a staging site for the replacement of the bridge. However, in consideration of the availability of funding, provincial priorities and the long term performance of the bridge replacement, the TESR

(Transportation Environmental Study Report) will seek clearance for both rehabilitation and replacement approaches for the bridge management plan.

It is recommended to use site **PE-06** (see **Figure 2**). Site **PE-06** covers the MTO/municipal ROW north of Chamberlain Avenue (between Bronson Avenue and Percy Street), and includes the former School Board building site. It is noted that the westerly area of this site generally exhibits flatter grades (along Highway 417) when compared to the easterly portion of the site. The site consists of a large, contiguous area that easily meets the dimensions required for an adequate staging area site.

Since there is only one RBR staging site being carried forward for the Eastbound and Westbound bridges, both structures will need to be replaced simultaneously on a long weekend (i.e. a 3-day weekend). Appropriate site preparation will be required in advance of the bridge structure replacements.

Figure 2
Location of Shortlisted RBR Staging Areas – Percy Street (Sites 3-061.1 and 3-061.2)



2 September 2014

100 Craig Henry Drive, Suite 103
Ottawa, Ontario, K2G-5W3

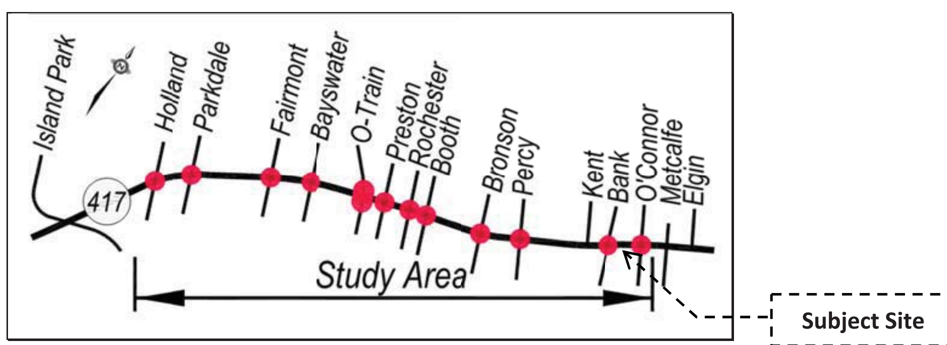
MEMORANDUM

TO:	File BTE13-001	**DATE:**	September 2, 2014
FROM:	Bytown Engineering	**PROJECT #:**	BTE13-001
PROJECT:	Preliminary Design and Environmental Assessment Study for the Rehabilitation/Replacement of Ottawa Queensway Mid-Town Bridges from Holland to O'Connor, GWP# 4075-11-00		
SUBJECT:	Preliminary Review of Staging Area Sites for Rapid Bridge Replacement Option/**UPDATE 2 Bank Street - Sites 3-063.1 and 3-063.2**		

1. INTRODUCTION

The Ontario Ministry of Transportation (MTO) will, over the next decade, undertake the rehabilitation or replacement of 23 structures on Highway 417 in the City of Ottawa. The structures are generally located within the central part of the City extending from Holland Avenue to O'Connor Street (see ***Figure 1***). The location considered in this review (i.e. Bank Street structure) is also highlighted.

Figure 1: Study Area



Bridge replacement and rehabilitation options are being considered for all 23 structures under study. The rehabilitation options extend the service life of the bridge by making appropriate and targeted repairs; replacement is considered if a new bridge can be constructed as a cost effective alternative to repairing the existing bridge. The replacement approach considers different bridge types and construction methods. One replacement option includes a Rapid Bridge Replacement (RBR) which entails the removal of the existing structure and insertion of a new structure. This process has been used at other bridge sites on Highway 417 immediately west of the study area; MTO has recently employed the RBR process for structures at Carling Avenue (westbound) and Kirkwood Avenue. This approach requires the closure of the freeway (eastbound and westbound lanes) while the old structure is removed and the new bridge is placed.

MTO has also tendered the first RBR for a rigid frame bridge in Ontario (i.e. Highway 401/Cornwall Centre Road). For a rigid frame bridge, the RBR process requires a duration that exceeds most recent deck replacements on Highway 417. For example, the Highway 401/Cornwall Centre Road pilot project allows 8 weeks for the removal and installation of a new rigid frame bridge.

A Group 'B' Environmental Assessment (EA) is being undertaken by the Ministry of Transportation for a bridge management plan for structural improvements (rehabilitation or replacements) to bridges on the Ottawa Queensway from Holland Avenue easterly to O'Connor Street. The project is being described as the Ottawa Queensway Mid-town bridges project.

The MTO's Provincial Class EA is a planning and design procedure developed to ensure that all potential natural, social/cultural and economic environments as well as property and land use effects are considered in undertaking certain projects.

This document summarizes part of the analysis and evaluation process to define staging areas that could be used to construct replacement bridges using Accelerated Bridge Construction (ABC). The staging areas would provide an area to build new rigid frame bridges and a lay-down area for the contractor, and house the existing bridge temporarily after it is removed for it to be demolished.

This memo reviews candidate staging areas for each of the bridge sites and selects one as a preferred location based on the experience of the previous ABC projects completed by MTO on the Queensway. This will demonstrate that ABC is achievable and then allow for the temporary effects of creating a site and clearing a path from the site to the bridge, to be considered in the evaluation of alternatives. The subsequent evaluation of alternatives will be completed after Public Information Centre (PIC) No. 1, and will systematically analyze, evaluate and select the Technically Preferred Alternatives (TPA's) for the 23 bridge sites under study. This sequential methodology will include community and stakeholder input at all key milestones of the study including consideration of the temporary staging areas. The effects and mitigation as a result of the TPA may be modified during subsequent stages of public consultation and will be further defined at the detail design stage. This document will become a component of the Transportation Environmental Study Report (TESR). The use of temporary staging areas will be negotiated by the MTO Property Section, and the locations identified in this memorandum may be changed at the time of replacement if there are other more suitable sites that can be identified. At this point the identification of a staging area reflects the technical feasibility to implement an ABC project as a candidate alternative using Rapid Bridge Replacement (RBR) with heavy lift technology.

The staging areas for the Queensway Bridges in this study need to be large enough to accommodate the temporary structure where the new bridge is built and the 2 self-propelled modular transporters (SPMT's) that need to be assembled and disassembled. There is also a requirement for a construction lay-down area.

A key consideration for the use of RBR relates to the provision of a construction staging area where the new structure is constructed and prepared for insertion into the existing location (i.e. replaces the old structure). The sequencing of bridge replacement will be addressed following the structural reviews/investigations. This memorandum provides a preliminary assessment of possible RBR construction staging areas at the subject site. Both north side and south side locations are addressed in this review.

2. DESIGN CRITERIA

The design criteria for a suitable RBR staging area should include the following:

1. Large overall area (50 m x 50 m = 2500 m^2) to accommodate new structure, storage of old bridge when removed, lay-down area for contractor and maneuverability of SPMT's.
2. Moderate grades (below 1.5%) on travel route to bridge site.
3. Dimensions of site to exceed the size of the new bridge and include workspace on all sides of the new bridge. Bridges are in the order of (25-30 m) x 25 m so desirable lateral dimension is 50 m and minimum dimension must exceed width/span of new bridge.
4. Where no site is available on one side of the Queensway, both east and westbound bridges may be replaced on the same weekend using a larger staging area on one side of the Queensway.

3. STAGING AREA REVIEW PARAMETERS

The following assumptions were used in this preliminary examination of potential staging sites:

- Property ownership was not explicitly considered in the review. Municipal, private, federal and/or provincial lands were all deemed acceptable.
- The expropriation of property for use as a temporary construction staging area was not considered. Any use or acquisition would be subject to property negotiations.
- The staging sites will require areas for the construction of the new structures and storage of the old structures, and must allow vehicle access/circulation.
- RBR staging areas are required on the north and south sides at each site (unless both bridges are replaced on the same weekend).
- Flat/minimal grades are preferred within the staging area and on the approaches to the replacement site.

Subject: Assessment of Potential Staging Areas for Rapid Bridge Replacement Option – ***BANK STREET***
Project: Preliminary Design and Environmental Assessment Study for the Rehabilitation/Replacement of Ottawa Queensway Mid-Town Bridges from Holland to O'Connor, GWP# 4075-11-00/BTE13-001
Date: September 2, 2014

- Site preparation is required under all options.
- The extension of the staging area into adjacent travel lanes was considered feasible at locations where volumes were minimal and/or multiple travel lanes are provided (unless both bridges are replaced on the same weekend).
- The proposed staging area should be in close proximity to the replacement structure site.
- The site should readily accommodate construction vehicles, preferably on a designated truck route.

Off-site staging areas which meet the guidelines are preferred. It is recognized that there are inherent challenges such as impacts on adjacent residents/land uses, the limited sites available to construct a new structure/store the old structure; the need to relocate utilities; vegetation, trees and other landscape features; and noise/dust issues. Although some challenges exist, the RBR process significantly reduces the amount of time required to close the road to traffic when compared to conventional reconstruction.

4. SITE REVIEW

Bank Street is a major north/south arterial road which accommodates approximately 12,500 vehicles/day (2010 AADT south of Highway 417). The roadway comprises 4 lanes under Highway 417 and signalized intersections are located immediately north and south of the highway - at Catherine Street and Chamberlain Avenue/Isabella Street. Bank Street also accommodates transit service and is a designated truck route (i.e. restricted load).

The availability of staging areas of the required size in an urban setting such as Central Ottawa is challenging. Potential opportunities for staging sites typically consist of parks/sports fields, commercial/municipal parking areas and extended boulevards. The use of these facilities for RBR sites requires the removal of some or all of the existing functions; complete reinstatement will occur following the construction activities.

In addition, RBR staging areas within the municipal ROW (i.e. the north and/or south approaches to the structure) are considered where viable alternative sites do not exist and where roadway features satisfy the identified requirements.

Using the parameters listed in the previous section, a preliminary assessment of possible RBR locations was undertaken. The results are summarized in subsequent tables. It is noted that the dimensions identified in this review were scaled from online mapping services and reflect the level of detail associated with those sources. ***Table 1*** provides a qualitative assessment of the various RBR sites based on ***Good, Fair*** and ***Poor*** criteria. The ratings are meant to quantify, in a broad manner, the potential of each site considering the factors listed above.

Table 1
Analysis of Potential RBR Staging Areas – Bank Street (Sites 3-063.1 and 3-063.2)

	Location	***Discussion***	***RBR Potential***
North Side	***BA-01*** - Commercial parking area in SE corner of Bank/Catherine	• Available area approx. 55 m x 35 m = 1925 m^2 • Does not meet minimum area/dimension requirements; would need to be used in combination with another site • Impact on office parking supply • Moderate grade difference between parking lot/potential staging area and adjacent roadways • Approx. 100 m from staging area to bridge site (via Catherine/Bank) • Catherine/Bank are truck routes • Preparation of transport route required	• ***FAIR*** → *Does not meet minimum required area and dimensions desirable for a staging area site* → *Moderate distance to bridge site*
	BA-02 - Commercial parking area in SE quadrant of Catherine/Kent intersection	• Available area approx. 50 m x 50 m = 2500 m^2 • Approx. 175 m from staging area to bridge site (via Catherine/Bank) • Impact on office parking supply • Catherine/Bank are truck routes • Preparation of transport route required	• ***GOOD*** → *Size acceptable* → *Reasonably close proximity to bridge site*
	BA-03 - Commercial parking area in SW quadrant	• Available area approx. 50 m x (varies 25-30 m) = 1250 m^2 – 1500 m^2 • Does not meet minimum dimension/area requirements; would need to be used in combination with another site to achieve 2500 m^2 • Approx. 100 m from staging area to bridge site (via Catherine/Bank) • Catherine/Bank are designated truck routes • Impact on office parking supply • Slope on Catherine (just west of Bank) exceed 1.5% • Preparation of transport route required	• ***FAIR*** → *Does not meet minimum size/ dimension requirements* → *Relatively short distance to bridge site* → *Potential grade issues may be encountered on Catherine Street*
	PE-01 - Surface parking lot at private development on Catherine Street east of Percy Street	• Available area approx. 80 m x 50 m = 4000 m^2 • Approx. 550 m from staging area to bridge site (via Chamberlain/Bank) • Impact on office parking supply • Moderate grade difference between parking lot • Approx. 30 m from staging area to bridge site Preparation of transport route required • Pinch point at 320 Catherine (west of Lyon) • Trees located east of Kent St may be impacted during the movement of the bridge structure • Grade changes exceed 1.5% approaching the intersection of Catherine/Bank from the west	• ***FAIR*** → *Size acceptable* → *Moderate distance to bridge site* → *Grade changes exceed 1.5% close to bridge site*
	BR-05 - McNabb Park at southeast corner of Gladstone and Bronson	• Available area approx. 75 m x 50 m = 3750 m^2 • Approx. 1400 m (1.4 km) from staging area to bridge site (via Bronson/Gladstone/Bank) • Travel route will cause significant impact on traffic • Loss of recreational space for community and students attending McNabb School	• ***POOR*** → *Long and complex travel route that would affect multiple arterial roadways* → *Impact to both*

Subject: Assessment of Potential Staging Areas for Rapid Bridge Replacement Option – ***BANK STREET***
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Date: September 2, 2014

			businesses and residences
South Side	***BA-04*** - Municipal parking area in SW quadrant of Bank/Chamberlain/ Isabella intersection	• Contiguous area of approx. 25 m x 25 m = 625 m^2 available • Approx. 80 m from staging area to bridge site (via Bank) • Impact on office parking supply (to east and west) • Chamberlain/Isabella/Bank are truck routes • Approx. 50 m from staging area to bridge site	• ***FAIR*** → *Does not meet the minimum required area of 2500m²* → *Close to bridge site*
	BA-05 - Commercial parking area west of Bank	• Available area approx. 30 m x 45 m = 1350 m^2 • Approx. 175 m from staging area to bridge site (via Chamberlain/Bank) • Impact on office parking supply • Chamberlain/Isabella/Bank are truck routes	• ***FAIR*** → *Does not meet the minimum required area of 2500m²*
	BA-06 - Commercial parking area east of Bank	• Available area approx. 80 m x 30 m + 30 m x 20 m = 3000 m^2 • Approx. 150 m from staging area to bridge site (via Isabella/Bank) • Impact on office parking supply • Chamberlain/Isabella/Bank are truck routes	• ***FAIR*** → *Site is narrow in some locations; does not meet minimum area requirement*
	BA-07 - MTO right-of-way between the Queensway and Chamberlain (west of Bank)	• Available area approx. 25 m x 120 m = 3000 m^2 • Approx. 150 m from staging area to bridge site (via Chamberlain/Bank) • Site will need to be re-landscaped to meet grade requirements, remove trees/shrubs • Sheet pile retaining wall would be required to help support Queensway structure, after the fill located adjacent to it has been removed	• ***GOOD*** → *Satisfies area requirement of 2500m²* → *Located within close proximity to the bridge site*
	PE-05 - Tennis courts immediately north of Glendale	• Available area approx. 50 m x 35 m = 1750 m^2 • Approx. 520 m from staging area to bridge site (via Chamberlain/Bank) • Chamberlain and Bank are designated truck routes • Utility impacts using this site	• ***POOR*** → *Does not meet the minimum required area of 2500m²* → *Utility impacts*
	PE-06 – Grassed area between Chamberlain and Queensway including the former School Board building site	• Available area approx. 120 m x (varies from 40-80m) = 4800 m^2 – 9600 m^2 • Approx. 900 m from staging area to bridge site (via Chamberlain and Bank) • Chamberlain and Bank are designated truck routes • Grade for SPMT are met	• ***GOOD*** → *Large area that satisfies minimum area/dimension requirements* → *Relatively long distance from staging area to bridge site*

5. COARSE SCREENING EVALUATION OF RBR SITES

The potential candidate RBR staging areas were assessed as part of a coarse screening analysis against three criteria (size, access route gradient and access route impacts) to assess if a site was feasible to carry forward. The conclusions of this assessment are presented in **Table 2** and **Table 3**.

Table 2
RBR Staging Area Coarse Screening Analysis
Bridge Site: Bank Street WB

Candidate RBR Staging Area	**Achieve Minimum Area requirement (2500 m²) Yes/No**	**Route Access: Meet Gradient requirement <1.5% slope**	**Route Access: Level of Impact on Travel Route**	**Comments**	**Carry Forward Yes/No**
BA-01 - Commercial parking area in SE corner of Bank/Catherine	No (minor reduction in design standard) 35 m x 55 m = 1925 m^2	Yes	High	To achieve a level gradient, significant excavation on private property	No
BA-02 Commercial parking area in SE corner of Catherine/Kent intersection	No (minor reduction in design standard) 50 m x 50 m = 2500 m^2	Yes	Moderate	Impacts to vehicles travelling on Catherine and Bank	Yes (Subject to investigation)
BA-03 Commercial parking in SW corner of Catherine/ Bank	No 50 m x (varies 25-30 m) = 1250-1500 m^2	Yes	Low	Some impacts to traffic on Catherine and Bank	No
PE-01 Surface parking lot at private development on Catherine Street east of Percy	Yes 80 m x 50 m = 4000 m^2	Yes	High	There is a pinch point at 320 Catherine Street where street is too narrow (west of Lyon)	No
BR-05 McNabb Park at southeast corner of Gladstone and Bronson	Yes 75 m x 50 m = 3750 m^2 (This only includes part of McNabb Park. It could be expanded if necessary.)	Yes	High – travel route down Bronson to Catherine; or High - travel route on Gladstone to Bank	There are pinch points on Catherine Street (370, 458 Catherine) too narrow. Bank Street buildings too narrow to travel to Gladstone.	No
Preliminary Recommendation: Carry Forward BA-02 as site subject to investigation.					

Table 3
RBR Staging Area Coarse Screening Analysis
Bridge Site: Bank Street EB

Candidate RBR Staging Area	**Achieve Minimum Area requirement (2500 m²) Yes/No**	**Route Access: Meet Gradient requirement <1.5% slope**	**Route Access: Level of Impact on Travel Route**	**Comments**	**Carry Forward Yes/No**
BA-04 Municipal parking area in SW quadrant of Bank/ Chamberlain/ Isabella intersection	No 25 m x 25 m = 625 m^2	Yes	Moderate	Impacts to traffic on Bank	No
BA-05 Commercial parking area west of Bank	No 45 m x 30 m = 1350 m^2	Yes	Moderate	Impacts to traffic on Chamberlain and Bank	No
BA-06 Commercial parking area east of Bank	Yes (80 x 30 m) + 30 m x 20 m = 3000 m^2	Yes	Moderate	Insufficient area due to narrow dimensions of site	No
BA-07 MTO right-of-way between the Queensway and Chamberlain (west of Bank)	Yes 25 m x 120 m = 3000 m	Yes	Low	Existing site for Kent St. RBR	Yes - Subject to investigation. This site is below the desirable 2500 m^2 staging area size and the lateral dimension north/south is approximately the minimum dimension of the new bridge (without narrowing Chamberlain Street).
PE-05 Tennis courts immediately north of Glendale	No 50 m x 35 m = 1750 m^2	Yes	High	Utility impacts	No
PE-06 – Grassed area between Chamberlain and Queensway including the former School Board building site	Yes 120 x (varies 40-80 m) = 4800-9600 m^2	Yes	Moderate	Travel Route on Chamberlain to include utility relocations and roadway protection to widen towards Highway 417	Yes (Preference to use BA-07 if constructed for Kent Street bridge RBR)
Preliminary Recommendations: Staging site **BA-07** (used for Kent Street RBR sites) and **PE-06**					

Site **BA-02** (see **Table 2**) generally exhibits more favourable characteristics for the replacement of the north Bank Street Queensway bridge structure, while **BA-07** and **PE-06** (**see Table 3**) generally exhibit more favorable characteristics for the replacement of the south Bank Street Queensway bridge structure. The sites are analyzed based on a combination of the following criteria: proximity to the site, access route characteristics, size of staging area, impacts on adjacent uses and ability to relocate the current use of the site.

Subject: Assessment of Potential Staging Areas for Rapid Bridge Replacement Option – ***BANK STREET***
Project: Preliminary Design and Environmental Assessment Study for the Rehabilitation/Replacement of Ottawa Queensway Mid-Town Bridges from Holland to O'Connor, GWP# 4075-11-00/BTE13-001
Date: September 2, 2014

6. PREFERRED RBR STAGING SITES

Based on this preliminary review, the preferred RBR staging sites recommended for consideration are presented in **Figure 2**. The evaluation of alternatives includes the following:

North Side

- **Site BA-02** is located in the parking space on the northeast corner of Bank Street and Catherine Street. The site is within close proximity to the Queensway north Bank Street bridge structure; however, it cannot be accessed directly from Bank Street because of the grade separation between the parking facility and Bank Street. Instead, the bridge structure will need to be transported west on Catherine Street, then south on Bank Street. Despite this added travel distance, the staging area is still reasonably close to the bridge structure (approx. 175 m), and it is expected to cause minimal overall traffic delays on Bank Street and Catherine Street. The biggest impact of using this site as a staging area will be the loss of parking supply for the surrounding buildings. The site meets the minimum required area that is necessary to assemble the SPMT, store/dismantle the existing north Bank Street bridge structure and construct the replacement bridge structure. The site is slightly less than the actual dimensions of the parking lot, as a 5m allowance has been made for sheet piling that may need to be installed along the south property line of the parking lot, abutting the Queensway.

South Side

- **Site BA-07** is located in the MTO and municipal ROW north of Chamberlain Avenue (between Kent Street and Bank Street). The staging area site is in close proximity to the Bank Street south bridge structure, and should result in less impact for traffic than some of the other staging area sites that are farther away, and require more complex travel routes to access the bridge structure site. The area meets the minimum area requirement of 2500 m^2; however, it will need to be re-graded so that it meets the maximum gradient of 1.5% that can be handled by the SPMT. A 5 m strip of land located along the north property line has been allocated for the installation of sheet piling along the Queensway structure, and it not included in the site dimensions for BA-07.
- **Site PE-06** is located in the MTO right-of-way north of Chamberlain Avenue (between Bronson Avenue and Percy Street). The site limits also include the former School Board Building. This space easily meets the size and dimension requirements that are necessary to construct the new bridge structure and store the existing bridge structure. The travel is relatively lengthy (approx. 900m), compared with some of the other options (e.g. site BA-07); however, the grade requirement of 1.5% for the SPMT is met, and

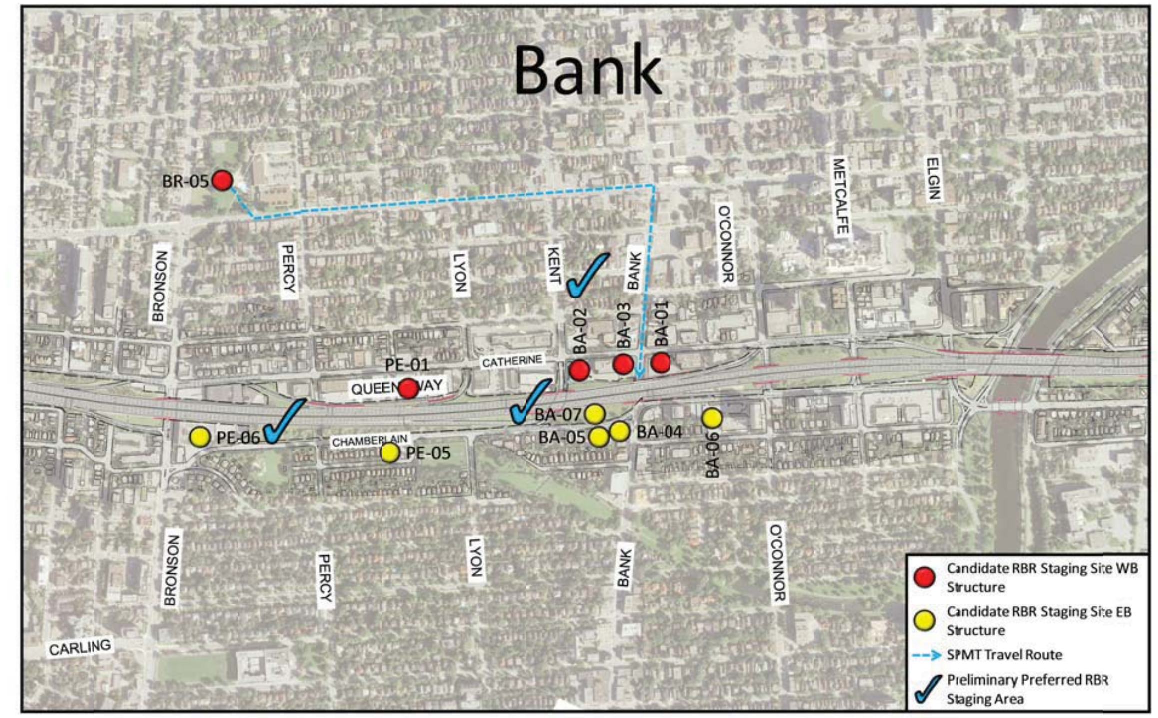
there would be minimal affect on residences, since Chamberlain Avenue has very few front-facing residential properties. Chamberlain Avenue, however, is a city-designated truck route. Trucks that typically make use of this route will likely need to be detoured to a nearby east/west arterial road during the rapid bridge replacement.

As stated, appropriate site preparation will be required for the selected RBR staging locations.

7. TECHNICALLY PREFERRED ALTERNATIVE

This technical memorandum on potential RBR staging areas has been used as input into the overall technical evaluation of bridge management alternatives. Based on the evaluation of alternatives, RBR is not the technically preferred option for the Bank Street structures. The overall MATS (Multi-Attribute Tradeoff System) evaluation is described in a standalone Analysis and Evaluation Report. Based on the outcome of the evaluation, there will not be a need for a staging site for the replacement of the bridge. However, in consideration of the availability of funding, provincial priorities and the long term performance of the rehabilitation of the bridge, the TESR (Transportation Environmental Study Report) will seek clearance for both rehabilitation and replacement approaches for the bridge management plan. Therefore, an RBR staging area for the ultimate bridge replacement will be revisited at a future date and will include a review of the sites identified in this technical memorandum.

Figure 2
Location of Shortlisted RBR Staging Areas – Bank Street (Sites 3-063.1 and 3-063.2)



24 April 2014

100 Craig Henry Drive, Suite 103
Ottawa, Ontario, K2G-5W3

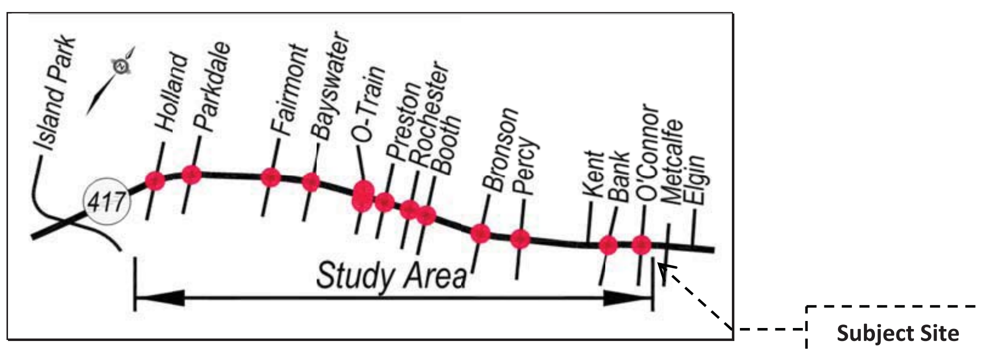
MEMORANDUM

TO:	File BTE13-001	**DATE:**	September 2, 2014
FROM:	Bytown Engineering	**PROJECT #:**	BTE13-001
PROJECT:	Preliminary Design and Environmental Assessment Study for the Rehabilitation/Replacement of Ottawa Queensway Mid-Town Bridges from Holland to O'Connor, GWP# 4075-11-00		
SUBJECT:	Preliminary Review of Staging Area Sites for Rapid Bridge Replacement Option/**UPDATE 3** **O'Connor Street - Site 3-064**		

1. INTRODUCTION

The Ontario Ministry of Transportation (MTO) will, over the next decade, undertake the rehabilitation or replacement of 23 structures on Highway 417 in the City of Ottawa. The structures are generally located within the central part of the City extending from Holland Avenue to O'Connor Street (see ***Figure 1***). The location considered in this review (i.e. O'Connor Street structure) is also highlighted.

Figure 1: Study Area



Bridge replacement and rehabilitation options are being considered for all 23 structures under study. The rehabilitation options extend the service life of the bridge by making appropriate and targeted repairs; replacement is considered if a new bridge can be constructed as a cost effective alternative to repairing the existing bridge. The replacement approach considers different bridge types and construction methods. One replacement option includes a Rapid Bridge Replacement (RBR) which entails the removal of the existing structure and insertion of a new structure**.** This process has been used at other bridge sites on Highway 417 immediately west of the study area; MTO has recently employed the RBR process for structures at Carling Avenue (westbound) and Kirkwood Avenue. This approach requires the closure of the freeway (eastbound and westbound lanes) while the old structure is removed and the new bridge is placed.

MTO has also tendered the first RBR for a rigid frame bridge in Ontario (i.e. Highway 401/Cornwall Centre Road). For a rigid frame bridge, the RBR process requires a duration that exceeds most recent deck replacements on Highway 417. For example, the Highway 401/Cornwall Centre Road pilot project allows 8 weeks for the removal and installation of a new rigid frame bridge.

A Group 'B' Environmental Assessment (EA) is being undertaken by the Ministry of Transportation for a bridge management plan for structural improvements (rehabilitation or replacements) to bridges on the Ottawa Queensway from Holland Avenue easterly to O'Connor Street. The project is being described as the Ottawa Queensway Mid-town bridges project.

The MTO's Provincial Class EA is a planning and design procedure developed to ensure that all potential natural, social/cultural and economic environments as well as property and land use effects are considered in undertaking certain projects.

This document summarizes part of the analysis and evaluation process to define staging areas that could be used to construct replacement bridges using Accelerated Bridge Construction (ABC). The staging areas would provide an area to build new rigid frame bridges and a lay-down area for the contractor, and house the existing bridge temporarily after it is removed for it to be demolished.

This memo reviews candidate staging areas for each of the bridge sites and selects one as a preferred location based on the experience of the previous ABC projects completed by MTO on the Queensway. This will demonstrate that ABC is achievable and then allow for the temporary effects of creating a site and clearing a path from the site to the bridge, to be considered in the evaluation of alternatives. The subsequent evaluation of alternatives will be completed after Public Information Centre (PIC) No. 1, and will systematically analyze, evaluate and select the Technically Preferred Alternatives (TPA's) for the 23 bridge sites under study. This sequential methodology will include community and stakeholder input at all key milestones of the study including consideration of the temporary staging areas. The effects and mitigation as a result of the TPA may be modified during subsequent stages of public consultation and will be further defined at the detail design stage. This document will become a component of the Transportation Environmental Study Report (TESR). The use of temporary staging areas will be negotiated by the MTO Property Section, and the locations identified in this memorandum may be changed at the time of replacement if there are other more suitable sites that can be identified. At this point the identification of a staging area reflects the technical feasibility to implement an ABC project as a candidate alternative using Rapid Bridge Replacement (RBR) with heavy lift technology.

The staging areas for the Queensway Bridges in this study need to be large enough to accommodate the temporary structure where the new bridge is built and the 2 self-propelled modular transporters (SPMT's) that need to be assembled and disassembled. There is also a requirement for a construction lay-down area.

A key consideration for the use of RBR relates to the provision of a construction staging area where the new structure is constructed and prepared for insertion into the existing location (i.e. replaces the old structure). The sequencing of bridge replacement will be addressed following the structural reviews/investigations. This memorandum provides a preliminary assessment of possible RBR construction staging areas at the subject site. Both north side and south side locations are addressed in this review.

2. DESIGN CRITERIA

The design criteria for a suitable RBR staging area should include the following:

1. Large overall area (50 m x 50 m = 2500 m^2) to accommodate new structure, storage of old bridge when removed, lay-down area for contractor and maneuverability of SPMT's.
2. Moderate grades (below 1.5%) on travel route to bridge site.
3. Dimensions of site to exceed the size of the new bridge and include workspace on all sides of the new bridge. Bridges are in the order of (25-30 m) x 25 m so desirable lateral dimension is 50 m and minimum dimension must exceed width/span of new bridge.
4. Where no site is available on one side of the Queensway, both east and westbound bridges may be replaced on the same weekend using a larger staging area on one side of the Queensway.

3. STAGING AREA REVIEW PARAMETERS

The following assumptions were used in this preliminary examination of potential staging sites:

- Property ownership was not explicitly considered in the review. Municipal, private, federal and/or provincial lands were all deemed acceptable.
- The expropriation of property for use as a temporary construction staging area was not considered. Any use or acquisition would be subject to property negotiations.
- The staging sites will require areas for the construction of the new structures and storage of the old structures, and must allow vehicle access/circulation.
- RBR staging areas are required on the north and south sides at each site (unless both bridges are replaced on the same weekend).
- Flat/minimal grades are preferred within the staging area and on the approaches to the replacement site.

Subject: Assessment of Potential Staging Areas for Rapid Bridge Replacement Option – ***O'CONNOR STREET***
Project: Preliminary Design and Environmental Assessment Study for the Rehabilitation/Replacement of Ottawa Queensway Mid-Town Bridges from Holland to O'Connor, GWP# 4075-11-00/BTE13-001
Date: September 2, 2014

- Site preparation is required under all options.
- The extension of the staging area into adjacent travel lanes was considered feasible at locations where volumes were minimal and/or multiple travel lanes are provided (unless both bridges are replaced on the same weekend).
- The proposed staging area should be in close proximity to the replacement structure site.
- The site should readily accommodate construction vehicles, preferably on a designated truck route.

Off-site staging areas which meet the guidelines are preferred. It is recognized that there are inherent challenges such as impacts on adjacent residents/land uses, the limited sites available to construct a new structure/store the old structure; the need to relocate utilities; vegetation, trees and other landscape features; and noise/dust issues. Although some challenges exist, the RBR process significantly reduces the amount of time required to close the road to traffic when compared to conventional reconstruction.

4. SITE REVIEW

O'Connor Street is a north/south arterial road which accommodates moderate traffic demands (15,500 AADT in 2012 south of Highway 417). It functions as a one-way southbound facility comprising 3 travel lanes under the structure and a signed bicycle lane. Signalized intersections are located at both Catherine Street and Isabella Street. O'Connor Street is a designated truck route.

The availability of staging areas of the required size in an urban setting such as Central Ottawa is challenging. Potential opportunities for staging sites typically consist of parks/sports fields, commercial/municipal parking areas and extended boulevards. The use of these facilities for RBR sites requires the removal of some or all of the existing functions; complete reinstatement will occur following the construction activities.

In addition, RBR staging areas within the municipal ROW (i.e. the north and/or south approaches to the structure) are considered where viable alternative sites do not exist and where roadway features satisfy the identified requirements.

Using the parameters listed in the previous section, a preliminary assessment of possible RBR locations was undertaken. The results are summarized in subsequent tables. It is noted that the dimensions identified in this review were scaled from online mapping services and reflect the level of detail associated with those sources. ***Table 1*** provides a qualitative assessment of the various RBR sites based on ***Good, Fair*** and ***Poor*** criteria. The ratings are meant to quantify, in a broad manner, the potential of each site considering the factors listed above.

Table 1
Analysis of Potential RBR Staging Areas – O'Connor Street (Site 3-064)

	Location	Discussion	RBR Potential
North Side	***OC-01*** – Municipal ROW/ Boulevard/ landscape area on Catherine between Metcalfe and O'Connor	• Available area approx. 155 m x (varies 15-30 m) = 2325 m^2 to 4650 m^2 • Approx. 100 m from staging area to bridge site (via Catherine/O'Connor) • Highway 417 elevated in this area • Temporary lane "borrow" possible on Catherine • Impacts on residential uses on north side of Catherine • Catherine/O'Connor are designated truck routes • Travel route meets grade requirements (i.e. slope is less than 1.5%)	• ***GOOD*** → *Grade difference between Catherine and (elevated) Highway 417* → *Size appears insufficient/ lane borrow possible from Catherine* → *Travel route meets grade requirements*
	OC-02 – Office parking area in southwest corner of O'Connor/ Catherine	• Available area approx. 85 m x (varies from 15 m to 30 m) = 2000 m^2 • Approx. 100 m from staging area to bridge site (via Catherine/O'Connor) • Irregular shaped lot • Impact on office parking supply • Catherine/O'Connor are designated truck routes • Travel route meets grade requirements (i.e. slope is less than 1.5%)	• ***GOOD*** → *Does not meet size requirement of* 2500 m^2, but could be used in combination with BA-01 → *Subject to availability from property owner* → *Travel route meets grade requirements*
	OC-03 – Office parking area in northeast quadrant of Catherine/ Bank intersection	• Available area approx. 55 m x 60 m = 3300 m^2 • Approx. 250 m from staging area to bridge site (via Catherine) • Impact on office parking supply in the area • Catherine/Bank are truck routes • Travel route meets grade requirements (i.e. slope is less than 1.5%)	• ***FAIR*** → *Size acceptable* → *Moderate distance to bridge site* → *Travel route meets grade requirements*
	BA-01 – Commercial parking area in SE corner of Bank/ Catherine	• Available area approx. 35 m x 55 m -= 1925 m^2 • Approx. 250 m from staging area to bridge site (via Catherine/Bank) • Impact on office parking supply in the area • Catherine/Bank are truck routes • Travel route meets grade requirements (i.e. slope is less than 1.5%)	• ***GOOD*** → *Does not meet size requirements, but could be used in combination with OC-02* → *Travel route meets grade requirements*
South Side	***OC-04*** – Office parking area in southwest quadrant of O'Connor/ Isabella intersection	• Available area approx. 80 m x 30 m + 30 m x 20 m = 3000 m^2 • Approx. 100 m from staging area to bridge site (via Isabella and O'Connor) • Irregular shaped lot • Approx. 150 m to bridge site via Isabella • Impact on office parking supply • O'Connor/Isabella are designated truck routes	• ***FAIR*** → *Within close proximity to bridge site* → *Meets area requirement of 2500* m^2
	BA-07 – MTO ROW between Kent and Bank (north of Chamberlain)	• Available area approx. 25 m x 120 m = 3000 m^2 • Approx. 430 m from staging area to bridge site (via Chamberlain/Bank/Isabella/O'Connor) • Chamberlain and Bank are truck routes • Meets max. grade requirement of 1.5% • Travel route meets grade requirements (i.e. slope is less than 1.5%)	• ***GOOD*** → *Meets area requirement of 2500* m^2 → *Moderate distance between staging area and bridge* → *Travel route meets grade requirements*

5. COARSE SCREENING EVALUATION OF RBR SITES

The potential candidate RBR staging areas were assessed as part of a coarse screening analysis against three criteria (size, access route gradient and access route impacts) to assess if a site was feasible to carry forward. The conclusions of this assessment are presented in **Table 2** and **Table 3**.

Table 2
RBR Staging Area Coarse Screening Analysis
Bridge Site: O'Connor Street WB

Candidate RBR Staging Area	Achieve Minimum Area requirement (2500 m²) Yes/No	Route Access: Meet Gradient requirement <1.5% slope	Route Access: Level of Impact on Travel Route	Comments	Carry Forward Yes/No
OC-01 MTO and municipal right-of-way between Highway 417 and Catherine Street between Metcalfe Street and O'Connor using roadway protection along Queensway	Yes (irregular shape to include roadway protection to maximize dimension in north-south orientation to fit new structure size) 155 m x (varies 15-30 m) = 2325-4650 m^2	Yes	Low	Site is located within close proximity to O'Connor, and will result in relatively small impacts to traffic	Yes
OC-02 Office parking in northeast quadrant of O'Connor /Isabella intersection	No 85m x (varies 15m to 32m) = 2000 m^2	Yes	Low	Subject to availability from property owner. Potential to use this site in combination with site BA-01.	Yes (Subject to investigation. If selected, should be used in combination with BA-01).
OC-03 Museum of Nature grassed area/parking lot at corner of Argyle and O'Connor Streets	Yes 55 m x 60 m = 3300 m^2	Yes	High	Impacts national tourist destination	No (Preference to avoid site if others closer to Queensway available)
BA-01 Commercial parking area in NE quadrant	No (minor reduction in design standard) 35 m x 55 m = 1925 m^2	Yes	Low	Determine if used for a Bank Street RBR site and available for reuse. Potential to use this site in combination with site OC-02.	Yes (Subject to investigation. If selected, should be used in combination with OC-02).
Preliminary Recommendation: **Sites OC-01 and OC-02/BA-01 are being carried forward**					

Table 3
RBR Staging Area Coarse Screening Analysis
Bridge Site: O'Connor Street EB

Candidate RBR Staging Area	Achieve Minimum Area requirement ($2500\ m^2$) Yes/No	Route Access: Meet Gradient requirement <1.5% slope	Route Access: Level of Impact on Travel Route	Comments	Carry Forward Yes/No
OC-04 Office parking area in southwest corner of O'Connor /Isabella	No (80 m x 30 m) + (30 m x 20 m) = $3000\ m^2$	Yes	Low	Width of site is too narrow	No
BA-07 MTO ROW between Kent and Bank (north of Chamberlain)	Yes 25 m x 120 m = $3000\ m^2$	Yes	Low	Existing site for Kent St. RBR	Yes - Subject to investigation. N/S dimension is narrow, but site meets area requirements for the new bridge.
Preliminary Recommendation: **Site BA-07 is being carried forward**					

Sites **OC-01** and **OC-02**/**BA-01** (see **Table 2**) generally exhibit more favourable characteristics for the replacement of the north O'Connor Street Queensway bridge structure, while site **BA-07** (see **Table 3**) generally exhibits more favorable characteristics for the replacement of the south O'Connor Street Queensway bridge structure. The sites have been analyzed based on a combination of the following criteria: proximity to the site, access route characteristics, size of staging area, impacts on adjacent uses and ability to relocate the current use of the site.

6. PREFERRED RBR STAGING SITES

Based on this preliminary review, the preferred RBR staging sites recommended for consideration are presented in **Figure 2**. The evaluation of alternatives includes the following:

North Side

- **Site OC-01** is located within the MTO and municipal ROW south of Catherine Street (between O'Connor Street and Metcalfe Street). Construction of a replacement structure appears feasible in this area although site grading and other preparation will be required. The temporary extension of the RBR staging area into the Catherine Street corridor is also possible (i.e. consider the use of the dedicated westbound left turn lane which will not be operational during construction). In addition, the old structure could be stored and dismantled within the limits of this site.
- **Sites OC-02 & BA-01** are located on the southwest corner of O'Connor/Catherine Street and the southeast corner of Bank/Catherine Street, respectively. If selected, these two (2) sites would have to be used in combination with each other, since they do not meet the dimension and area requirements to carry out the construction works associated with the O'Connor bridge structure replacement when considered on an individual basis. One of the sites would be used to store and dismantle the existing bridge structure, while the other site would be used to construct the new structure.

South Side

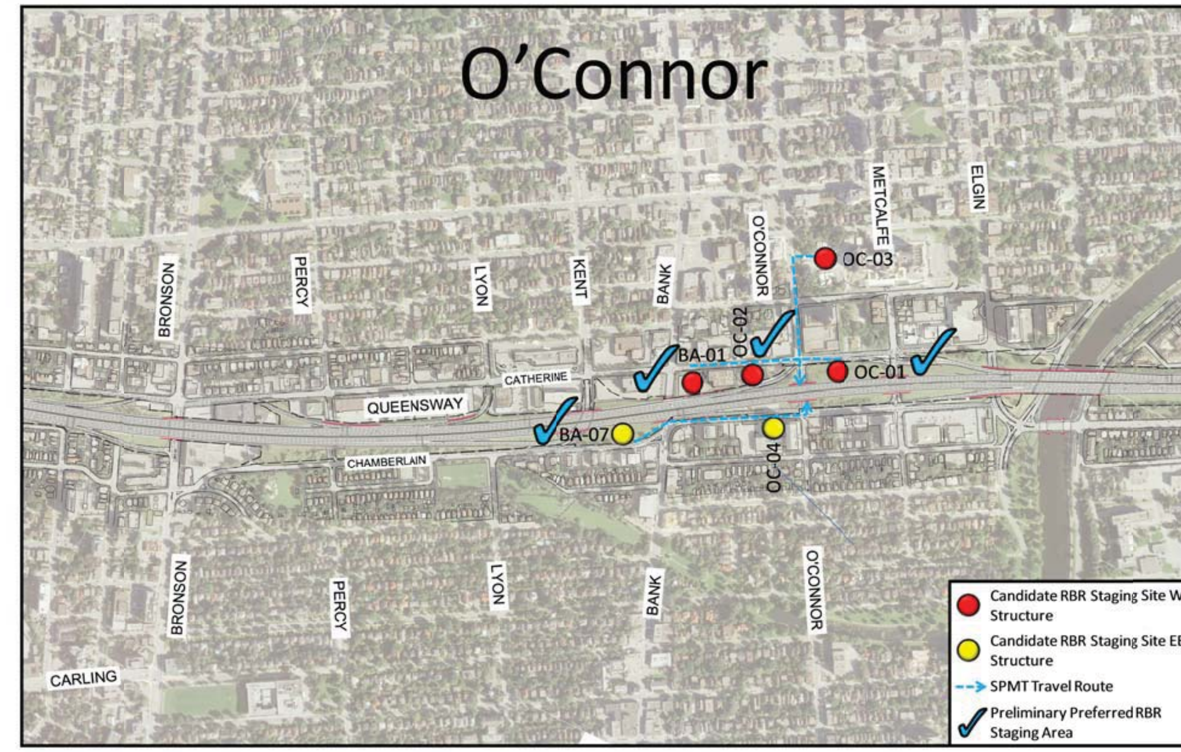
- **Site BA-07** is located within the Ministry of Transportation (MTO) grassed right-of-way (ROW) that is on the northwest corner of Bank Street and Chamberlain Avenue. In order to prepare the site to be used as a construction staging area, it will need to be re-landscaped, which will involve the removal of trees/shrubs located on the site and re-grading the site, so that it satisfies the maximum grade requirement of 1.5%. In addition, reinforcement will need to be provided along the portion of the Queensway that abuts the site, in order to ensure its stability after the necessary landscaping work has been completed. The new structure would be constructed within this strip of ROW, and transferred to the bridge site by way of Chamberlain Avenue, Bank Street and Isabella Street.

As stated, appropriate site preparation will be required for each of the selected RBR staging locations.

7. TECHNICALLY PREFERRED ALTERNATIVE

This technical memorandum on potential RBR staging areas has been used as input into the overall technical evaluation of bridge management alternatives. Based on the evaluation of alternatives, RBR is not the technically preferred option for the O'Connor Street structure. The overall MATS (Multi-Attribute Tradeoff System) evaluation is described in a standalone Analysis and Evaluation Report. Based on the outcome of the evaluation, there will not be a need for a staging site for the replacement of the bridge. However, in consideration of the availability of funding, provincial priorities and the long term performance of the rehabilitation of the bridge, the TESR (Transportation Environmental Study Report) will seek clearance for both rehabilitation and replacement approaches for the bridge management plan. Therefore, an RBR staging area for the ultimate bridge replacement will be revisited at a future date and will include a review of the sites identified in this technical memorandum.

Figure 2
Location of Shortlisted RBR Staging Areas – O'Connor Street (Site 3-064)



24 April 2014

APPENDIX D: Preliminary Long List of Candidate Evaluation Criteria and Screening

APPENDIX D

LONG LIST OF EVALUATION CRITERIA

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Factors and Sub-Factors	Definition	Unit of Measure	Sub-factors Short Listed	Remarks
Transportation				
Maximum Peak Queue Length on Queensway	This sub-factor measures the forecast queue length in the peak hour including measures to divert trips and induce transportation demand management during construction. This sub-factor is indicative of highway performance and safety, and is related to effects on ramp operations, rear end collisions influenced by stop and go traffic and poor weaving conditions.	Km*days (peak hour)	✓	
Delays	This sub-factor measures the total lane closure peak period delay to drivers on the Queensway during the construction period. It includes the total peak period delay forecast for the duration of construction of the alternative. The delay sub-factor, although measuring vehicles on the Queensway, is also indicative of the delays for the drivers diverted from the Queensway and operating on the municipal road system.	Veh h	✓	
Ramp Closures	This sub-factor measures the impact to community access (business and residential) by quantifying the volume of peak hour ramp trips that will be removed from entering or exiting the Queensway. The sub-factor measures the peak hour ramp volume for each stage of the highway staging plan and quantifies the duration of the closure.	Veh (peak hour)	✓	
Travel Time	This sub-factor measures the increase in travel time for a driver through the construction zone for a single trip across the Study Area. The effects of travel time are measured under the delay sub-factor.	min	×	Considered to be measured by delay sub-factor
Fuel Consumption	This sub-factor measures the increase fuel consumption caused as a result of travel delay.	l	×	Considered to be measured by delay sub-factor
Road User Costs	This sub-factor measures the personal lost time of individual.	$	×	Considered to be measured by delay sub-factor
Movement of Goods	This sub-factor measures delays to trucking along the Queensway. Alternatives that minimize the delay to commercial vehicles are preferred.	h	×	Considered to be measured by delay sub-factor

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Factors and Sub-Factors	Definition	Unit of Measure	Sub-factors Short Listed	Remarks
Ability to bundle bridges	This sub-factor measures the potential to combine several bridges within a single project. Doing so can reduce the overall duration of traffic staging and traffic impacts on the Queensway. Rehabilitation allows 1-4 bridges to be completed using one traffic staging plan, whereas replacement bridges are expected to be completed individually.	Yes/No	×	
Highway Safety - Collision Potential	This sub-factor measures the collision potential of the alternative by measuring the length of time that drivers will be required to transition through the construction zone.	days	✓	
Highway Safety – Design Consistency of Traffic Staging Design	This sub-factor measures the collision potential of the highway staging. Those alternatives including a non-conventional battleship design are least preferred.	Yes/No	✓	
Pedestrian – Delay and Out-of-way Travel	This sub-factor measures the length and duration of pedestrian out-of-way travel on the side streets while work is completed to rehabilitate or replace the structure.	High/ Medium/Low	✓	Carried forward for Rigid Frame bridges. See CPR/O-Train criteria for pedestrian out-of way travel
Bicycle – Delay and Out-of-Way Travel	This sub-factor measures if an alternative provides greater lateral space to increase pedestrian and bicycle safety. Those alternatives providing the largest span are preferred (high potential) and those alternatives matching the existing span are not preferred. the length and duration of bicycle out-of-way travel on the side streets while work is completed to rehabilitate or replace the structure.	High/ Medium/Low	✓	Carried forward for Rigid Frame bridges. See CPR/O-Train criteria for bicycle out-of way travel
Pedestrian/Bicycle Safety	This sub-factor measures if an alternative provides potential to increase pedestrian/bicycle safety. The measurement reflects that those options with larger spans can provide a greater lateral separation for pedestrians and cyclists from vehicular traffic. Having greater lateral separation and space are preferred.	High/ Low	✓	Carried forward for Rigid Frame sites.
Multi-use Pathway - Safety and Personal Security Level	This sub-factor measures the safety and personal security of alternatives. Those alternatives with either a small opening size of box culvert or a relocation to Preston Street are considered low. Those alternatives with an open span are	High/ Medium/Low	✓	Carried forward for the CPR/O-Train structure only

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Factors and Sub-Factors	Definition	Unit of Measure	Sub-factors Short Listed	Remarks
	considered medium.			
Multi-use Pathway Users - Out-of-way Travel	This sub-factor measures the length of out-of-way travel for active modes of transportation along the multi-use trail. Alternatives which minimize the length of travel are preferred. Alternatives which maintain the alignment parallel to the O-Train reduce walking distance by 290 m and avoid pedestrian conflicts on Preston Street and need for way finding signage. Alternatives which have no out-of-way travel are preferred.	Yes/No	✓	Carried forward for the CPR/O-Train structure only
Multi-use Trail - Safety	This sub-factor measures the safety of active modes of transportation using the multi-use trail. Those alternatives introducing conflicts along Preston Street are least preferred; those introducing an alignment shift (reduced visibility) are moderately preferred; and those with a straight alignment are preferred.	High/ Medium/Low	×	Carried forward for the CPR/O-Train structure only
Transit (O-Train) Closure	This sub-factor measures the duration of the closure of the O-Train service to accommodate the jack and slide operation for the installation of a new bridge.	days	✓	Carried forward for the CPR/O-Train structure only
Transit Operations Delay	This sub-factor measures the delay during construction that will affect transit operations.	High/ Medium/Low	✓	Carried forward for Rigid Frame sites having bus routes operating on the street
General Traffic Municipal Street Delay	This sub-factor measures the delay during construction that will affect general traffic operations.	High/ Medium/Low	✓	This criteria only measures the period when the street is closed to traffic at a rigid frame site.
Municipal Street Traffic Signals Operations	This sub-factor measures the traffic effect to the existing traffic signals on the municipal street as a result of both construction traffic accessing the site as well as restrictions on turning movements to/from the side street. Those alternatives that affect the traffic signal operation are less preferred.	Yes/No	✓	Carried forward for Parkdale only due to existing on-street parking under structure.
Provision of Ramp Terminal LT	This sub-factor measures whether the alternative allows for potential southbound left turn lane movements to Chamberlain Street	Yes/No	✓	Carried forward for Bronson Avenue only.
Natural Environment				
Air quality	This sub-factor measures changes in emission of criteria contaminants for the	Tonnes / year	×	This sub-factor is not recommended to be

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Factors and Sub-Factors	Definition	Unit of Measure	Sub-factors Short Listed	Remarks
	temporary works on the Queensway.			carried forward as the vehicle usage in the Region is reduced during construction and there is not considered to be a meaningful difference between alternatives. See 2007 TESR for regional air quality analysis.
Endangered species	This sub-factor measures whether an alternative will impact an endangered species	No.	×	This sub-factor is not recommended to be carried forward based on the 2013 site inventories of the study area.
Cold water fish habitat impacted	This sub-factor measures whether an alternative will impact cold water fish habitat. Alternatives that do not impact cold water habitat are preferred.	m^2	×	This sub-factor is not recommended to be carried forward based on the 2013 site inventories of the study area.
Cool water fish habitat impacted	This sub-factor measures whether an alternative will impact cool water fish habitat. Alternatives that do not impact cold water habitat are preferred.	m^2	×	This sub-factor is not recommended to be carried forward based on the 2013 site inventories of the study area.
Warm water fish habitat impacted	This sub-factor measures whether an alternative will impact warm water fish habitat. Alternatives that do not impact cold water habitat are preferred.	m^2	×	This sub-factor is not recommended to be carried forward based on the 2013 site inventories of the study area.
Water quality (stormwater surface runoff)	This sub-factor measures the amount of surface runoff generated by an alternative using a rainfall duration for comparison. The alternative that produces the least volume of runoff is preferred.	m^3	×	This sub-factor is not recommended to be carried forward as the relative differences in alternatives are not considered meaningful.
Species at Risk	This sub-factor measures the presence of Species at Risk. This includes the potential for the Chimney Swift (bird SAR).	Yes/No	×	This sub-factor is not recommended to be carried forward based on the 2013 site inventories of the study area.
Archaeological potential (moved to Cultural)				

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Factors and Sub-Factors	Definition	Unit of Measure	Sub-factors Short Listed	Remarks
Wildlife Habitats and Movement/Corridor	This sub-factor measures the loss of a wildlife travel corridor along the current multi-use trail corridor. Those alternatives relocating the path remove the wildlife movement and are not preferred.	Y/N	×	
Migratory bird nesting impact	This sub-factor measures whether an alternative will have an impact to bird nesting habitat.	Y/N	×	All alternatives considered equal
Provincially significant (PS) natural areas and habitat	This sub-factor measures whether an alternative has potential to impact Provincially Significant vegetation and habitat.	ha	×	This sub-factor is not recommended to be carried forward based on the 2013 site inventories of the study area.
Regionally significant natural areas and habitat	This sub-factor measures whether an alternative has potential to impact Regionally Significant vegetation and habitat.	ha	×	This sub-factor is not recommended to be carried forward based on the 2013 site inventories of the study area.
Natural habitat impacted	This sub-factor measures whether an alternative has potential to impact natural habitat.	m^2	×	This effect is measured under the wildlife corridor sub-factor for the CPR/O-Train.
Specimen trees removed	This sub-factor measures whether an alternative will remove any specimen tree.	Yes/No	×	This sub-factor is not recommended to be carried forward based on the 2013 site inventories of the study area
Existing Vegetation / Landscaping	This sub-factor measures the potential to impact existing vegetation / landscaping. The alternatives that do not have an impact are preferred.	m^2	×	
Wildlife habitat, including, reptiles, mammals and insects, amphibians and flora	This sub-factor measures the potential to impact wildlife habitat, including reptiles, mammals and flora. The alternatives that do not impact wildlife habitat are preferred.	m^2	×	This sub-factor is not recommended to be carried forward based on the 2013 site inventories of the study area
Climate Change	This sub-factor measures the potential for the alternative to have an impact on climate change.	Yes / No	×	Alternatives are not expected to have measurable differences and several related sub-factors (e.g. Fuel Consumption) are addressed elsewhere.
Wetlands	This sub-factor measures the potential for	m^2	×	This sub-factor is not

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Factors and Sub-Factors	Definition	Unit of Measure	Sub-factors Short Listed	Remarks
	the alternative to have an impact on wetlands through encroachment; changing the water balance; or discharging into a wetland.			recommended to be carried forward based on the 2013 site inventories of the study area.
Woodlands and other Vegetated Areas	This sub-factor measures the potential for the alternative to have an impact on woodlands and other vegetated areas through encroachment or road salt run-off/spray.	m^2	×	This sub-factor is not recommended to be carried forward based on the 2013 site inventories of the study area.
Groundwater	This sub-factor measures the potential for the alternative to cause a change in groundwater hydraulic regime or reduce groundwater quality.	Yes / No	×	This sub-factor is not recommended to be carried forward based on the 2013 site inventories of the study area.
Designated Areas	This sub-factor measures the potential for the alternative to impact designated areas.	Yes / No	×	This sub-factor is not recommended to be carried forward based on the 2013 site inventories of the study area.
Social and Cultural Environment				
Historic Archaeological potential	This sub-factor measures the potential impact to historic archaeological potential by an alternative.	ha	×	This sub-factor is not recommended to be carried forward based on the 2013 site inventories of the study area
Prehistoric archaeological potential areas impacted	This sub-factor measures the potential impact to prehistoric archaeological potential by an alternative	ha	×	This sub-factor is not recommended to be carried forward based on the 2013 site inventories of the study area
Built heritage sites impacts	This sub-factor measures the potential impact to heritage sites by an alternative.	No.	×	This sub-factor is not recommended to be carried forward based on the conclusion that no existing bridges in the study area are heritage structures.
Cultural landscape features	This sub-factor measures the potential impact to areas with cultural landscapes such as, waterscapes, roadscapes, and railscapes.	No.	×	This sub-factor is not recommended to be carried forward based on the 2013 site inventories of the study

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Factors and Sub-Factors	Definition	Unit of Measure	Sub-factors Short Listed	Remarks
				area
Aboriginal archaeological potential	This sub-factor measures the potential impact to archaeological potential by an alternative	ha	×	This sub-factor is not recommended to be carried forward based on the 2013 site inventories of the study area
Noise impacts	This sub-factor measures the number of noise sensitive areas that will be affected by temporary operations with sound level changes greater than 3 dBA.	No.	×	All alternatives considered equal and will comply with municipal noise control bylaw.
Vibration impacts	This sub-factor measures if there will be a residence that could be affected by vibration by temporary operations.	No.	×	All alternatives considered equal and will comply with municipal noise control bylaw
Community Cohesion	This sub-factor measures the impact to adjacent communities by widening or narrowing a structure. Those alternatives which increase the span and increase the openness of the local street are preferred and those that reduce the span are least preferred.	High/ Medium/Low	×	This factor is not carried forward. All alternatives considered equal..
Green Spaces Impacted	This sub-factor measures the area of permanent lost community green space. Alternatives which maintain existing green space along the MUP are preferred. Impact is measured as relocated path).	Yes/No	✓	This sub-factor will apply to the CPR/O-Train alternatives only.
Community Festivals	This sub-factor measures the potential or disruption to community festivals with construction operations or loss of parking during the months where festivals occur.	Yes/No	×	
Potentially contaminated property	This sub-factor measures whether the construction will require works on potentially contaminated sites.	Yes/No	✓	
Excess Materials Management	This sub-factor measures whether the construction will release existing site contamination during construction or release contaminants from product handling, storage, and use and the management of excess materials.	Yes/No	×	
Water wells impacted	This sub-factor measures the potential impact to water wells. Alternatives which affect the least number of wells are preferred.	No.	×	This sub-factor is not recommended to be carried forward based on the 2013 site inventories of the study area

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Factors and Sub-Factors	Definition	Unit of Measure	Sub-factors Short Listed	Remarks
Lighting and Visual impacts	This sub-factor measures the number of existing residences impacted by light spillover from temporary staging areas.	No.	×	
Impact to Emergency Response	This sub-factor measures the effect to emergency response providers (ambulance, fire and police) who will be delayed when using the Queensway.	days	✓	
Economic Environment				
Loss of Parking - Permanent	This sub-factor measures the loss of permanent parking spaces with an alternative. Those alternatives requiring no loss of parking are preferred.	Yes/No	✓	
Loss of Parking - Temporary	This sub-factor measures the loss of on-street parking spaces during a construction season. Those alternatives requiring no loss of parking are preferred.	No.	✓	
Preston Street Business Effects	This sub-factor measures the permanent business effects for alternatives that relocate the MUP and remove parking on Preston Street.	Yes/No	✓	This sub-factor will apply to the CPR/O-Train alternatives only.
Land Use and Property				
Temporary Property Impacts	This sub-factor measures whether property is required for temporary use as a bridge staging area.	Yes/No	✓	
Property required	This sub-factor measures one of the following: the area of loss of residential property for temporary use as a staging area; . the area of commercial/industrial property for temporary or permanent use; the area of institutional property for temporary or permanent use; or the area of agricultural property required for an alternative.	m²	✓	Commercial/industrial property: CPR/O-Train alternatives consider 47 Young Street property
Number of potentially contaminated sites	This sub-factor measures the number of contaminated sites that will be impacted by an alternative.	No.	×	All alternatives are considered equal.
Temporary Property Impacts - Federal (NCC)	This sub-factor measures the temporary loss of the NCC lands currently being used by the City of Ottawa for their works yard on Loretta Street, and the City of Ottawa lands currently being used for municipal parking. Alternatives which do no impact the works yard are preferred.	Yes/No	✓	CPR/O-Train Alternatives WB structure
Group Telecom Buried Fibre Impacts	This sub-factor measures if there is a potential to relocate buried fibre optic cables.	Yes/No	×	Considered at CPR/O-Train
Supports Ottawa TMP	This sub-factor measures whether the alternative supports the Ottawa TMP with respect to cycling network.	Yes/No	×	This sub-factor is not carried forward, due to double-counting of effects with respect to the pathway criteria (See Transportation criteria.)
Agricultural Lands Required	This sub-factor measures the area of agricultural property required for an alternative.	m²	×	This sub-factor is not recommended to be carried forward based on the 2013 site inventories of the study area
Recreation and Natural Areas of Provincial Significance Property Required	This sub-factor measures the area of loss of recreation and Natural Areas of Provincial Significance property for temporary use as a staging area.	m²	×	This sub-factor is not recommended to be carried forward based on the 2013 site inventories of the study area
Aggregates/Mines Property Impacts	This sub-factor measures the area of loss of aggregates/mines property for temporary use as a staging area.	m²	×	This sub-factor is not recommended to be carried forward based on the 2013 site inventories of the study area
Permanent Property Impacts	This sub-factor measures whether property (i.e. residence) is required in order to access a bridge staging area, as per the RBR Staging Sites memo. The north staging area is to be used for both Holland EB and Holland WB rapid replacements. In order to access the staging area, a residence will be purchased.	Yes/No	✓	Applicable to Holland WB
Business Buyout	This sub-factor measures the number of business buyouts as a result of an alternative.	No.	×	Applicable to the CPR/O-Train
Environmental Impacts along CPR/O-Train Corridor	This sub-factor measures the incremental environmental effects (compared to the approved North-South LRT EA plan) to widen the CPR/O-Train corridor should the CPR/O-Train bridge be replaced with separate spans to accommodate the future twin tracking. By using separate spans, it will widen the right-of-way and increase the land required for the future twinning of the rail line. The wider alignment has	Poor/Good	✓	Applicable to the CPR/O-Train

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Factors and Sub-Factors	Definition	Unit of Measure	Sub-factors Short Listed	Remarks
	property impacts to Railway Street as well as NCC and City of Ottawa lands.			
Cost				
Capital Cost	This sub-factor measures the difference in initial capital cost of the alternative (bridge, traffic staging, staging area, utility and property costs). Those alternatives with the lowest capital cost are preferred.	$	✓	
Future Life Cycle Cost	This sub-factor measures the difference in future life cycle costs (maintenance, operating costs and long term replacement and rehabilitation in the 40 year planning horizon). Those alternatives with the lowest long term life cycle cost are preferred.	$	✓	
Structural Management	This sub-factor measures the MTO structural management necessary for an alternative. Those alternatives requiring the least management of the structure are preferred. Those alternatives which implement a replacement strategy are preferred.	Yes/No	×	This sub-factor is not carried forward. All alternatives are considered equal.
Provincial Asset Management Policy	This sub-factor measures if the alternative can achieve the Provincial Policy of asset management preservation. Those alternatives which maintain the existing bridge structures to extend their service life are preferred under this sub-factor.	Yes/No	×	This sub-factor is not carried forward. All alternatives are considered equal.
Schedule Certainty				
Potential	This sub-factor measure the risk of completing all works within a 3 day weekend based on construction industry input. Those alternatives where there is risk in not completing all works within a weekend closure potentially may risk not opening the Queensway. Those that have certainty are preferred.	Yes/No	✓	

APPENDIX E: Utility Function Definitions and Measurements for Short Listed Evaluation Criteria

VERSION: December 10, 2014

APPENDIX E

SUB-FACTOR UTILITY FUNCTION DEFINITIONS AND MEASUREMENTS FOR SHORT LISTED EVALUATION CRITERIA

HOLLAND AVENUE EASTBOUND BRIDGE

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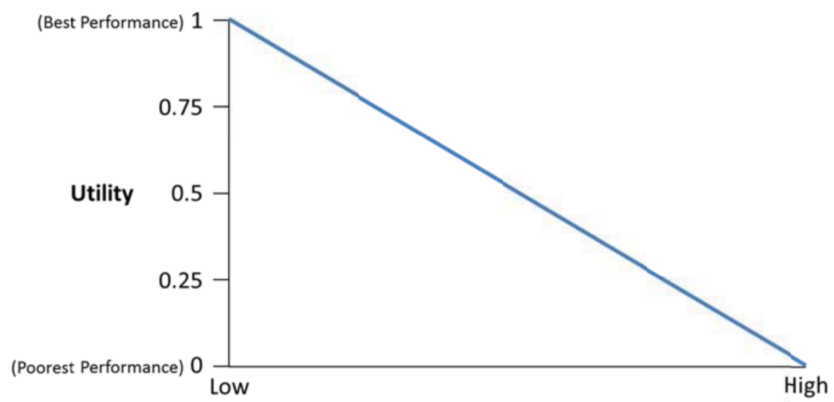
Factor Group: Transportation

Maximum Peak Queue Length on Queensway



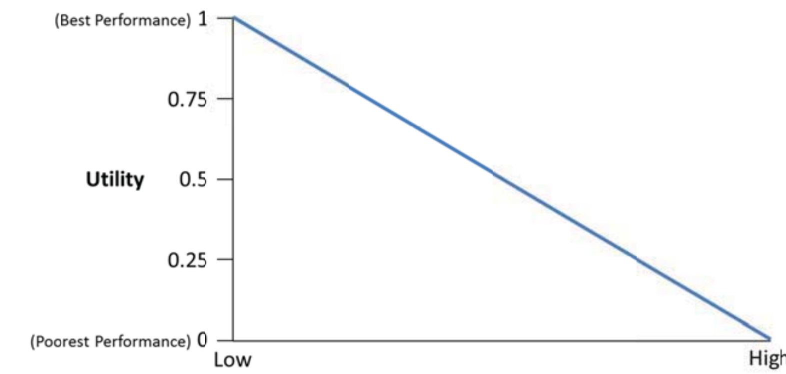
Description: This sub-factor measures the forecast queue length effect in the peak hour including measures to divert trips and induce transportation demand management during construction. The sub-factor measures the queue duration (days) and the forecast queue length (after the use of mitigation). This sub-factor is indicative of highway performance and safety, and is related to: effects on ramp operations, rear end collisions influenced by stop and go traffic, poor weaving conditions and traffic congestion.

(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	km days (peak hour)	Utility Score
Alternative A2e Rapid Rehab/Existing Span	41	0.98
Alternative A5e Conventional Rehab/Existing Span	780	0.59
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	1920	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	1920	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	3	1
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	3	1
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	3	1

Mitigation: The use of advance advertising and advising drivers of the scheduled lane closures through PVMS placement in advance of construction will be measures that will reduce demand by: changing the time of travel of commuters, use of transit as an alternate mode of travel, or by inducing diversion to the municipal road system as an alternate route.

Delays

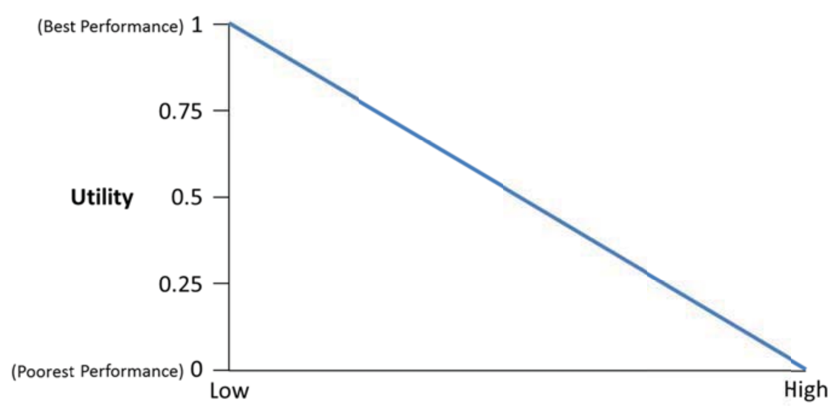


Description: This sub-factor measures the total lane closure peak period delay to drivers on the Queensway during the construction period. It includes the total peak period delay forecast for the duration of construction of the alternative. The delay sub-factor, although measuring vehicles on the Queensway, is also indicative of the delays for drivers diverted from the Queensway and operating on the municipal road system.
(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	Veh h	Utility Score
Alternative A2e Rapid Rehab/Existing Span	16,520	1
Alternative A5e Conventional Rehab/Existing Span	1,537,200	0.6
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	3,782,800	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	3,782,800	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	780	1
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	780	1
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	780	1

Mitigation: N/A

Ramp Closures

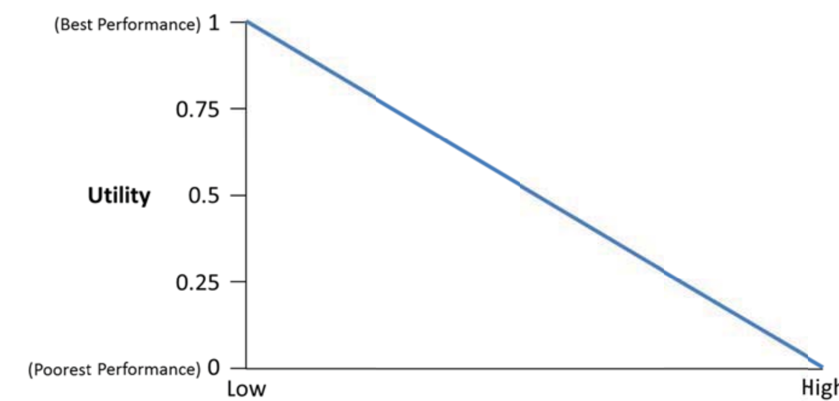


Description: This sub-factor measures the impact to community access by quantifying the volume of peak hour ramp trips that will be removed from entering or exiting from the Queensway. The sub-factor measures the peak hour ramp volume for each stage of the highway staging plan for the duration of the closure.

Alternatives	Veh (peak hour)	Utility Score
Alternative A2e Rapid Rehab/Existing Span	16,030	0.93
Alternative A5e Conventional Rehab/Existing Span	0	1
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	231,424	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	231,424	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	17,961	0.92
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	17,961	0.92
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	17,961	0.92

Mitigation: Ramps may be closed by time of day to allow access in non-peak hours.

Highway Safety - Collision Potential

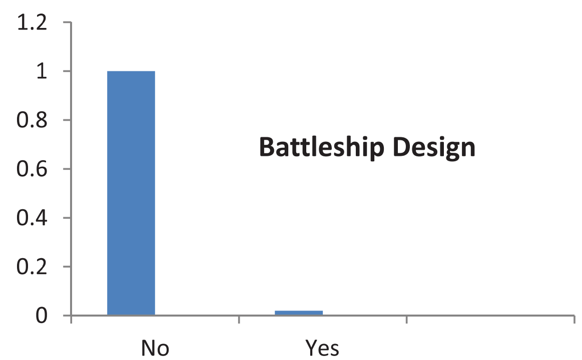


Description: This sub-factor measures the collision potential of the alternative by measuring the time duration that drivers will be required to transition through the construction zone.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	0.9
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	0	3	3	1
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	0	3	3	1
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	0	3	3	1

Mitigation: N/A

Highway Safety – Design Consistency of Traffic Staging Design

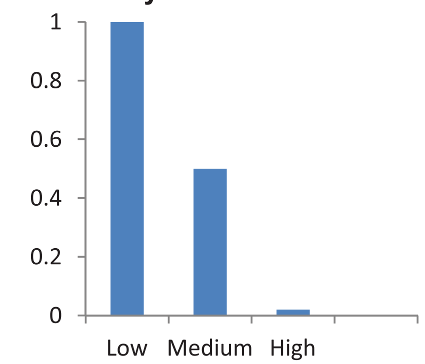


Description: This sub-factor measures the collision potential of the highway staging design. Those alternatives including a non-conventional battleship design (i.e. yes) are least preferred.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Yes	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Yes	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	No	1
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	No	1
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	No	1

Mitigation: Tow truck plan/incident plan.

Pedestrian – Delay and Out-of-way Travel



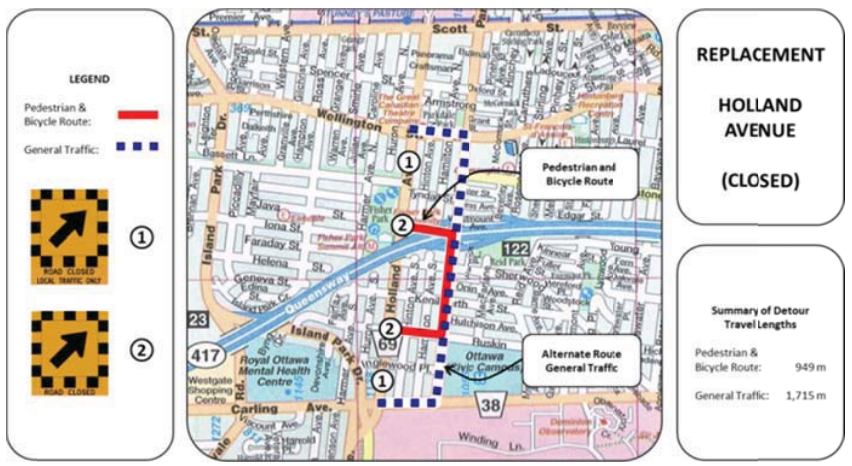
Description: This sub-factor measures the length and duration of pedestrian out-of-way travel on the side streets while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily sidewalk closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period. Pedestrians will be signed to use the opposite sidewalk from the adjacent signalized intersections.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. Pedestrians will use a single sidewalk and cross the street at the temporary signals. The duration of the temporary signals will be 6 weeks.

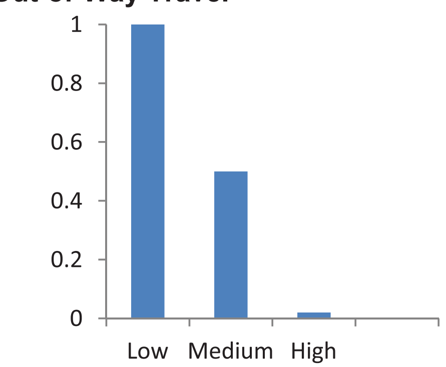
High impacts: The road will be closed to accommodate scaffolding and false work for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure pedestrians will be directed to Parkdale Avenue. This assumes that pedestrians will be rerouted to Parkdale via Sherwood (south) or Tyndall (north), for a maximum out-of-way travel of 0.9 km. This sub-factor measures a one-way trip only. For the detour route, refer to the Preliminary Highway Engineering Traffic Staging Alternatives Report, dated August 6, 2014.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5

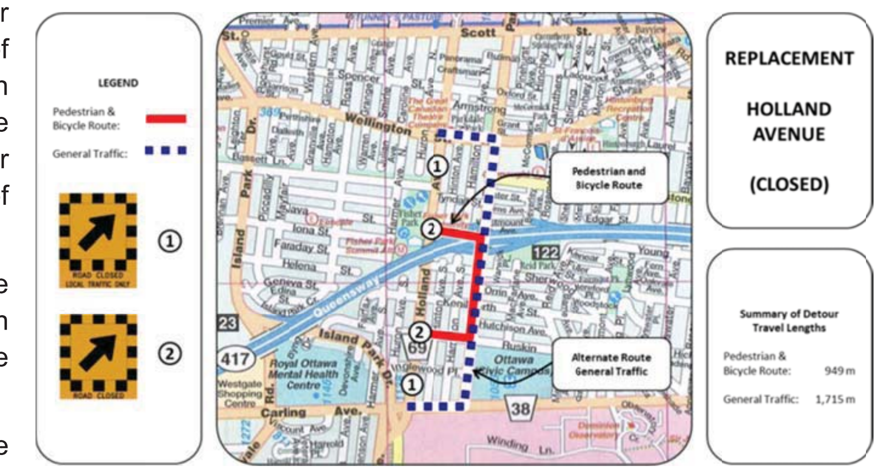


Mitigation: Advance signage for pedestrians to travel to the alternate sidewalk route as well as pre-event information to the property owners.

Bicycle – Delay and Out-of-Way Travel



Description: This sub-factor measures the length and duration of bicycle delay and out-of-way travel on the side street (Holland Avenue) while work is completed to rehabilitate or replace the structure. Categories of effects include:



Low impacts – daily lane and bike lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

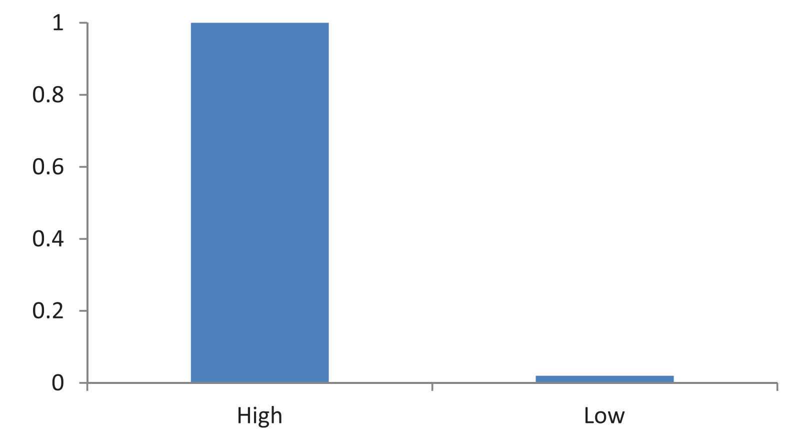
Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. Bicyclists will use the single lane detour through the temporary signals. The duration of the temporary signals will be 6 weeks.

High impacts: The road will be closed to accommodate scaffolding and false work for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the detour route, refer to the Preliminary Highway Engineering Traffic Staging Alternatives Report, dated August 6, 2014.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5

Mitigation: Advance signage for cyclists to choose an alternate route as well as pre-event information to the Regional cycling clubs.

Pedestrian/Bicycle Safety

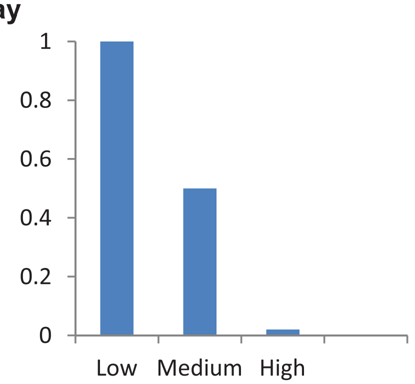


Description: This sub-factor measures if an alternative provides greater lateral space to increase pedestrian and bicycle safety. Those alternatives providing the largest span are preferred (high potential) and those alternatives matching the existing span are not preferred (i.e. low potential).

Alternatives	High/Low	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	0
Alternative A5e Conventional Rehab/Existing Span	Low	0
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Low	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	1
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Low	0
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	High	1
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	High	1

Mitigation: None.

Transit Operations Delay



Description: This sub-factor measures the delay during construction that will affect transit operations. Bus routes affected include Nos. 16, 86, 102, and 176. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

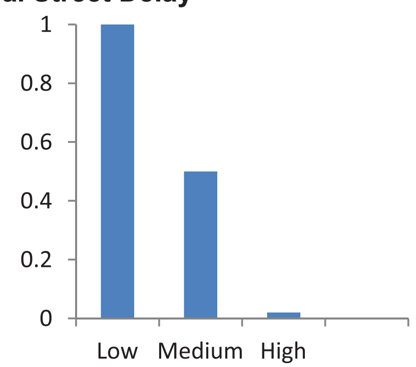
Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. The duration of the temporary signals will be 6 weeks.

High impacts: The road will be closed to accommodate scaffolding and false work for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure transit will be directed to Parkdale Avenue. This assumes that transit will be rerouted to Parkdale via Sherwood (south) or Tyndall (north), for a maximum out-of-way travel of 0.8 km. This sub-factor measures a one-way trip only. For the detour route, refer to the Preliminary Highway Engineering Traffic Staging Alternatives Report, dated August 6, 2014.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative D6l***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5

Mitigation: Advance information to OC Transpo and temporary bus stop relocations if required.

General Traffic Municipal Street Delay



Description: This sub-factor measures the delay during construction that will affect general traffic operations. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. The duration of the temporary signals will be 6 weeks.

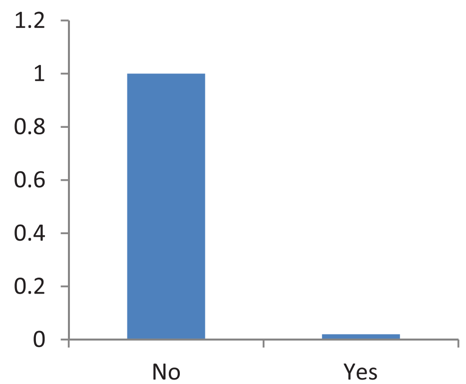
High impacts: The road will be closed to accommodate scaffolding and false work for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure vehicles will be directed to Parkdale Ave. This assumes that vehicles will be rerouted to Parkdale via Sherwood (south) or Tyndall (north), for a maximum out-of-way travel of 1.7 km. This sub-factor measures a one-way trip only. For the detour route, refer to the Preliminary Highway Engineering Traffic Staging Alternatives Report, dated August 6, 2014.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5

Mitigation: The use of advisory signage and potential use of variable message signage can be used to advise drivers before reaching the construction site.

Factor Group: Social and Cultural Environment

Community Green Spaces Impacts

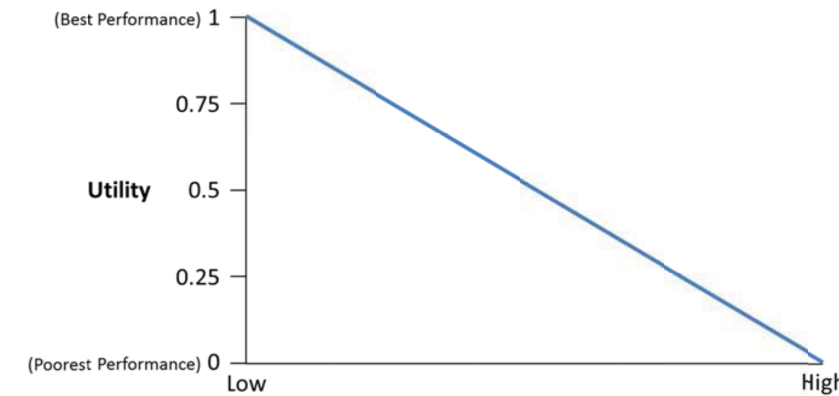


Description: This sub-factor measures the temporary impacts to Community Green Space. For the Holland Avenue bridges, the green space is the sports field north of the Fisher Park/Summit Alternative Public School which will be used as the construction and staging area for RBR bridges. Alternatives that do not impact parks or playground green spaces are preferred. The duration of the loss of park space is estimated to be 8 months. See Temporary Property Impacts sub-factor for the impact to the school.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	No	1
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	No	1
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Yes	0
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Yes	0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Yes	0

Mitigation: Avoidance.

Impact to Emergency Response



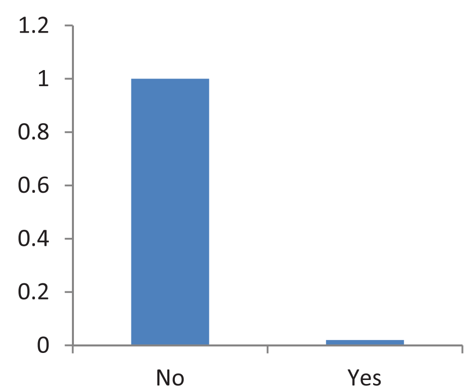
Description: This sub-factor measures the duration of Queensway closure that will affect emergency response service (police, ambulance and fire). Alternatives that reduce the length of time that there are lane closures on the Queensway are preferred.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	0.9
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0.0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0.0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	0	3	3	1.0
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	0	3	3	1.0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	0	3	3	1.0

Mitigation: Advanced warning of lane closures or detour routes.

Factor Group: Land Use and Property

Temporary Property Impacts

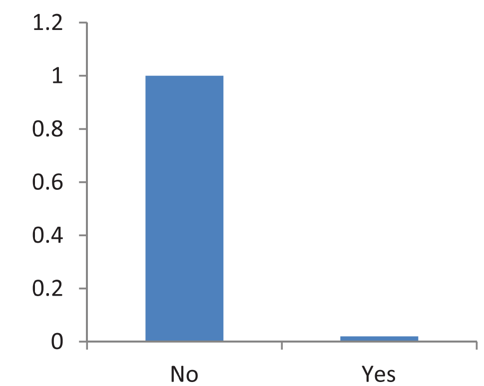


Description: This sub-factor measures whether property (i.e. Fisher Park/Summit Alternative Public School yard) is required for temporary use as a bridge staging area, as per the RBR Structure Staging Sites memo. The north staging area is to be used for both Holland EB and Holland WB rapid replacements. See Community Green Space sub-factor for effects to community uses of the parkland.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	No	1
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	No	1
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Yes	0
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Yes	0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Yes	0

Mitigation: N/A

Permanent Property Impacts



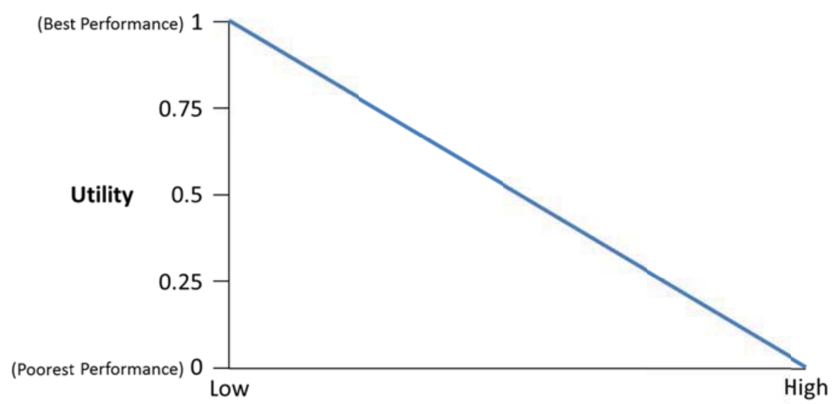
Description: This sub-factor measures whether property (i.e. residence) is required in order to access a bridge staging area, as per the RBR Structure Staging Sites memo. The north staging area is to be used for both Holland EB and Holland WB rapid replacements. In order to access the staging area, a residence will be purchased.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	No	1
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	No	1
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Yes	0
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Yes	0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Yes	0

Mitigation: Financial compensation

Factor Group: Cost

Capital Cost

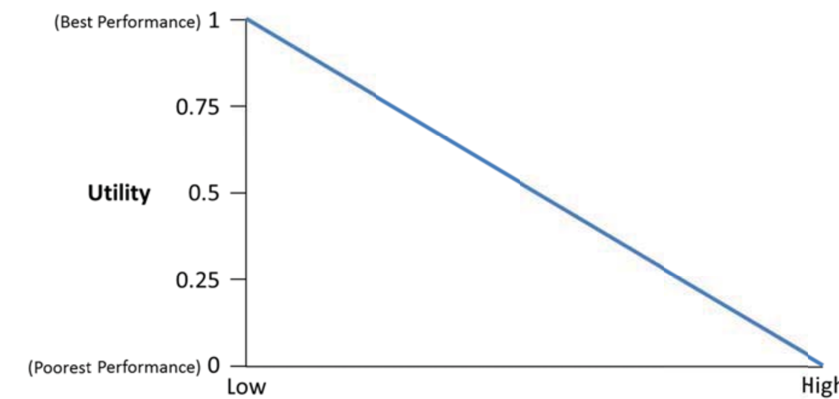


Description: This sub-factor measures the difference in initial capital cost of the alternative (bridge, traffic staging, staging area, and property costs). Those alternatives with the lowest capital cost are preferred. These costs do not include Engineering Costs.

Alternatives	$M		Utility Score
Alternative A2e Rapid Rehab/Existing Span	Structure 1.6 Staging 0.6 Property 0	2.2	1
Alternative A5e Conventional Rehab/Existing Span	Structure 1.6 Staging 1.25 Property 0	2.85	0.89
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Structure 3.61 Staging 1.2 Property 0	4.81	0.55
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Structure 4.48 Staging 1.2 Property 0	5.68	0.40
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Structure 5.5 Staging 0.60 Property 0.20	6.3	0.29
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Structure 7.2 Staging 0.60 Property 0.20	8.0	0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Structure 6.4 Staging 0.60 Property 0.20	7.2	0.14

Mitigation: N/A

Future Life Cycle Cost



Description: This sub-factor measures the difference in future life cycle costs (maintenance, operating costs and long term replacement and rehabilitation in the 40 year planning horizon). Those alternatives with the lowest long term life cycle cost are preferred. A 5% discount rate was used.

Alternatives	$M	Utility Score
Alternative A2e Rapid Rehab/Existing Span	4.6	1
Alternative A5e Conventional Rehab/Existing Span	5.3	0.87
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	5.5	0.83
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	6.5	0.64
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	7.1	0.53
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	9.0	0.17
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	8.1	0.34

Mitigation: N/A

VERSION: November 11, 2014

APPENDIX E

SUB-FACTOR UTILITY FUNCTION DEFINITIONS AND MEASUREMENTS FOR SHORT LISTED EVALUATION CRITERIA

HOLLAND AVENUE WESTBOUND BRIDGE

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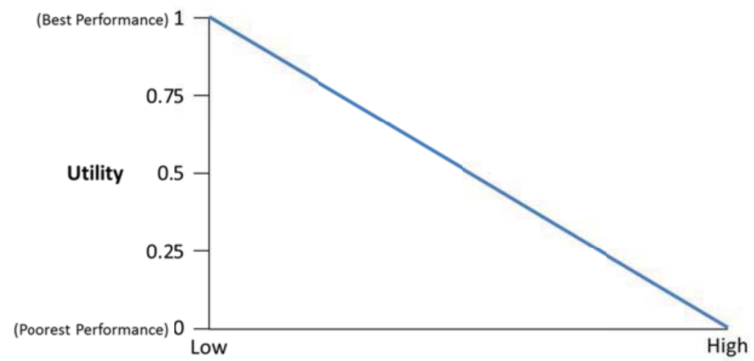
Factor Group: Transportation

Maximum Peak Queue Length on Queensway



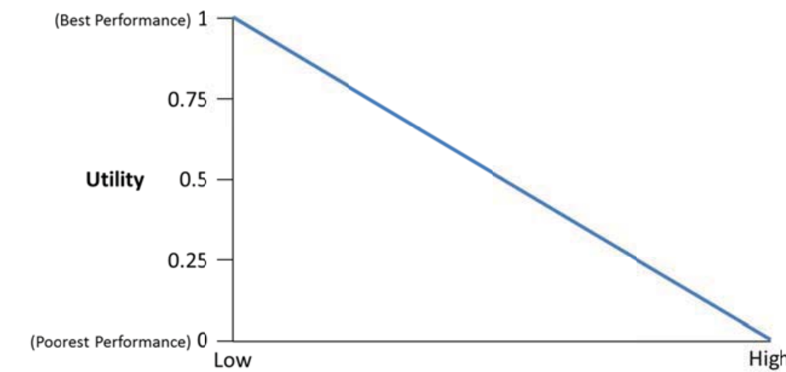
Description: This sub-factor measures the forecast queue length effect in the peak hour including measures to divert trips and induce transportation demand management during construction. The sub-factor measures the queue duration (days) and the forecast queue length (after the use of mitigation). This sub-factor is indicative of highway performance and safety, and is related to: effects on ramp operations, rear end collisions influenced by stop and go traffic, poor weaving conditions and traffic congestion.

(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	**km days (peak hour)**	**Utility Score**
Alternative A2e Rapid Rehab/Existing Span	41	0.98
Alternative A5e Conventional Rehab/Existing Span	780	0.59
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	1920	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	1920	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	3	1
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	3	1
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	3	1

Mitigation: The use of advance advertising and advising drivers of the scheduled lane closures through PVMS placement in advance of construction will be measures that will reduce demand by: changing the time of travel of commuters, use of transit as an alternate mode of travel, or by inducing diversion to the municipal road system as an alternate route.

Delays

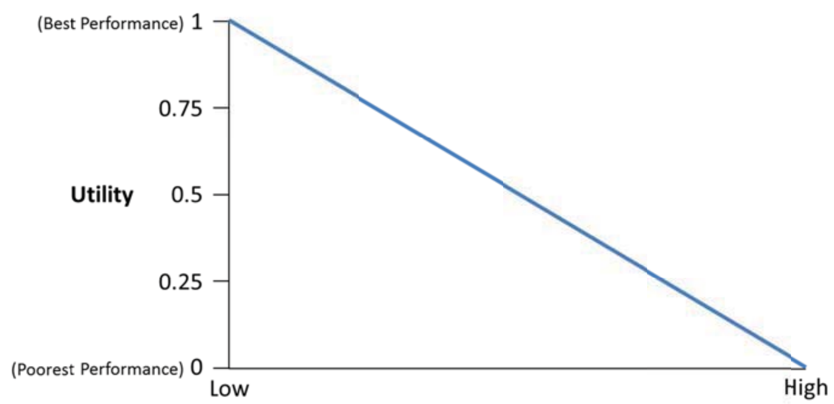


Description: This sub-factor measures the total lane closure peak period delay to drivers on the Queensway during the construction period. It includes the total peak period delay forecast for the duration of construction of the alternative. The delay sub-factor, although measuring vehicles on the Queensway, is also indicative of the delays for drivers diverted from the Queensway and operating on the municipal road system.
(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	**Veh h**	**Utility Score**
Alternative A2e Rapid Rehab/Existing Span	16,520	1
Alternative A5e Conventional Rehab/Existing Span	1,537,200	0.6
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	3,782,800	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	3,782,800	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	780	1
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	780	1
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	780	1

Mitigation: N/A

Ramp Closures

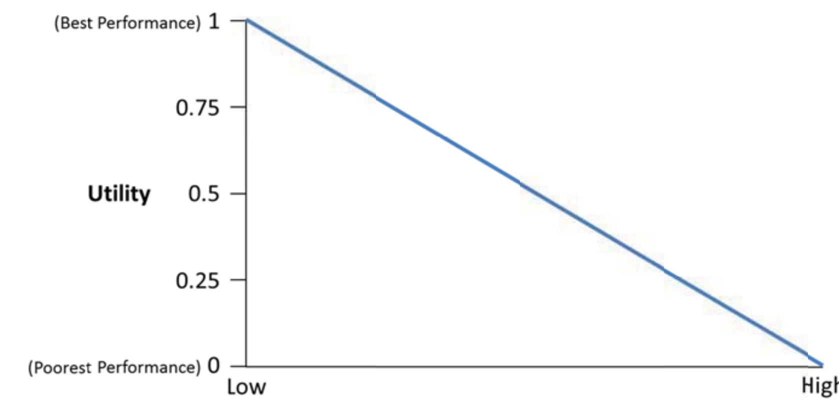


Description: This sub-factor measures the impact to community access by quantifying the volume of peak hour ramp trips that will be removed from entering or exiting from the Queensway. The sub-factor measures the peak hour ramp volume for each stage of the highway staging plan for the duration of the closure.

Alternatives	Veh (peak hour)	Utility Score
Alternative A2e Rapid Rehab/Existing Span	18,620	0.78
Alternative A5e Conventional Rehab/Existing Span	65,720	0
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	63,530	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	63,530	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	17,961	0.68
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	17,961	0.92
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	17,961	0.92

Mitigation: Ramps may be closed by time of day to allow access in non-peak hours.

Highway Safety - Collision Potential

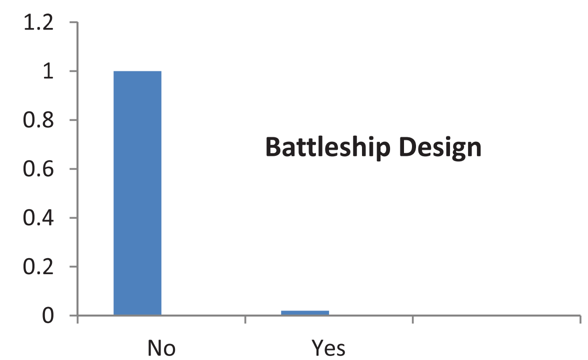


Description: This sub-factor measures the collision potential of the alternative by measuring the time duration that drivers will be required to transition through the construction zone.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	0.9
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	0	3	3	1
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	0	3	3	1
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	0	3	3	1

Mitigation: N/A

Highway Safety – Design Consistency of Traffic Staging Design

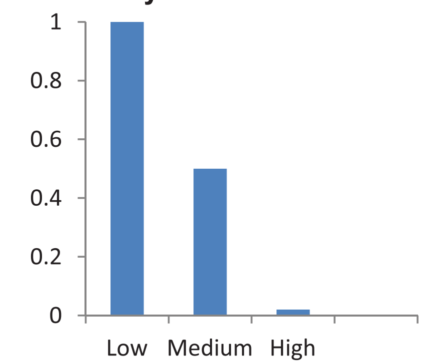


Description: This sub-factor measures the collision potential of the highway staging design. Those alternatives including a non-conventional battleship design (i.e. yes) are least preferred.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Yes	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Yes	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	No	1
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	No	1
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	No	1

Mitigation: Tow truck plan/incident plan.

Pedestrian – Delay and Out-of-way Travel



Description: This sub-factor measures the length and duration of pedestrian out-of-way travel on the side streets while work is completed to rehabilitate or replace the structure. Categories of effects include:

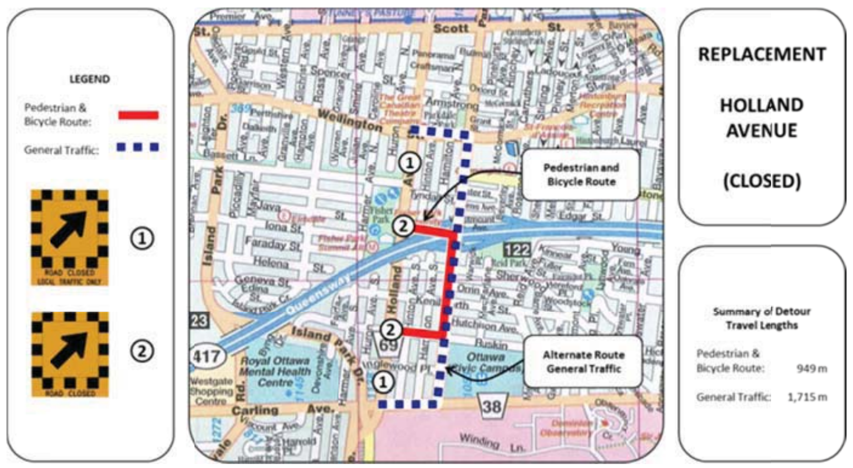
Low impacts – daily sidewalk closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period. Pedestrians will be signed to use the opposite sidewalk from the adjacent signalized intersections.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. Pedestrians will use a single sidewalk and cross the street at the temporary signals. The duration of the temporary signals will be 6 weeks.

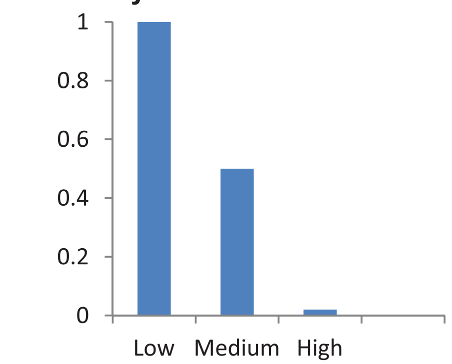
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure pedestrians will be directed to Parkdale Avenue. This assumes that pedestrians will be rerouted to Parkdale via Sherwood (south) or Tyndall (north), for a maximum out-of-way travel of 0.9 km. This sub-factor measures a one-way trip only. For the detour route, refer to the Preliminary Highway Engineering Traffic Staging Alternatives Report, dated August 6, 2014.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5

Mitigation: Advance signage for pedestrians to travel to the alternate sidewalk route as well as pre-event information to the property owners.



Bicycle – Delay and Out-of-Way Travel



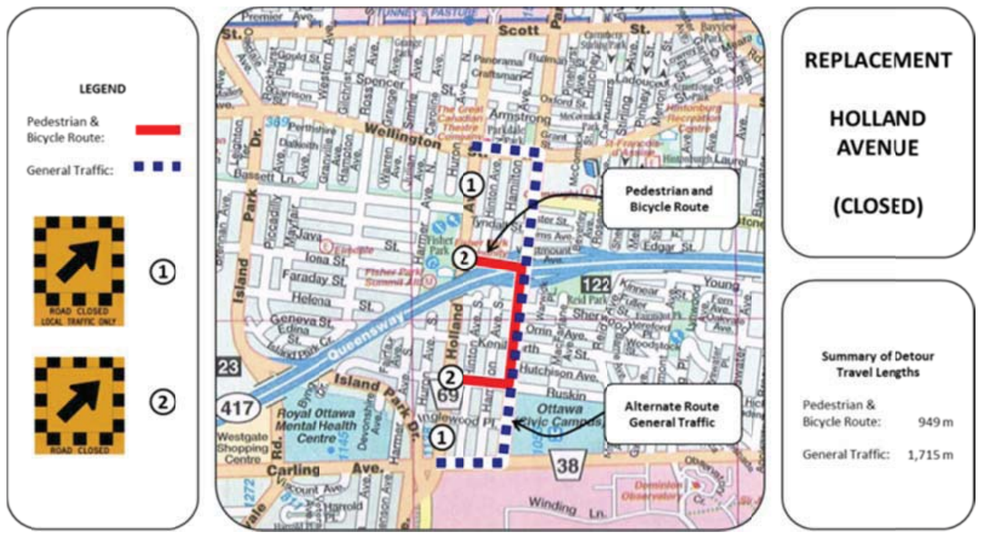
Description: This sub-factor measures the length and duration of bicycle delay and out-of-way travel on the side street (Holland Avenue) while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily lane and bike lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. Bicyclists will use the single lane detour through the temporary signals. The duration of the temporary signals will be 6 weeks.

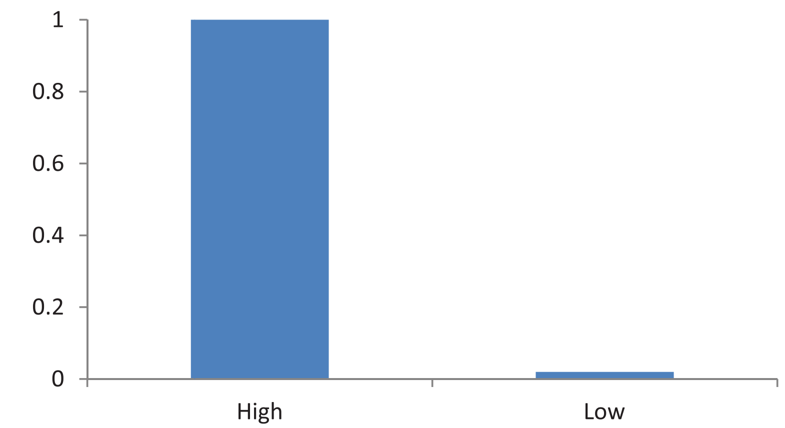
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure, bicyclists will be directed to Parkdale Ave. This assumes that bicyclists will be rerouted to Parkdale via Sherwood (south) or Tyndall (north), for a maximum out-of-way travel of 0.8 km. This sub-factor measures a one-way trip only. For the detour route, refer to the Preliminary Highway Engineering Traffic Staging Alternatives Report, dated August 6, 2014.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5



Mitigation: Advance signage for cyclists to choose an alternate route as well as pre-event information to the Regional cycling clubs.

Pedestrian/Bicycle Safety

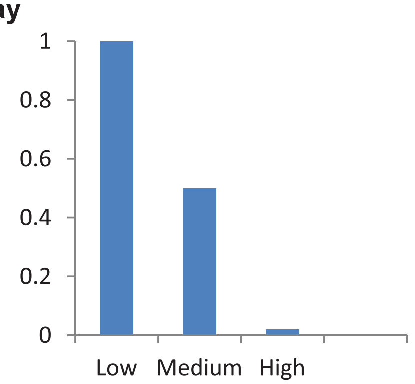


Description: This sub-factor measures if an alternative provides greater lateral space to increase pedestrian and bicycle safety. Those alternatives providing the largest span are preferred (high potential) and those alternatives matching the existing span are not preferred (i.e. low potential).

Alternatives	High/Low	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	0
Alternative A5e Conventional Rehab/Existing Span	Low	0
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Low	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	1
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Low	0
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	High	1
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	High	1

Mitigation: None.

Transit Operations Delay



Description: This sub-factor measures the delay during construction that will affect transit operations. Bus routes affected include Nos. 16, 86, 102, and 176. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

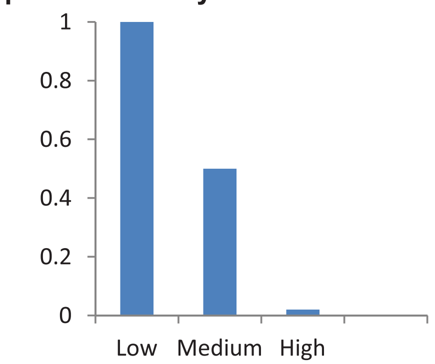
Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. The duration of the temporary signals will be 6 weeks.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure transit will be directed to Parkdale Avenue. This assumes that transit will be rerouted to Parkdale via Sherwood (south) or Tyndall (north), for a maximum out-of-way travel of 0.8 km. This sub-factor measures a one-way trip only. For the detour route, refer to the Preliminary Highway Engineering Traffic Staging Alternatives Report, dated August 6, 2014.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5

Mitigation: Advance information to OC Transpo and temporary relocation of bus stops if required.

General Traffic Municipal Street Delay



Description: This sub-factor measures the delay during construction that will affect general traffic operations. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. The duration of the temporary signals will be 6 weeks.

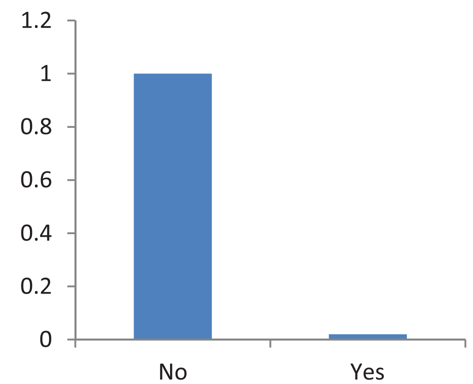
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure vehicles will be directed to Parkdale Ave. This assumes that vehicles will be rerouted to Parkdale via Sherwood (south) or Tyndall (north), for a maximum out-of-way travel of 1.7 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5

Mitigation: The use of advisory signage and potential use of variable message signage can be used to advise drivers before reaching the construction site.

Factor Group: Social and Cultural Environment

Community Green Spaces Impacts

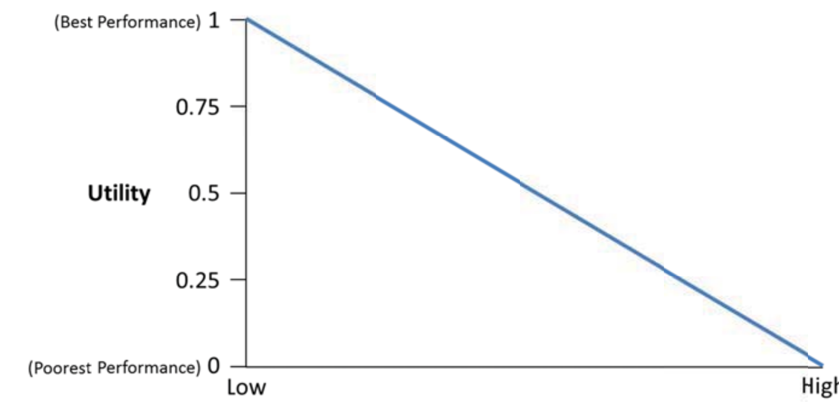


Description: This sub-factor measures the temporary impacts to Community Green Space. For the Holland Avenue bridges, the green space is the sports field north of the Fisher Park/Summit Alternative Public School which will be used as the construction and staging area for RBR bridges. Alternatives that do not impact parks or playground green spaces are preferred. The duration of the loss of park space is estimated to be 8 months. See Temporary Property Impacts sub-factor for the impact to the school.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	No	1
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	No	1
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Yes	0
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Yes	0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Yes	0

Mitigation: Avoidance.

Impact to Emergency Response



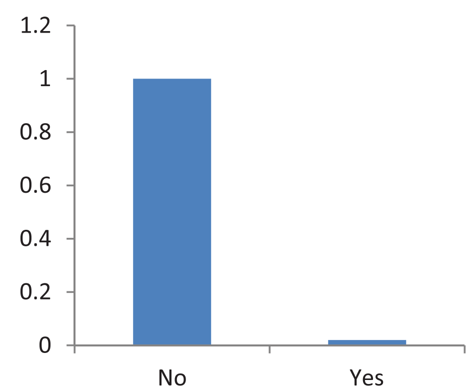
Description: This sub-factor measures the duration of Queensway closure that will affect emergency response service (police, ambulance and fire). Alternatives that reduce the length of time that there are lane closures on the Queensway are preferred.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	0.9
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0.0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0.0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	0	3	3	1.0
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	0	3	3	1.0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	0	3	3	1.0

Mitigation: Advanced warning of lane closures or detour routes.

Factor Group: Land Use and Property

Temporary Property Impacts

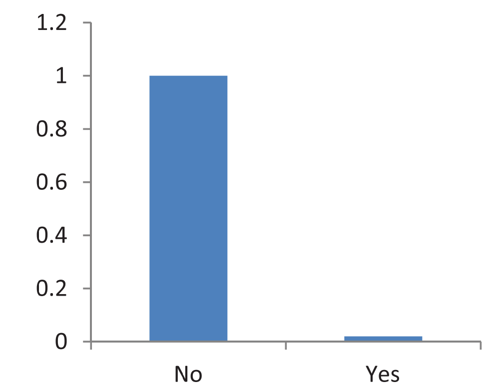


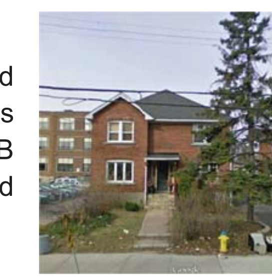
Description: This sub-factor measures whether property (i.e. Fisher Park/Summit Alternative Public School yard) is required for temporary use as a bridge staging area, as per the RBR Structure Staging Sites memo. The north staging area is to be used for both Holland EB and Holland WB rapid replacements. See Community Green Space sub-factor for effects to community uses of the parkland.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	No	1
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	No	1
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Yes	0
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Yes	0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Yes	0

Mitigation: N/A

Permanent Property Impacts





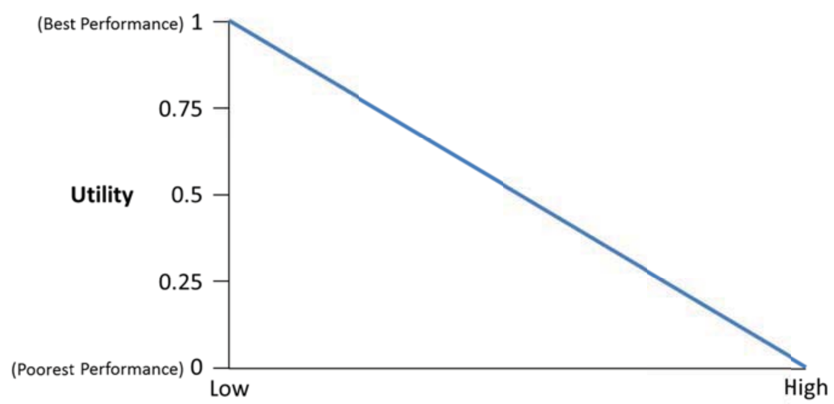
Description: This sub-factor measures whether property (i.e. residence) is required in order to access a bridge staging area, as per the RBR Structure Staging Sites memo. The north staging area is to be used for both Holland EB and Holland WB rapid replacements. In order to access the staging area, the residence at 234 Holland Avenue will be purchased.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	No	1
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	No	1
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Yes	0
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Yes	0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Yes	0

Mitigation: Financial compensation

Factor Group: Cost

Capital Cost

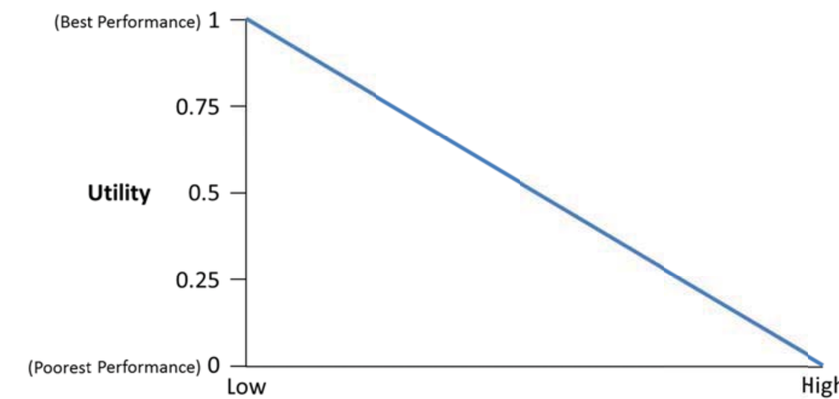


Description: This sub-factor measures the difference in initial capital cost of the alternative (bridge, traffic staging, staging area, and property costs). Those alternatives with the lowest capital cost are preferred. These costs do not include Engineering Costs.

Alternatives	$M		Utility Score
Alternative A2e Rapid Rehab/Existing Span	Structure 1.7 Staging 0.6 Property 0	2.3	1
Alternative A5e Conventional Rehab/Existing Span	Structure 1.7 Staging 1.3 Property 0	3.0	0.88
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Structure 3.6 Staging 1.2 Property 0	4.8	0.56
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Structure 4.5 Staging 1.2 Property 0	5.7	0.40
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Structure 5.5 Staging 0.60 Property 0.20	6.3	0.3
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Structure 7.2 Staging 0.60 Property 0.20	8.0	0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Structure 6.4 Staging 0.60 Property 0.20	7.2	0.14

Mitigation: N/A

Future Life Cycle Cost



Description: This sub-factor measures the difference in future life cycle costs (maintenance, operating costs and long term replacement and rehabilitation in the 40 year planning horizon). Those alternatives with the lowest long term life cycle cost are preferred. A 5% discount rate was used.

Alternatives	$M	Utility Score
Alternative A2e Rapid Rehab/Existing Span	4.7	1
Alternative A5e Conventional Rehab/Existing Span	5.4	0.84
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	5.5	0.81
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	6.5	0.58
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	7.1	0.44
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	9.0	0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	8.1	0.21

Mitigation: N/A

VERSION: November 11, 2014

APPENDIX E

SUB-FACTOR UTILITY FUNCTION DEFINITIONS AND MEASUREMENTS FOR SHORT LISTED EVALUATION CRITERIA

PARKDALE AVENUE EASTBOUND BRIDGE

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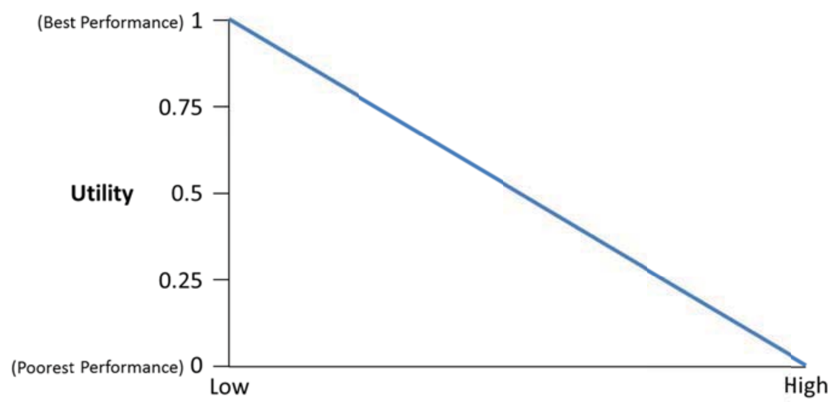
There are no EB or WB Staging Area sites; therefore no RBR alternatives are carried forward.

Factor Group: Transportation

Maximum Peak Queue Length on Queensway



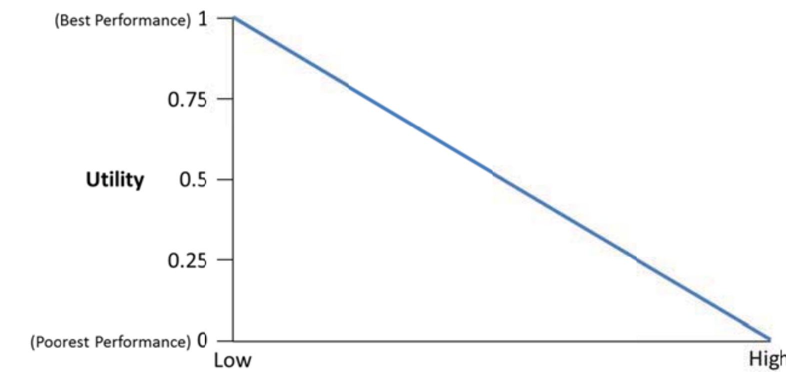
Description: This sub-factor measures the forecast queue length effect in the peak hour including measures to divert trips and induce transportation demand management during construction. The sub-factor measures the queue duration (days) and the forecast queue length (after the use of mitigation). This sub-factor is indicative of highway performance and safety, and is related to effects on ramp operations, rear end collisions influenced by stop and go traffic, poor weaving conditions and traffic congestion.

(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	km days (peak hour)	Utility Score
Alternative A2e Rapid Rehab/Existing Span	41	1
Alternative A5e Conventional Rehab/Existing Span	780	0.59
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	1920	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	1920	0

Mitigation: The use of advance advertising and advising drivers of the scheduled lane closures through PVMS placement in advance of construction will be measures that will reduce demand by: changing the time of travel of commuters, use of transit as an alternate mode of travel, or by inducing diversion to the municipal road system as an alternate route.

Delays

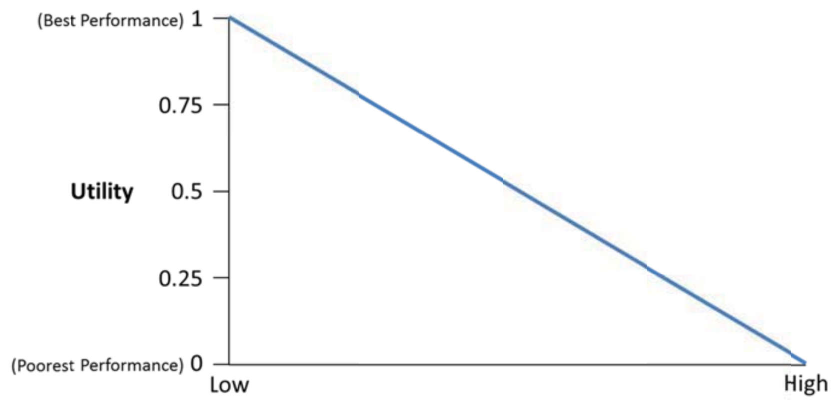


Description: This sub-factor measures the total lane closure peak period delay to drivers on the Queensway during the construction period. It includes the total peak period delay forecast for the duration of construction of the alternative. The delay sub-factor, although measuring vehicles on the Queensway, is also indicative of the delays for drivers diverted from the Queensway and operating on the municipal road system.
(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	Veh h	Utility Score
Alternative A2e Rapid Rehab/Existing Span	16,520	1
Alternative A5e Conventional Rehab/Existing Span	1,537,200	0.6
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	3,782,800	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	3,782,800	0

Mitigation: N/A

Highway Safety - Collision Potential

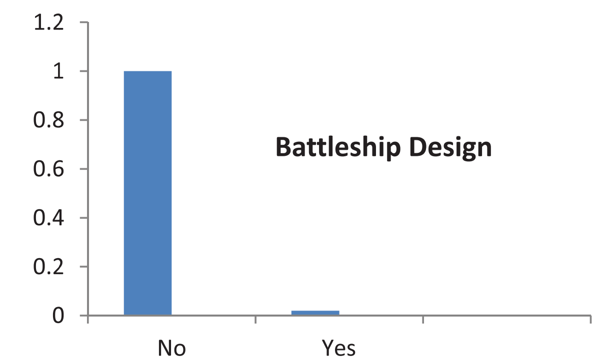


Description: This sub-factor measures the collision potential of the alternative by measuring the time duration that drivers will be required to transition through the construction zone.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	1
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0

Mitigation: N/A

Highway Safety – Design Consistency of Traffic Staging Design

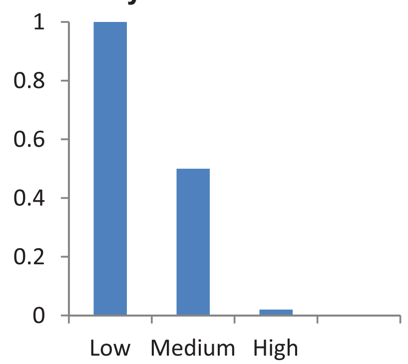


Description: This sub-factor measures the collision potential of the highway staging design. Those alternatives including a non-conventional battleship design (i.e. yes) are least preferred.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Yes	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Yes	0

Mitigation: Tow truck plan/incident plan.

Pedestrian – Delay and Out-of-way Travel



Description: This sub-factor measures the length and duration of pedestrian out-of-way travel on the side streets while work is completed to rehabilitate or replace the structure. Categories of effects include:

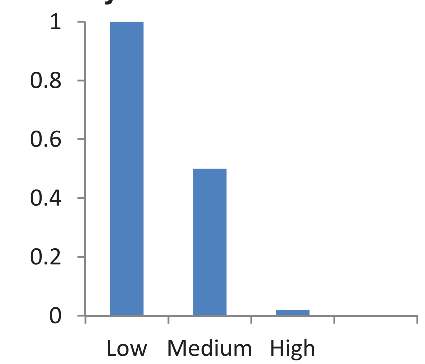
Low impacts – daily sidewalk closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period. Pedestrians will be signed to use the opposite sidewalk from the adjacent signalized intersections.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure pedestrians will be directed to Holland Ave., for a maximum out-of-way travel of 1.1 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0

Mitigation: Advance signage for pedestrians to travel to the alternate sidewalk route as well as pre-event information to the property owners.

Bicycle – Delay and Out-of-Way Travel



Description: This sub-factor measures the length and duration of bicycle delay and out-of-way travel on the side street while work is completed to rehabilitate or replace the structure. Categories of effects include:

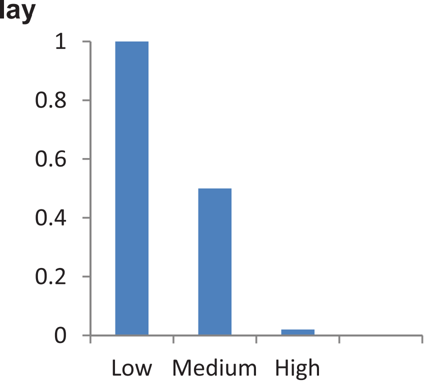
Low impacts – daily lane and bike lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure, bicyclists will be directed to Holland Avenue, for a maximum out-of-way travel of 1.1 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0

Mitigation: Advance signage for cyclists to choose an alternate route as well as pre-event information to the Regional cycling clubs.

Transit Operations Delay



Description: This sub-factor measures the delay during construction that will affect transit operations. Bus routes affected include Nos. 16, 86, 102, and 176. Categories of effects include:

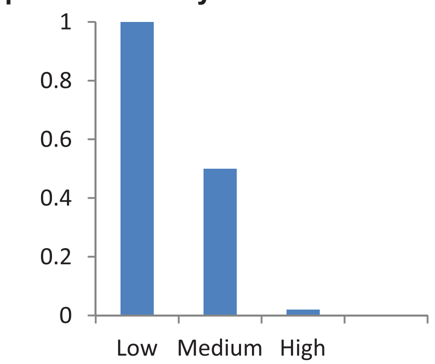
Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure transit will be directed to Holland Avenue, for a maximum out-of-way travel of 0.8 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0

Mitigation: Advance information to OC Transpo and temporary bus stop relocation if required.

General Traffic Municipal Street Delay



Description: This sub-factor measures the delay during construction that will affect general traffic operations. Categories of effects include:

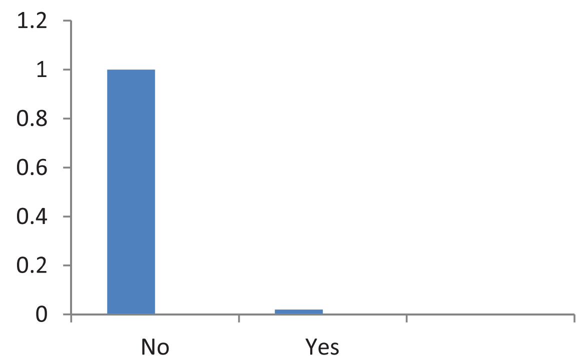
Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure vehicles will be directed to Holland Avenue, for a maximum out of-way-travel of 1.7 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0

Mitigation: The use of advisory signage and potential use of variable message signage can be used to advise drivers before reaching the construction site.

Municipal Street Traffic Signal Operations



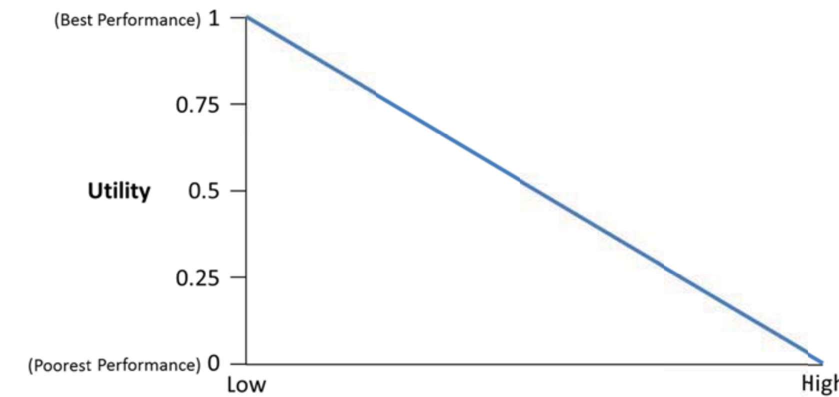
Description: This sub-factor measures the traffic effect to the existing traffic signals on the municipal street as a result of both construction traffic accessing the site as well as restrictions on turning movements to/from the side street. Those alternatives that affect the traffic signal operation are less preferred.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Yes	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Yes	0

Mitigation: Construction signage and revised signal timing.

Factor Group: Social and Cultural Environment

Impact to Emergency Response

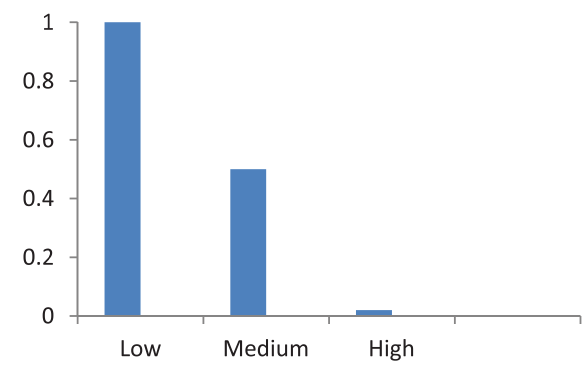


Description: This sub-factor measures the duration of Queensway closure that will affect emergency response service (police, ambulance and fire). Alternatives that reduce the length of time that there are lane closures on the Queensway are preferred.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	1
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0.0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0.0

Mitigation: Advanced warning of lane closures or detour routes.

Potentially Contaminated Property



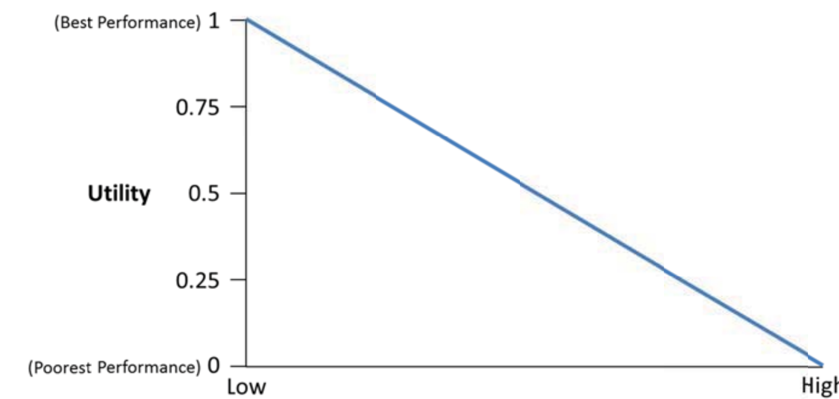
Description: This sub-factor measures whether there is potential to encounter potentially contaminated property during the construction of an alternative. Alternatives that minimize excavation are preferred. RBR staging sites have high potential (i.e. large footprint of excavation) to impact potentially contaminated property. Any alternative excavating in place has low potential to impact potentially contaminated property. The rehabilitation options have no potential to impact potentially contaminated property due to the small footprint of works.

Alternatives	No/Low/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0

Mitigation: Avoidance.

Factor Group: Cost

Capital Cost

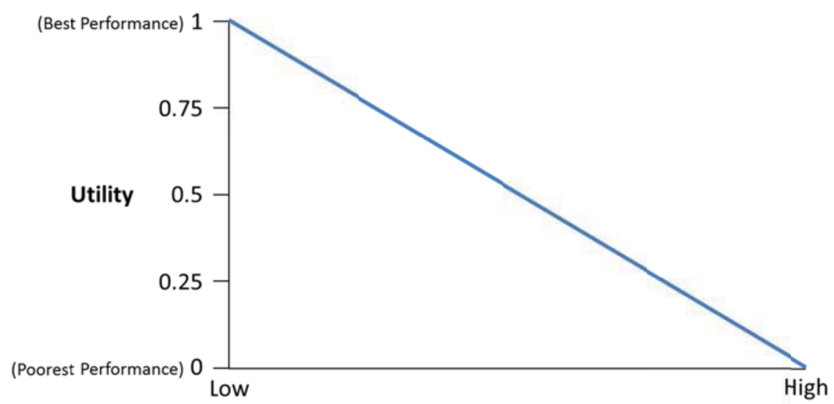


Description: This sub-factor measures the difference in initial capital cost of the alternative (bridge, traffic staging, staging area, and property costs). Those alternatives with the lowest capital cost are preferred. These costs do not include Engineering Costs.

Alternatives	$M		Utility Score
Alternative A2e Rapid Rehab/Existing Span	Structure 1.0 Staging 0.6 Property 0	1.6	1
Alternative A5e Conventional Rehab/Existing Span	Structure 1.0 Staging 1.3 Property 0	2.3	0.73
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Structure 2.4 Staging 1.2 Property 0	3.6	0.27
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Structure 3.0 Staging 1.2 Property 0	4.2	0

Mitigation: N/A

Future Life Cycle Cost



Description: This sub-factor measures the difference in future life cycle costs (maintenance, operating costs and long term replacement and rehabilitation in the 40 year planning horizon). Those alternatives with the lowest long term life cycle cost are preferred. A 5% discount rate was used.

Alternatives	$M	Utility Score
Alternative A2e Rapid Rehab/Existing Span	3.6	1
Alternative A5e Conventional Rehab/Existing Span	4.3	0.46
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	4.2	0.54
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	4.9	0

Mitigation: N/A

VERSION: November 11, 2014

APPENDIX E

SUB-FACTOR UTILITY FUNCTION DEFINITIONS AND MEASUREMENTS FOR SHORT LISTED EVALUATION CRITERIA

PARKDALE AVENUE WESTBOUND BRIDGE

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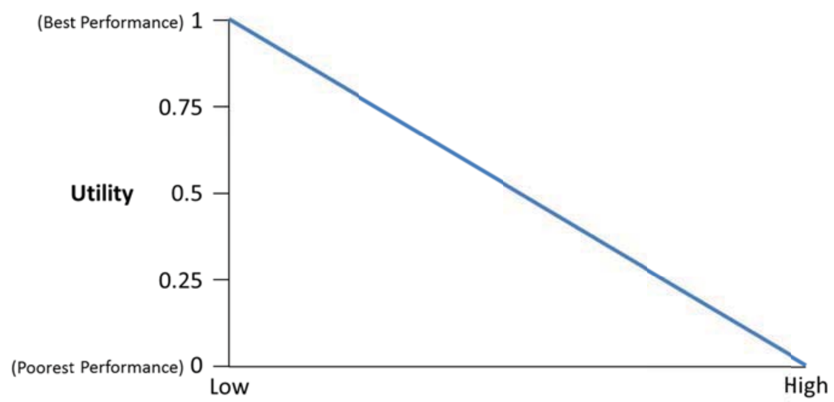
There are no EB or WB Staging Area sites; therefore no RBR alternatives are carried forward.

Factor Group: Transportation

Maximum Peak Queue Length on Queensway



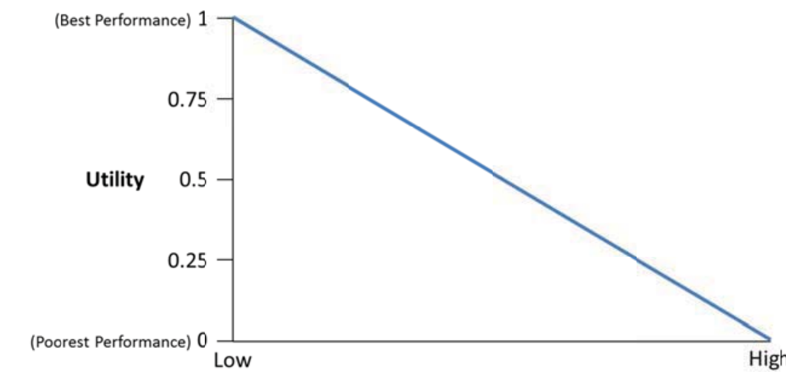
Description: This sub-factor measures the forecast queue length effect in the peak hour including measures to divert trips and induce transportation demand management during construction. The sub-factor measures the queue duration (days) and the forecast queue length (after the use of mitigation). This sub-factor is indicative of highway performance and safety, and is related to: effects on ramp operations, rear end collisions influenced by stop and go traffic, poor weaving conditions and traffic congestion.

(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	**km days (peak hour)**	**Utility Score**
Alternative A2e Rapid Rehab/Existing Span	41	1
Alternative A5e Conventional Rehab/Existing Span	780	0.6
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	1920	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	1920	0

Mitigation: The use of advance advertising and advising drivers of the scheduled lane closures through PVMS placement in advance of construction will be measures that will reduce demand by: changing the time of travel of commuters, use of transit as an alternate mode of travel or by inducing diversion to the municipal road system as an alternate route.

Delays

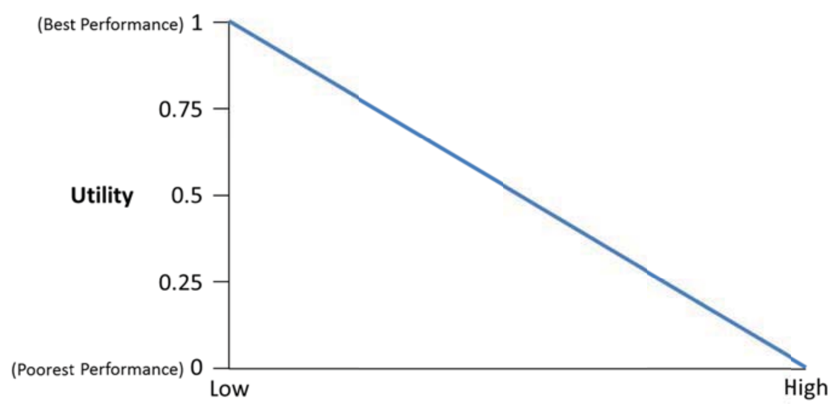


Description: This sub-factor measures the total lane closure peak period delay to drivers on the Queensway during the construction period. It includes the total peak period delay forecast for the duration of construction of the alternative. The delay sub-factor, although measuring vehicles on the Queensway, is also indicative of the delays for drivers diverted from the Queensway and operating on the municipal road system.
(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	**Veh h**	**Utility Score**
Alternative A2e Rapid Rehab/Existing Span	16,520	1
Alternative A5e Conventional Rehab/Existing Span	1,537,200	0.6
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	3,782,800	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	3,782,800	0

Mitigation: N/A

Highway Safety - Collision Potential

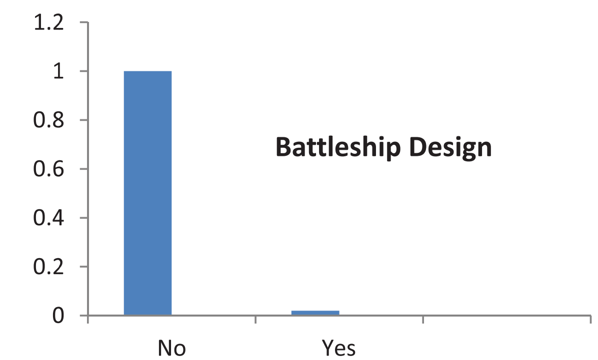


Description: This sub-factor measures the collision potential of the alternative by measuring the time duration that drivers will be required to transition through the construction zone.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	1
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0

Mitigation: N/A

Highway Safety – Design Consistency of Traffic Staging Design

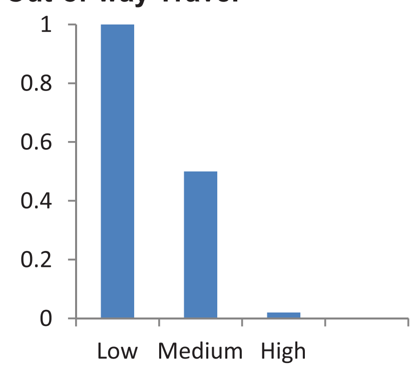


Description: This sub-factor measures the collision potential of the highway staging design. Those alternatives including a non-conventional battleship design (i.e. yes) are least preferred.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Yes	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Yes	0

Mitigation: Tow truck plan/incident plan.

Pedestrian – Delay and Out-of-way Travel



Description: This sub-factor measures the length and duration of pedestrian out-of-way travel on the side streets while work is completed to rehabilitate or replace the structure. Categories of effects include:

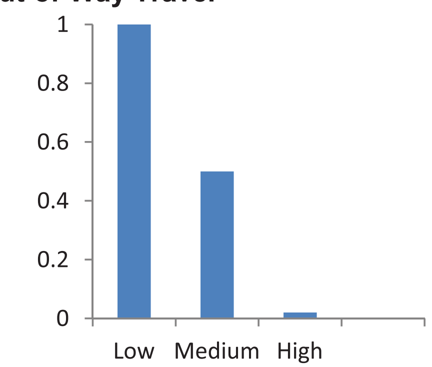
Low impacts – daily sidewalk closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period. Pedestrians will be signed to use the opposite sidewalk from the adjacent signalized intersections.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure pedestrians will be directed to Holland Ave., for a maximum out-of-way travel of 1.1 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0

Mitigation: Advance signage for pedestrians to travel to the alternate sidewalk route as well as pre-event information to the property owners.

Bicycle – Delay and Out-of-Way Travel



Description: This sub-factor measures the length and duration of bicycle delay and out-of-way travel on the side street while work is completed to rehabilitate or replace the structure. Categories of effects include:

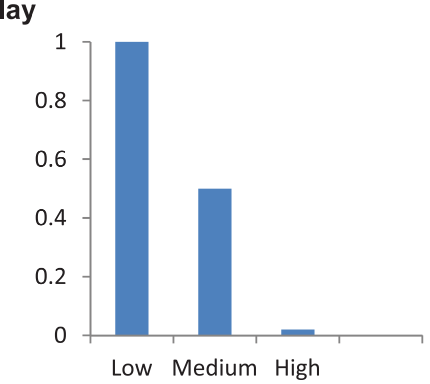
Low impacts – daily lane and bike lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure, bicyclists will be directed to Holland Ave., for a maximum out-of-way travel of 1.1 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0

Mitigation: Advance signage for cyclists to choose an alternate route as well as pre-event information to the Regional cycling clubs.

Transit Operations Delay



Description: This sub-factor measures the delay during construction that will affect transit operations. Bus routes affected include Nos. 16, 86, 102, and 176. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

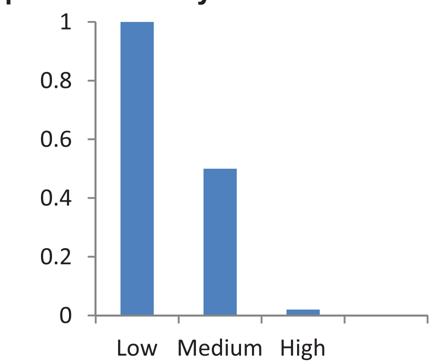
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure transit will be directed to Holland Ave., for a maximum out-of-way travel of 0.8 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0

Mitigation: Advance information to OC Transpo and temporary bus stop relocation if required.

Preliminary Design and Environmental Assessment Study for the Rehabilitation/Replacement of Ottawa Queensway Mid-town Bridges from Holland Avenue to O'Connor Street
UTILITY FUNCTION DEFINITIONS AND MEASUREMENTS FOR SHORT LISTED EVALUATION CRITERIA
PARKDALE AVENUE WESTBOUND BRIDGE
GWP #4075-11-00

General Traffic Municipal Street Delay

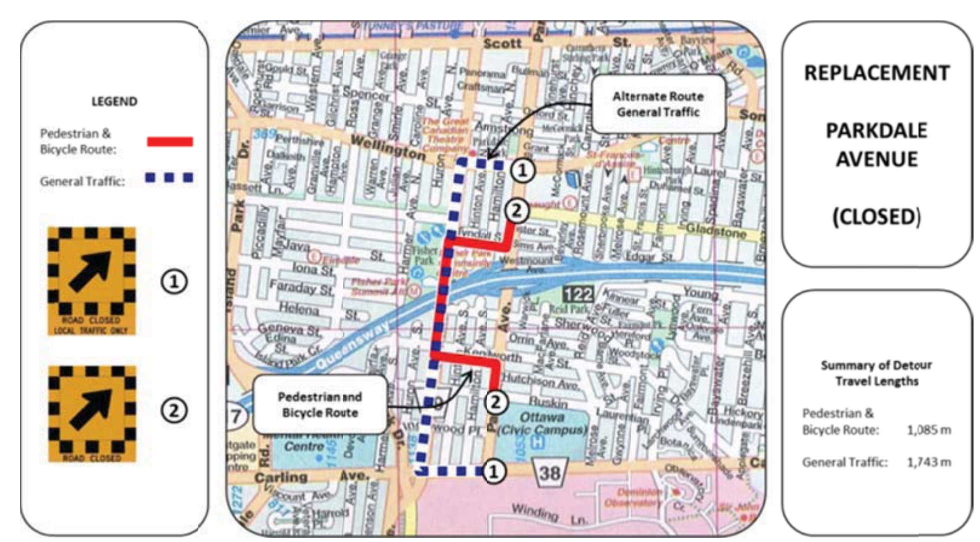


Description: This sub-factor measures the delay during construction that will affect general traffic operations. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period

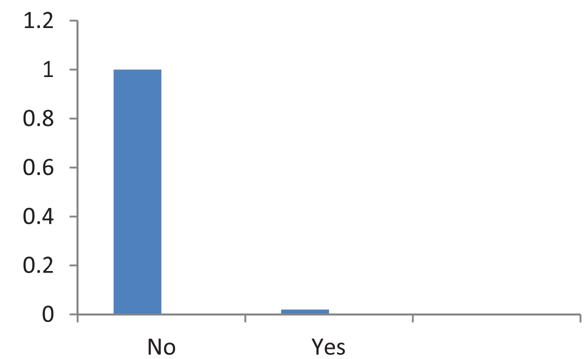
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure vehicles will be directed to Holland Avenue, for a maximum out-of-way travel of 1.7 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0



Mitigation: The use of advisory signage and potential use of variable message signage can be used to advise drivers before reaching the construction site.

Municipal Street Traffic Signal Operations



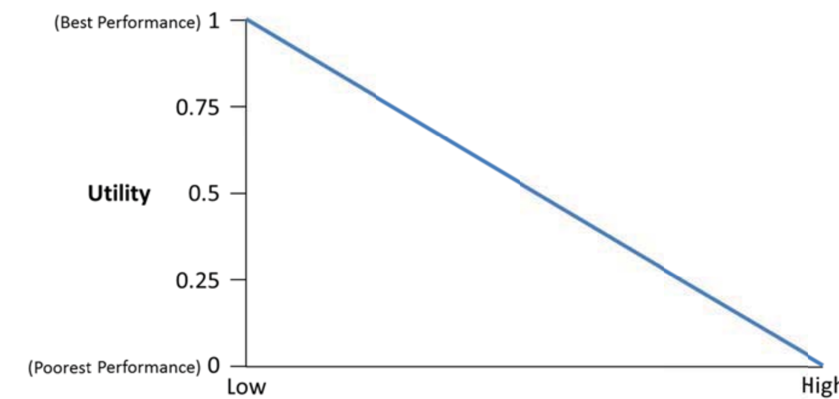
Description: This sub-factor measures the traffic effect to the existing traffic signals on the municipal street as a result of both construction traffic accessing the site as well as restrictions on turning movements to/from the side street. Those alternatives that affect the traffic signal operation are less preferred.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Yes	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Yes	0

Mitigation: Construction signage and revised signal timing.

Factor Group: Social and Cultural Environment

Impact to Emergency Response

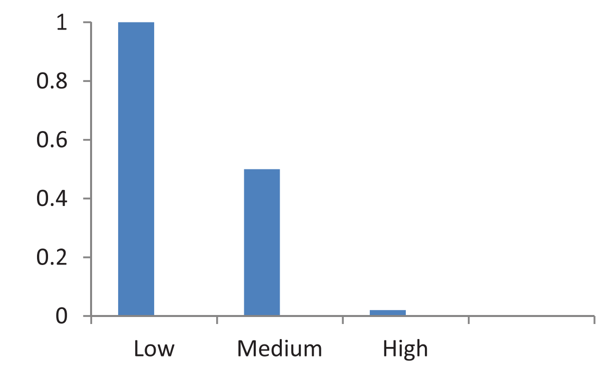


Description: This sub-factor measures the duration of Queensway closure that will affect emergency response service (police, ambulance and fire). Alternatives that reduce the length of time that there are lane closures on the Queensway are preferred.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	1
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0.0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0.0

Mitigation: Advanced warning of lane closures or detour routes.

Potentially Contaminated Property



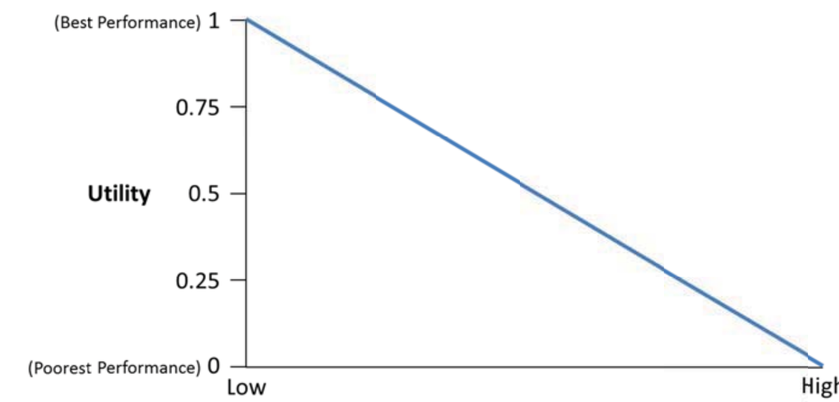
Description: This sub-factor measures whether there is potential to encounter potentially contaminated property during the construction of an alternative. Alternatives that minimize excavation are preferred. RBR staging sites have high potential (i.e. large footprint of excavation) to impact potentially contaminated property. Any alternative excavating in place has low potential to impact potentially contaminated property. The rehabilitation options have no potential to impact potentially contaminated property due to the small footprint of works.

Alternatives	No/Low/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Low	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Low	0

Mitigation: Avoidance.

Factor Group: Cost

Capital Cost

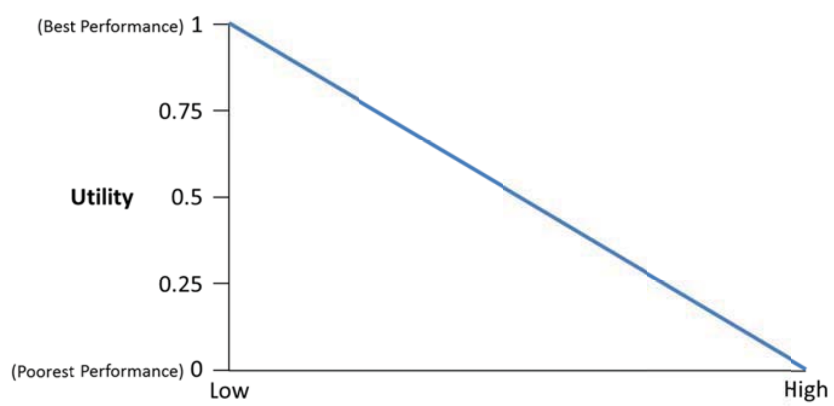


Description: This sub-factor measures the difference in initial capital cost of the alternative (bridge, traffic staging, staging area, and property costs). Those alternatives with the lowest capital cost are preferred. These costs do not include Engineering Costs.

Alternatives	$M		Utility Score
Alternative A2e Rapid Rehab/Existing Span	Structure 1.1 Staging 0.6 Property 0	1.7	1
Alternative A5e Conventional Rehab/Existing Span	Structure 1.1 Staging 1.3 Property 0	2.4	0.72
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Structure 2.4 Staging 1.2 Property 0	3.6	0.24
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Structure 3.0 Staging 1.2 Property 0	4.2	0

Mitigation: N/A

Future Life Cycle Cost



Description: This sub-factor measures the difference in future life cycle costs (maintenance, operating costs and long term replacement and rehabilitation in the 40 year planning horizon). Those alternatives with the lowest long term life cycle cost are preferred. A 5% discount rate was used.

Alternatives	$M	Utility Score
Alternative A2e Rapid Rehab/Existing Span	3.7	1
Alternative A5e Conventional Rehab/Existing Span	4.4	0.42
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	4.2	0.58
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	4.9	0

Mitigation: N/A

VERSION: November 11, 2014

APPENDIX E

SUB-FACTOR UTILITY FUNCTION DEFINITIONS AND MEASUREMENTS FOR SHORT LISTED EVALUATION CRITERIA

FAIRMONT AVENUE EASTBOUND BRIDGE

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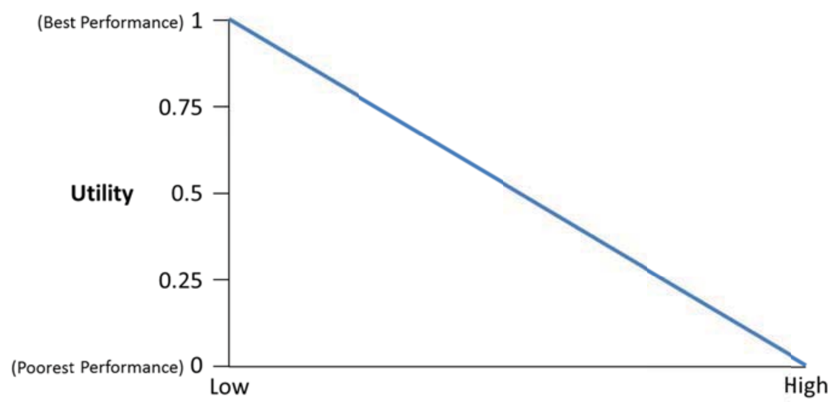
Future Life Cycle Cost 11

There are no EB or WB Staging Area sites; therefore no RBR alternatives are carried forward.

Factor Group: Transportation

Maximum Peak Queue Length on Queensway



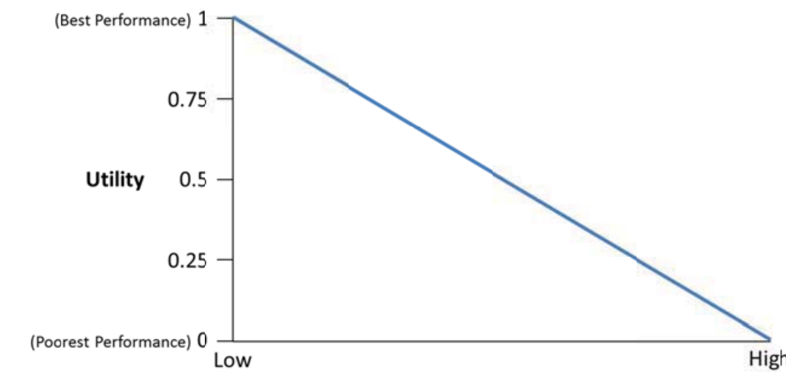
Description: This sub-factor measures the forecast queue length effect in the peak hour including measures to divert trips and induce transportation demand management during construction. The sub-factor measures the queue duration (days) and the forecast queue length (after the use of mitigation). This sub-factor is indicative of highway performance and safety, and is related to: effects on ramp operations, rear end collisions influenced by stop and go traffic, poor weaving conditions and traffic congestion.

(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	km days (peak hour)	Utility Score
Alternative A2e Rapid Rehab/Existing Span	41	1
Alternative A5e Conventional Rehab/Existing Span	780	0.59
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	1920	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	1920	0

Mitigation: The use of advance advertising and advising drivers of the scheduled lane closures through PVMS placement in advance of construction will be measures that will reduce demand by: changing the time of travel of commuters, use of transit as an alternate mode of travel, or by inducing diversion to the municipal road system as an alternate route.

Delays

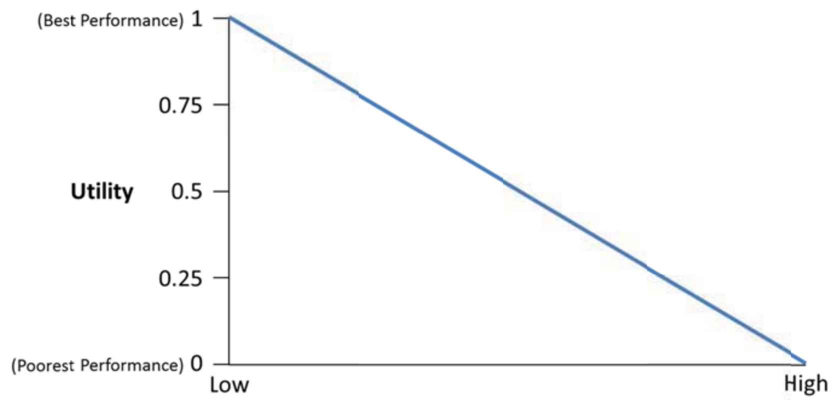


Description: This sub-factor measures the total lane closure peak period delay to drivers on the Queensway during the construction period. It includes the total peak period delay forecast for the duration of construction of the alternative. The delay sub-factor, although measuring vehicles on the Queensway, is also indicative of the delays for drivers diverted from the Queensway and operating on the municipal road system.
(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	Veh h	Utility Score
Alternative A2e Rapid Rehab/Existing Span	44,784	1
Alternative A5e Conventional Rehab/Existing Span	161,600	0.72
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	459,780	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	459,780	0

Mitigation: N/A

Highway Safety - Collision Potential

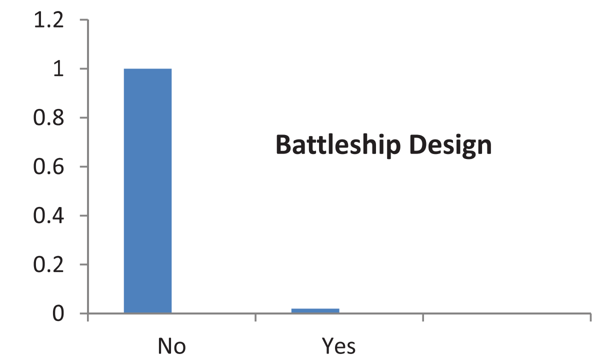


Description: This sub-factor measures the collision potential of the alternative by measuring the time duration that drivers will be required to transition through the construction zone.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	1
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0

Mitigation: N/A

Highway Safety – Design Consistency of Traffic Staging Design

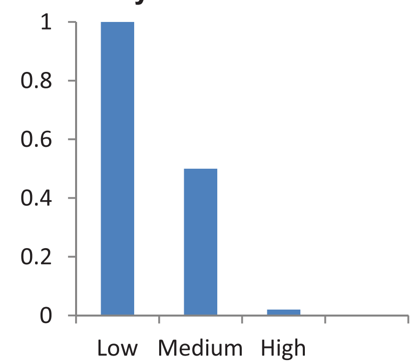


Description: This sub-factor measures the collision potential of the highway staging design. Those alternatives including a non-conventional battleship design (i.e. yes) are least preferred.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Yes	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Yes	0

Mitigation: Tow truck plan/incident plan.

Pedestrian – Delay and Out-of-way Travel



Description: This sub-factor measures the length and duration of pedestrian out-of-way travel on the side streets while work is completed to rehabilitate or replace the structure. Categories of effects include:

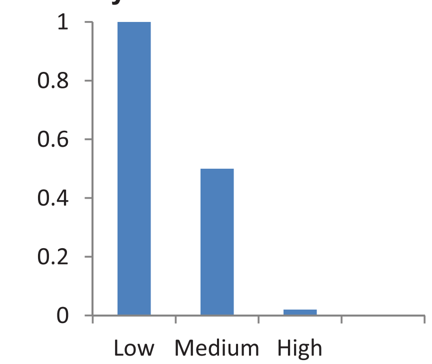
Low impacts – daily sidewalk closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period. Pedestrians will be signed to use the opposite sidewalk from the adjacent signalized intersections.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure pedestrians will be directed to Bayswater, for a maximum out of way travel of 0.8 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0

Mitigation: Advance signage for pedestrians to travel to the alternate sidewalk route as well as pre-event information to the property owners.

Bicycle – Delay and Out-of-Way Travel

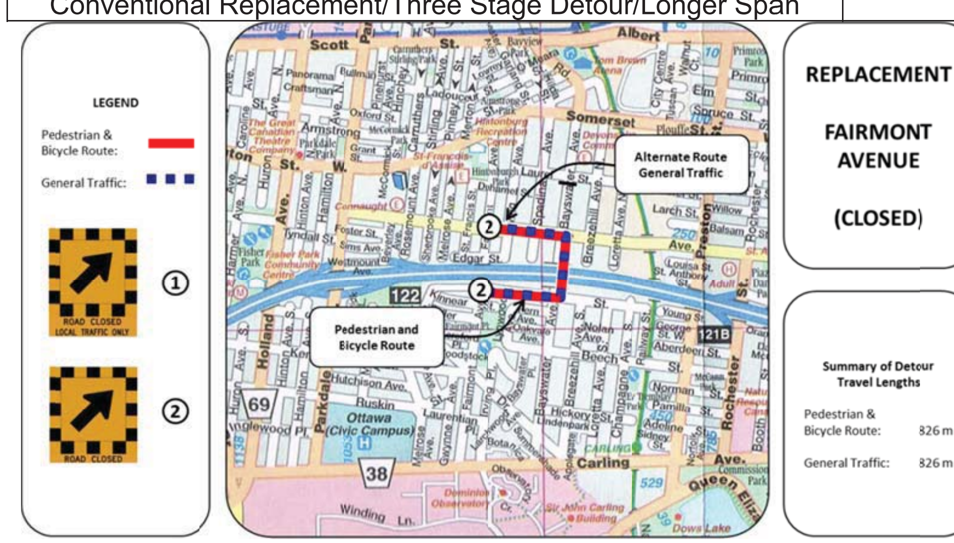


Description: This sub-factor measures the length and duration of bicycle delay and out-of-way travel on the side street while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily lane and bike lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

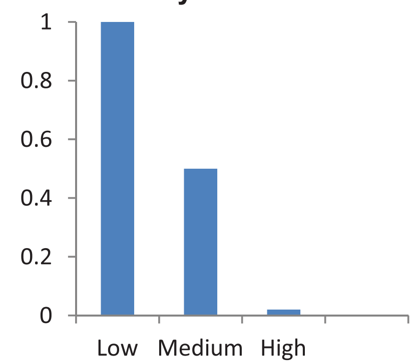
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure, bicyclists will be directed to Bayswater, for a maximum out-of-way travel of 0.8 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0



Mitigation: Advance signage for cyclists to choose an alternate route as well as pre-event information to the Regional cycling clubs.

General Traffic Municipal Street Delay

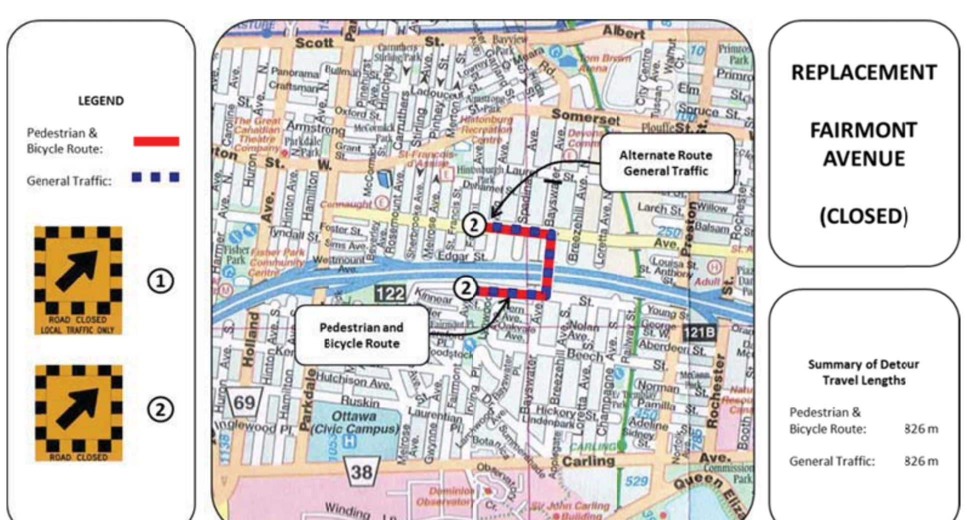


Description: This sub-factor measures the delay during construction that will affect general traffic operations. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure vehicles will be directed to Bayswater, for a maximum out-of-way travel of 0.8 km. This sub-factor measures a one-way trip only.

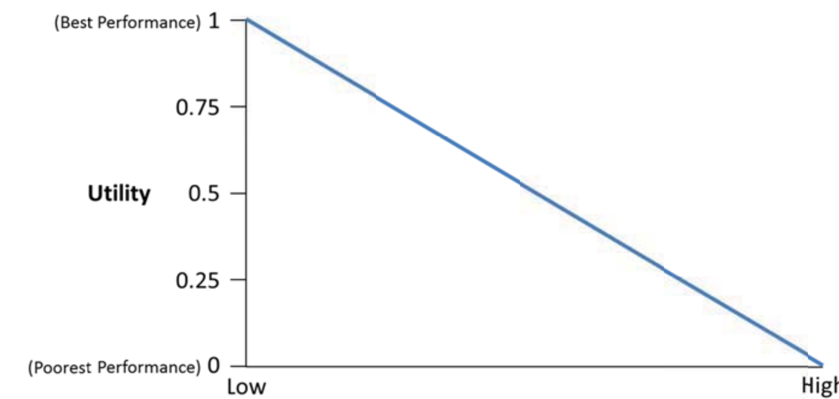
Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0



Mitigation: The use of advisory signage and potential use of variable message signage to advise drivers before reaching the construction site.

Factor Group: Social and Cultural Environment

Impact to Emergency Response

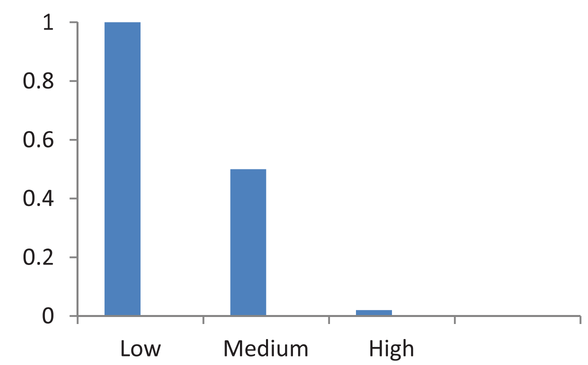


Description: This sub-factor measures the duration of Queensway closure that will affect emergency response service (police, ambulance and fire). Alternatives that reduce the length of time that there are lane closures on the Queensway are preferred.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	1
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0.0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0.0

Mitigation: Advanced warning of lane closures or detour routes.

Potentially Contaminated Property



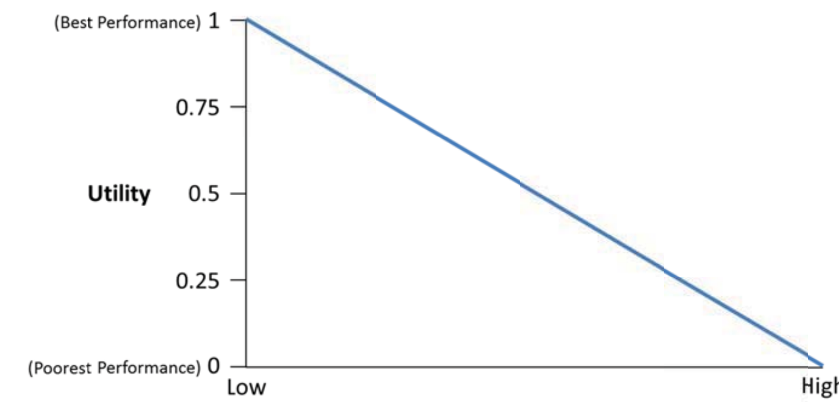
Description: This sub-factor measures whether there is high or low potential to encounter potentially contaminated property during the construction of an alternative. Alternatives that minimize excavation are preferred. For this site, a former landfill existed immediately adjacent to the bridge at the southeast quadrant. A longer span alternative would; therefore, have a high potential to impact the potentially contaminated site.

Alternatives	Low/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Low	1
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0

Mitigation: Avoidance.

Factor Group: Cost

Capital Cost

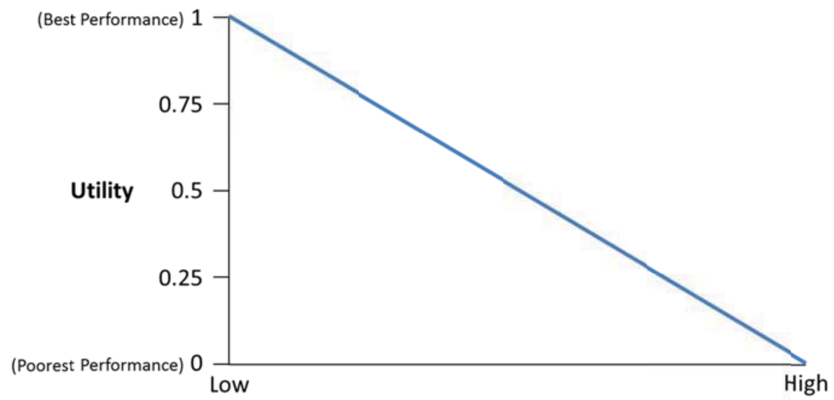


Description: This sub-factor measures the difference in initial capital cost of the alternative (bridge, traffic staging, staging area, and property costs). Those alternatives with the lowest capital cost are preferred. These costs do not include Engineering Costs.

Alternatives	$M		Utility Score
Alternative A2e Rapid Rehab/Existing Span	Structure 1.1 Staging 0.6 Property 0	1.7	1
Alternative A5e Conventional Rehab/Existing Span	Structure 1.1 Staging 1.3 Property 0	2.4	0.73
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Structure 2.4 Staging 1.2 Property 0	3.6	0.27
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Structure 3.1 Staging 1.2 Property 0	4.3	0

Mitigation: N/A

Future Life Cycle Cost



Description: This sub-factor measures the difference in future life cycle costs (maintenance, operating costs and long term replacement and rehabilitation in the 40 year planning horizon). Those alternatives with the lowest long term life cycle cost are preferred. A 5% discount rate was used.

Alternatives	$M	Utility Score
Alternative A2e Rapid Rehab/Existing Span	3.4	1
Alternative A5e Conventional Rehab/Existing Span	4.1	0.56
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	4.3	0.44
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	5.0	0

Mitigation: N/A

VERSION: November 11, 2014

APPENDIX E

SUB-FACTOR UTILITY FUNCTION DEFINITIONS AND MEASUREMENTS FOR SHORT LISTED EVALUATION CRITERIA

FAIRMONT AVENUE WESTBOUND BRIDGE

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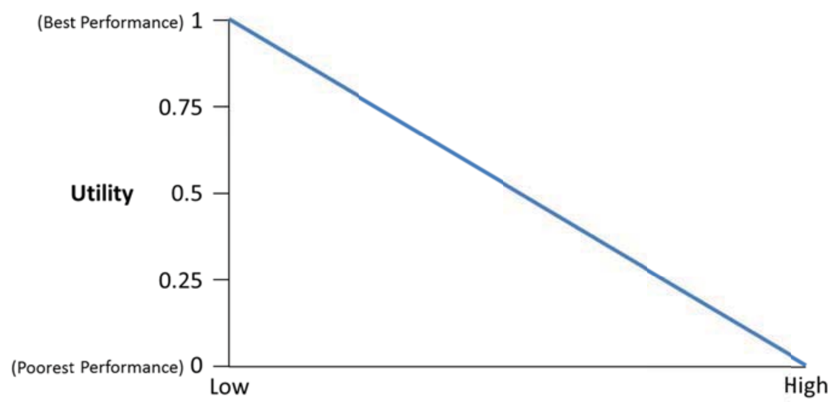
Impact to Emergency Response 9
FACTOR GROUP: COST **10**
Capital Cost 10
Future Life Cycle Cost 11

There are no EB or WB Staging Area sites; therefore no RBR alternatives are carried forward.

Factor Group: Transportation

Maximum Peak Queue Length on Queensway



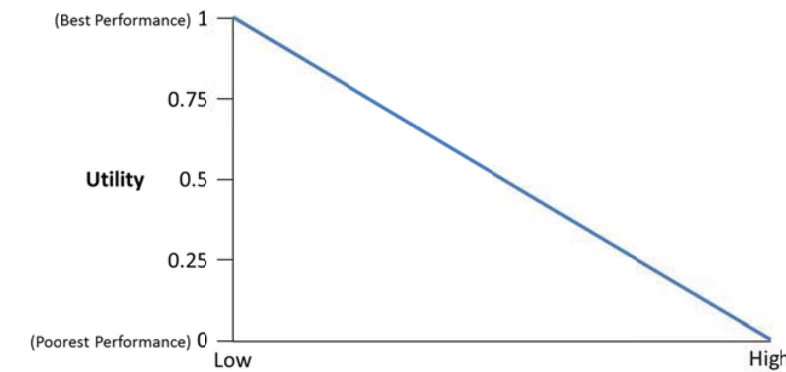
Description: This sub-factor measures the forecast queue length effect in the peak hour including measures to divert trips and induce transportation demand management during construction. The sub-factor measures the queue duration (days) and the forecast queue length (after the use of mitigation). This sub-factor is indicative of highway performance and safety, and is related to: effects on ramp operations, rear end collisions influenced by stop and go traffic, poor weaving conditions and traffic congestion.

(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	km days (peak hour)	Utility Score
Alternative A2e Rapid Rehab/Existing Span	41	1
Alternative A5e Conventional Rehab/Existing Span	780	0.59
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	1920	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	1920	0

Mitigation: The use of advance advertising and advising drivers of the scheduled lane closures through PVMS placement in advance of construction will be measures that will reduce demand by: changing the time of travel of commuters, use of transit as an alternate mode of travel, or by inducing diversion to the municipal road system as an alternate route.

Delays

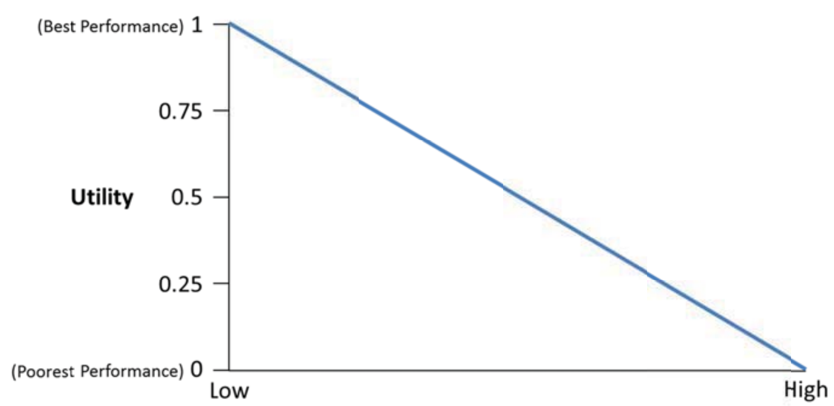


Description: This sub-factor measures the total lane closure peak period delay to drivers on the Queensway during the construction period. It includes the total peak period delay forecast for the duration of construction of the alternative. The delay sub-factor, although measuring vehicles on the Queensway, is also indicative of the delays for drivers diverted from the Queensway and operating on the municipal road system.
(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	Veh h	Utility Score
Alternative A2e Rapid Rehab/Existing Span	16,520	1
Alternative A5e Conventional Rehab/Existing Span	1,537,200	0.72
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	3,782,800	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	3,782,800	0

Mitigation: N/A

Ramp Closures

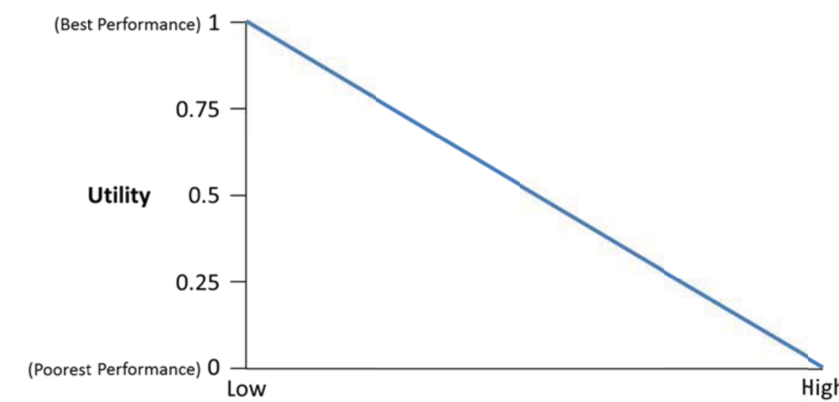


Description: This sub-factor measures the impact to community access by quantifying the volume of peak hour ramp trips that will be removed from entering or exiting from the Queensway. The sub-factor measures the peak hour ramp volume for each stage of the highway staging plan for the duration of the closure.

Alternatives	Veh (peak hour)	Utility Score
Alternative A2e Rapid Rehab/Existing Span	0	1
Alternative A5e Conventional Rehab/Existing Span	154,720	0.75
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	616,816	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	616,816	0

Mitigation: Ramps may be closed by time of day to allow access in non-peak hours.

Highway Safety - Collision Potential

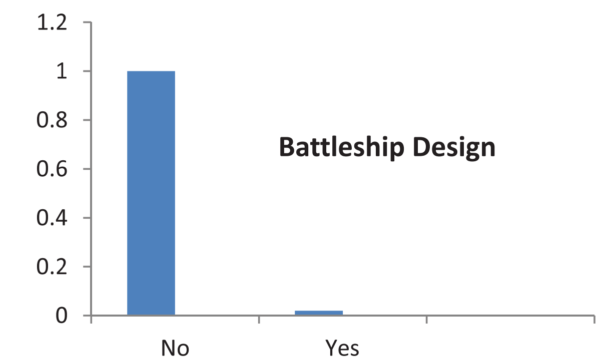


Description: This sub-factor measures the collision potential of the alternative by measuring the time duration that drivers will be required to transition through the construction zone.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	1
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0

Mitigation: N/A

Highway Safety – Design Consistency of Traffic Staging Design

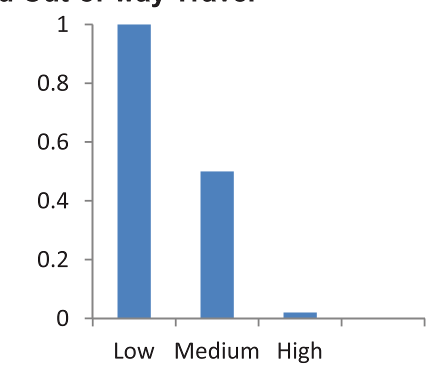


Description: This sub-factor measures the collision potential of the highway staging design. Those alternatives including a non-conventional battleship design (i.e. yes) are least preferred.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Yes	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Yes	0

Mitigation: Tow truck plan/incident plan.

Pedestrian – Delay and Out-of-way Travel

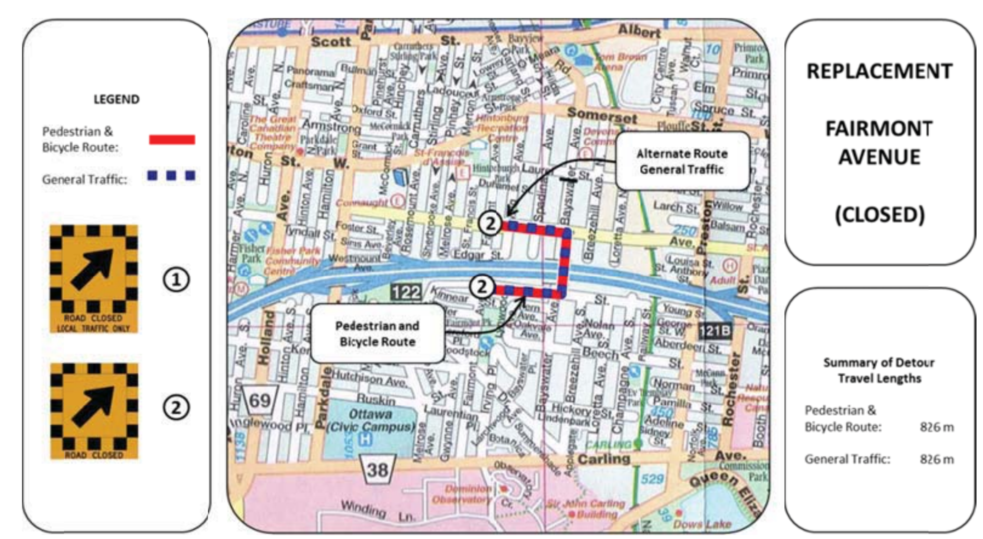


Description: This sub-factor measures the length and duration of pedestrian out-of-way travel on the side streets while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily sidewalk closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period. Pedestrians will be signed to use the opposite sidewalk from the adjacent signalized intersections.

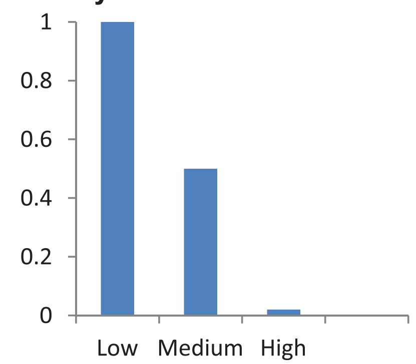
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure, pedestrians will be directed to Bayswater, for a maximum out-of-way travel of 0.8 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0



Mitigation: Advance signage for pedestrians to travel to the alternate sidewalk route as well as pre-event information to the property owners.

Bicycle – Delay and Out-of-Way Travel

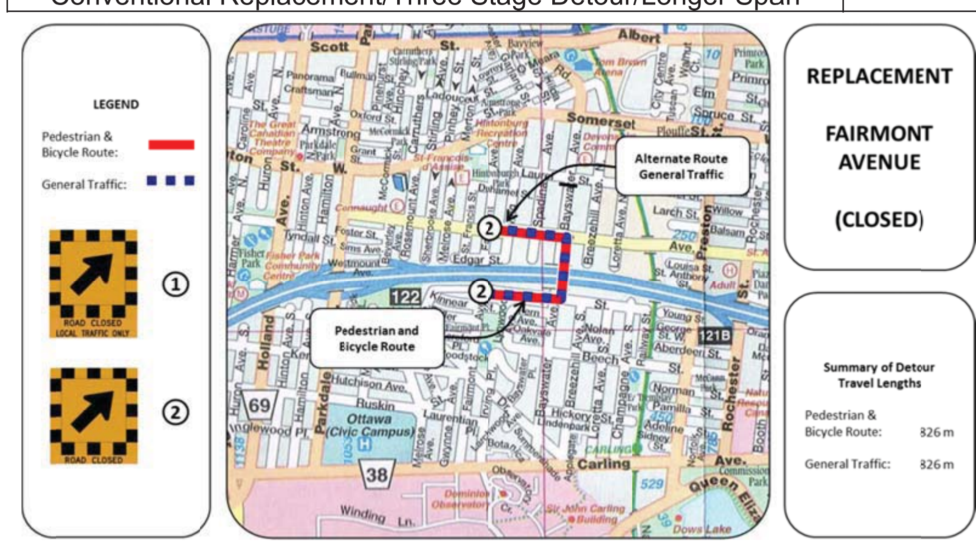


Description: This sub-factor measures the length and duration of bicycle delay and out-of-way travel on the side street while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily lane and bike lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

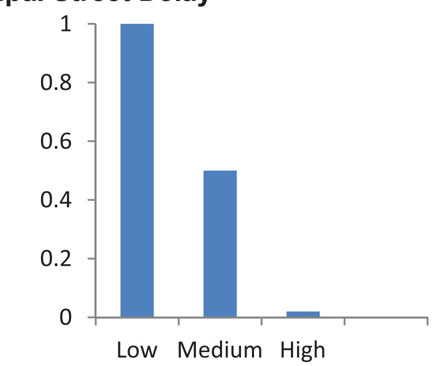
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure, bicyclists will be directed to Bayswater, for a maximum out-of-way travel of 0.8 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0



Mitigation: Advance signage for cyclists to choose an alternate route as well as pre-event information to the Regional cycling clubs.

General Traffic Municipal Street Delay

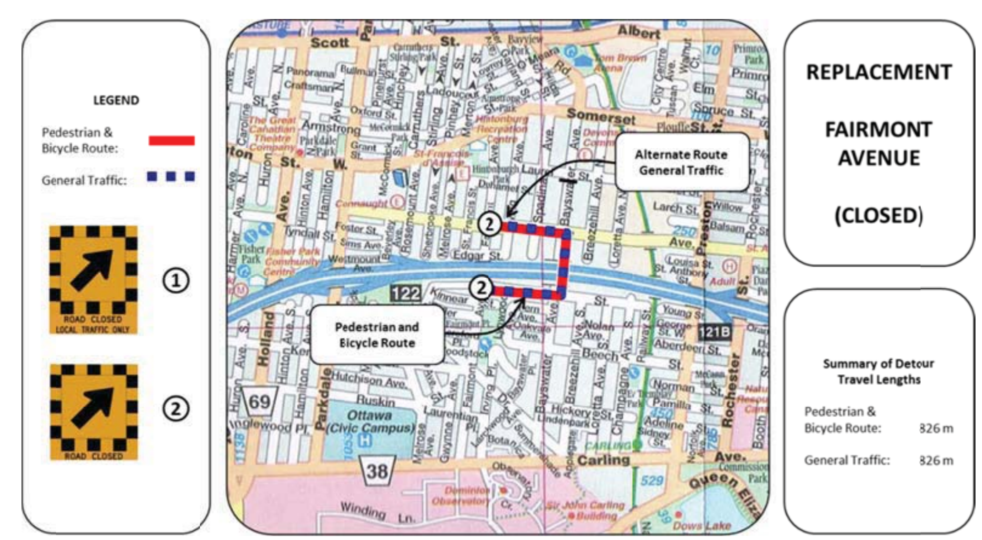


Description: This sub-factor measures the delay during construction that will affect general traffic operations. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure vehicles will be directed to Bayswater, for a maximum out-of-way travel of 0.8 km. This sub-factor measures a one-way trip only.

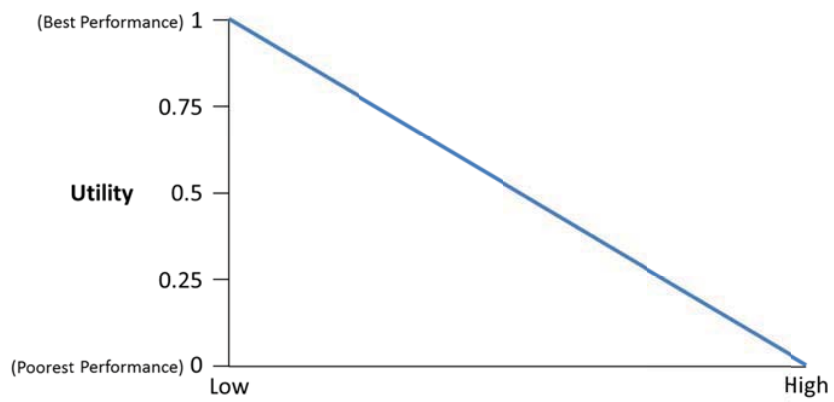
Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0



Mitigation: The use of advisory signage and potential use of variable message signage to advise drivers before reaching the construction site.

Factor Group: Social and Cultural Environment

Impact to Emergency Response



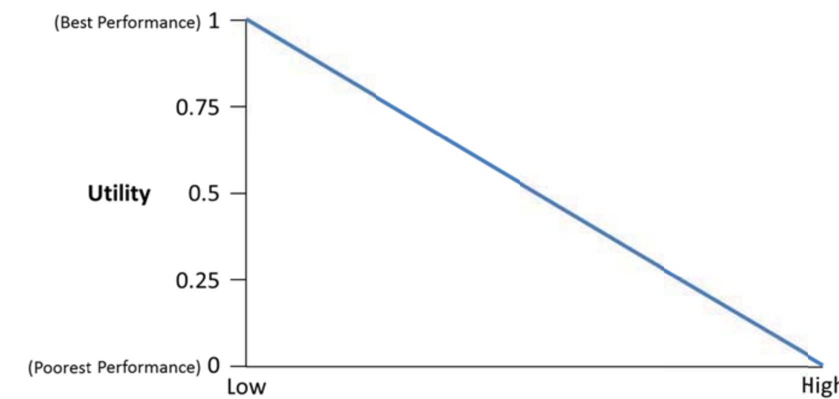
Description: This sub-factor measures the duration of Queensway closure that will affect emergency response service (police, ambulance and fire). Alternatives that reduce the length of time that there are lane closures on the Queensway are preferred.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	1
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0.0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0.0

Mitigation: Advanced warning of lane closures or detour routes.

Factor Group: Cost

Capital Cost

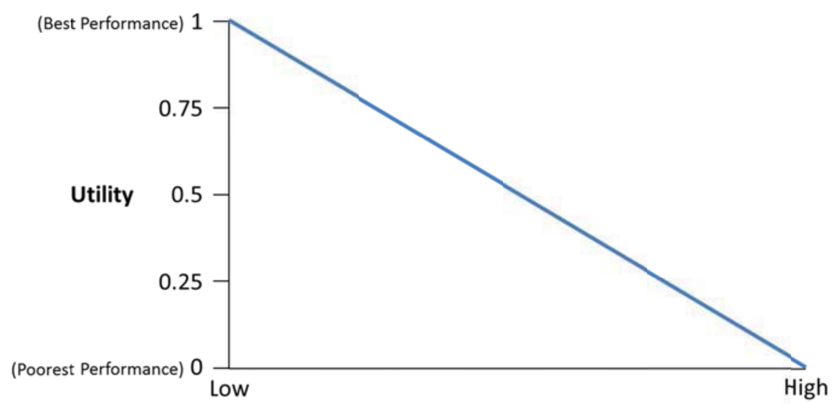


Description: This sub-factor measures the difference in initial capital cost of the alternative (bridge, traffic staging, staging area, and property costs). Those alternatives with the lowest capital cost are preferred. These costs do not include Engineering Costs.

Alternatives	$M		Utility Score
Alternative A2e Rapid Rehab/Existing Span	Structure 1.1 Staging 0.6 Property 0	1.7	1
Alternative A5e Conventional Rehab/Existing Span	Structure 1.1 Staging 1.3 Property 0	2.4	0.73
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Structure 2.4 Staging 1.2 Property 0	3.6	0.27
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Structure 3.1 Staging 1.2 Property 0	4.3	0

Mitigation: N/A

Future Life Cycle Cost



Description: This sub-factor measures the difference in future life cycle costs (maintenance, operating costs and long term replacement and rehabilitation in the 40 year planning horizon). Those alternatives with the lowest long term life cycle cost are preferred. A 5% discount rate was used.

Alternatives	$M	Utility Score
Alternative A2e Rapid Rehab/Existing Span	3.4	1
Alternative A5e Conventional Rehab/Existing Span	4.1	0.56
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	4.3	0.44
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	5.0	0

Mitigation: N/A

VERSION: November 11, 2014

APPENDIX E

SUB-FACTOR UTILITY FUNCTION DEFINITIONS AND MEASUREMENTS FOR SHORT LISTED EVALUATION CRITERIA

BAYSWATER AVENUE EASTBOUND BRIDGE

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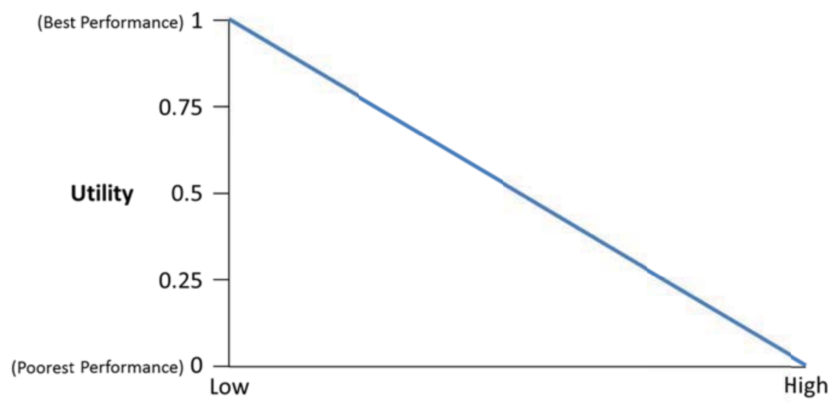
There are no EB or WB Staging Area sites; therefore no RBR alternatives are carried forward.

Factor Group: Transportation

Maximum Peak Queue Length on Queensway



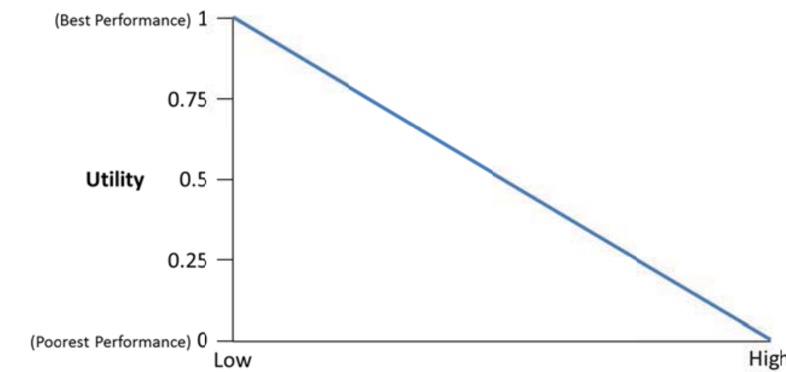
Description: This sub-factor measures the forecast queue length effect in the peak hour including measures to divert trips and induce transportation demand management during construction. The sub-factor measures the queue duration (days) and the forecast queue length (after the use of mitigation). This sub-factor is indicative of highway performance and safety, and is related to: effects on ramp operations, rear end collisions influenced by stop and go traffic, poor weaving conditions and traffic congestion.

(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	km days (peak hour)	Utility Score
Alternative A2e Rapid Rehab/Existing Span	41	1
Alternative A5e Conventional Rehab/Existing Span	780	0.59
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	1920	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	1920	0

Mitigation: The use of advance advertising and advising drivers of the scheduled lane closures through PVMS placement in advance of construction will be measures that will reduce demand by: changing the time of travel of commuters, use of transit as an alternate mode of travel, or by inducing diversion to the municipal road system as an alternate route.

Delays

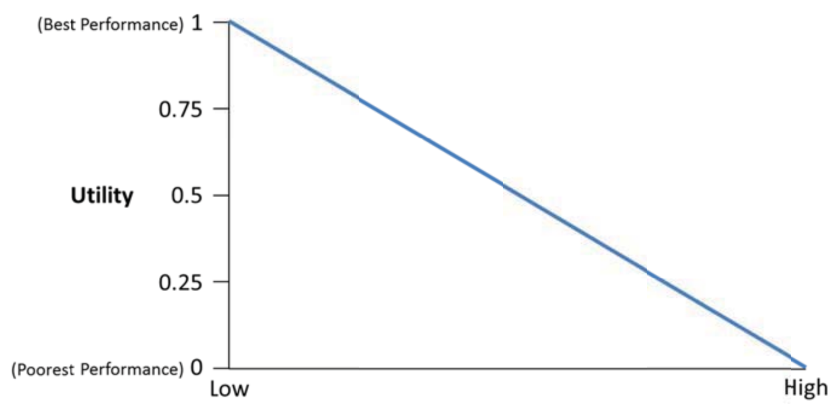


Description: This sub-factor measures the total lane closure peak period delay to drivers on the Queensway during the construction period. It includes the total peak period delay forecast for the duration of construction of the alternative. The delay sub-factor, although measuring vehicles on the Queensway, is also indicative of the delays for drivers diverted from the Queensway and operating on the municipal road system.
(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	Veh h	Utility Score
Alternative A2e Rapid Rehab/Existing Span	16,520	1
Alternative A5e Conventional Rehab/Existing Span	1,537,200	0.60
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	3,782,800	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	3,782,800	0

Mitigation: N/A

Highway Safety - Collision Potential

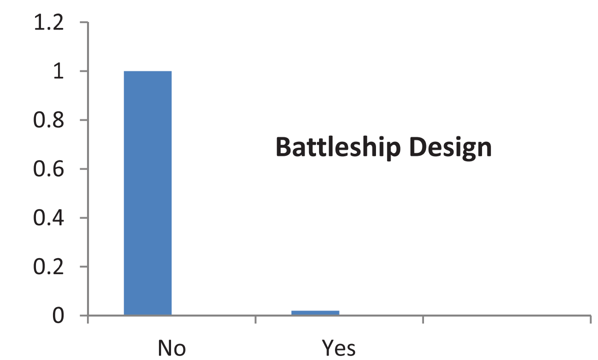


Description: This sub-factor measures the collision potential of the alternative by measuring the time duration that drivers will be required to transition through the construction zone.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	1
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0

Mitigation: N/A

Highway Safety – Design Consistency of Traffic Staging Design

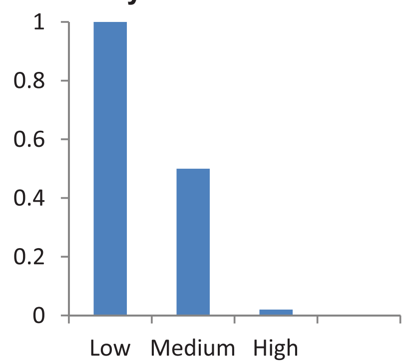


Description: This sub-factor measures the collision potential of the highway staging design. Those alternatives including a non-conventional battleship design (i.e. yes) are least preferred.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Yes	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Yes	0

Mitigation: Tow truck plan/incident plan.

Pedestrian – Delay and Out-of-way Travel

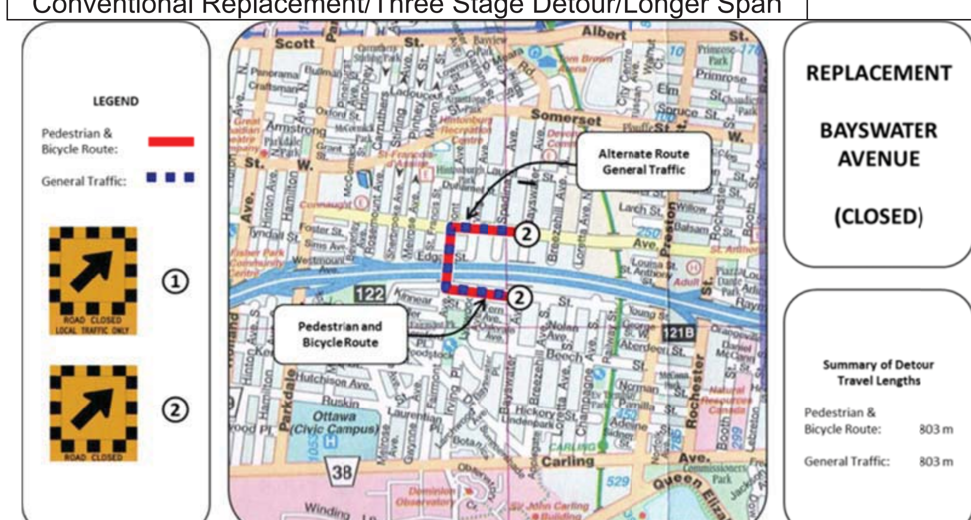


Description: This sub-factor measures the length and duration of pedestrian out-of-way travel on the side streets while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily sidewalk closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period. Pedestrians will be signed to use the opposite sidewalk from the adjacent signalized intersections.

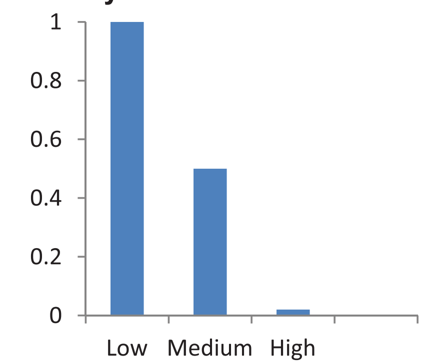
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure, pedestrians will be directed to Fairmont Avenue for a maximum out-of-way travel of 0.8 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0



Mitigation: Advance signage for pedestrians to travel to the alternate sidewalk route as well as pre-event information to the property owners.

Bicycle – Delay and Out-of-Way Travel

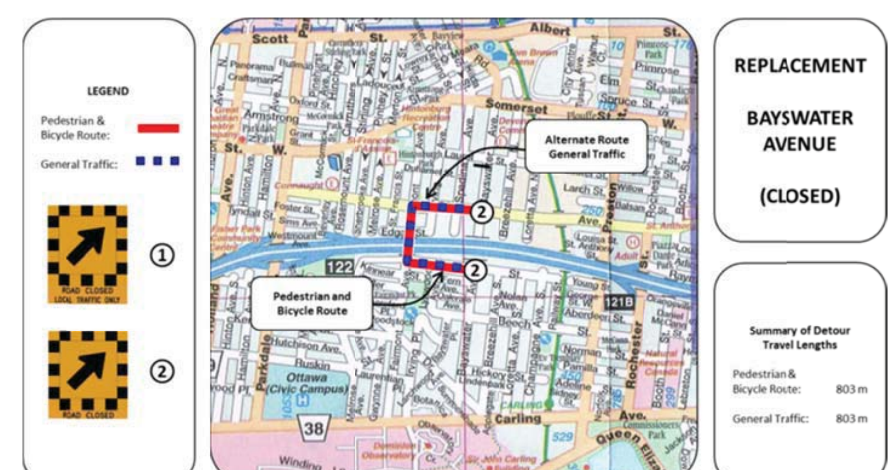


Description: This sub-factor measures the length and duration of bicycle delay and out-of-way travel on the side street while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily lane and bike lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

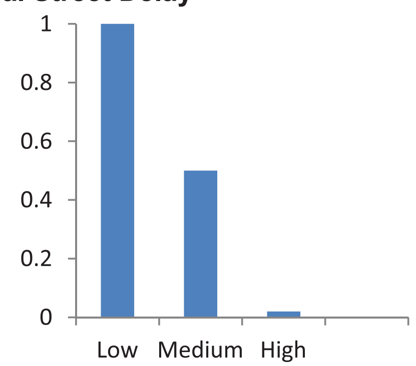
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure, bicyclists will be directed to Fairmont Avenue, for a maximum out-of-way travel of 0.8 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0



Mitigation: Advance signage for cyclists to choose an alternate route as well as pre-event information to the Regional cycling clubs.

General Traffic Municipal Street Delay

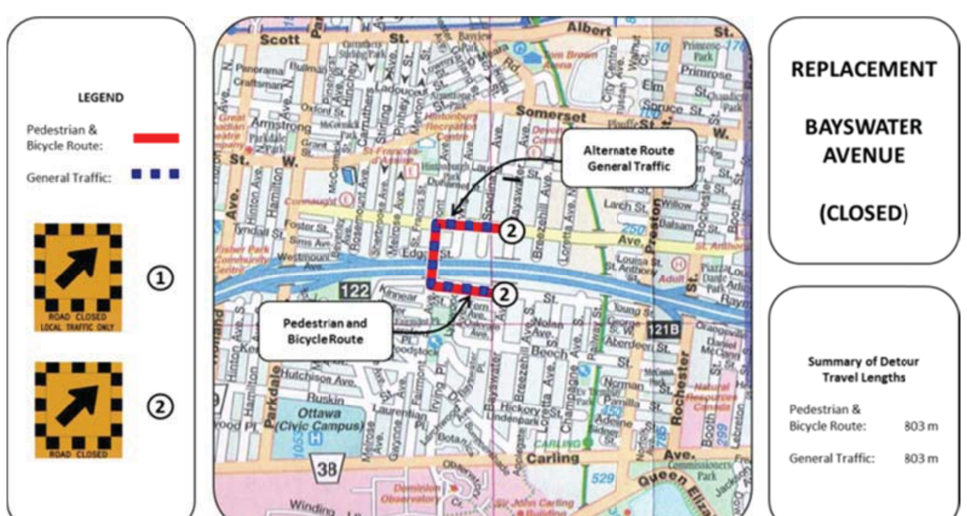


Description: This sub-factor measures the delay during construction that will affect general traffic operations. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure vehicles will be directed to Fairmont Avenue for a maximum out-of-way travel of 0.8 km. This sub-factor measures a one-way trip only.

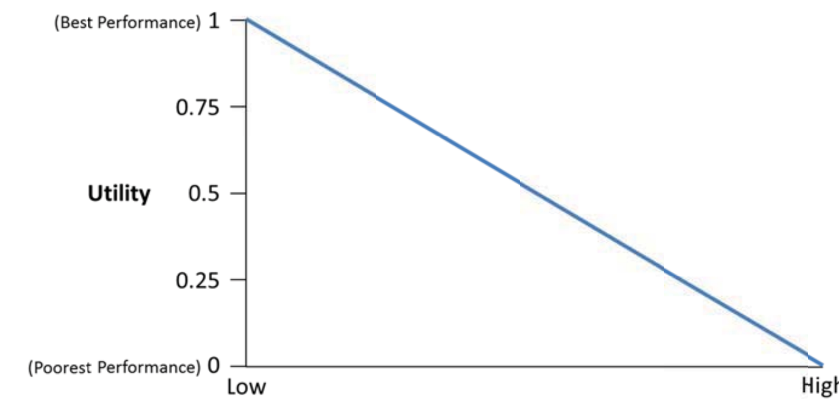
Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0



Mitigation: The use of advisory signage and potential use of variable message signage can be used to advise drivers before reaching the construction site.

Factor Group: Social and Cultural Environment

Impact to Emergency Response

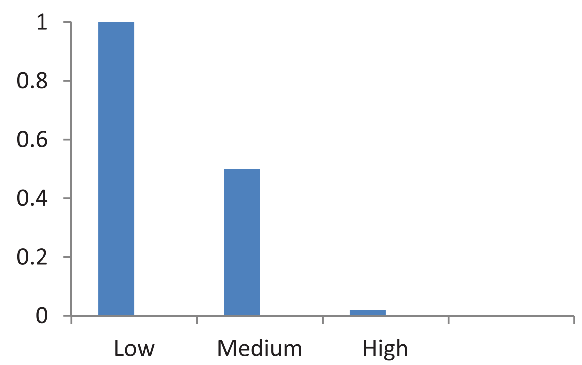


Description: This sub-factor measures the duration of Queensway closure that will affect emergency response service (police, ambulance and fire). Alternatives that reduce the length of time that there are lane closures on the Queensway are preferred.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	1
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0.0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0.0

Mitigation: Advanced warning of lane closures or detour routes.

Potentially Contaminated Property



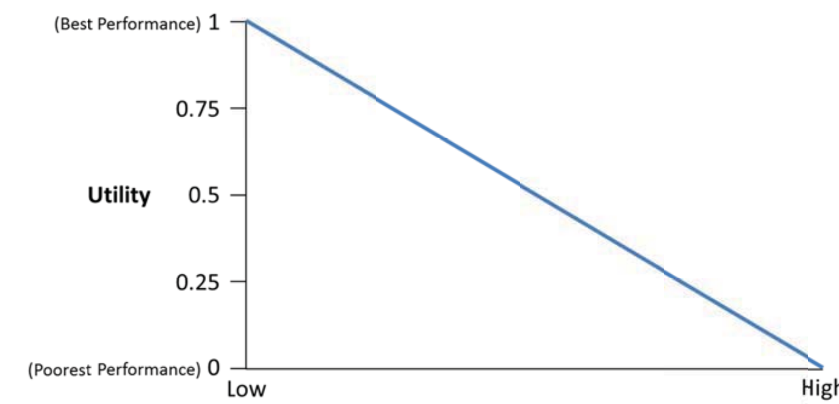
Description: This sub-factor measures whether there is potential to encounter potentially contaminated property during the construction of an alternative. Alternatives that minimize excavation are preferred. RBR staging sites have high potential (i.e. large footprint of excavation) to impact potentially contaminated property. Any alternative excavating in place has low potential to impact potentially contaminated property. The rehabilitation options have no potential to impact potentially contaminated property due to the small footprint of works.

Alternatives	Low/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0

Mitigation: Avoidance.

Factor Group: Cost

Capital Cost

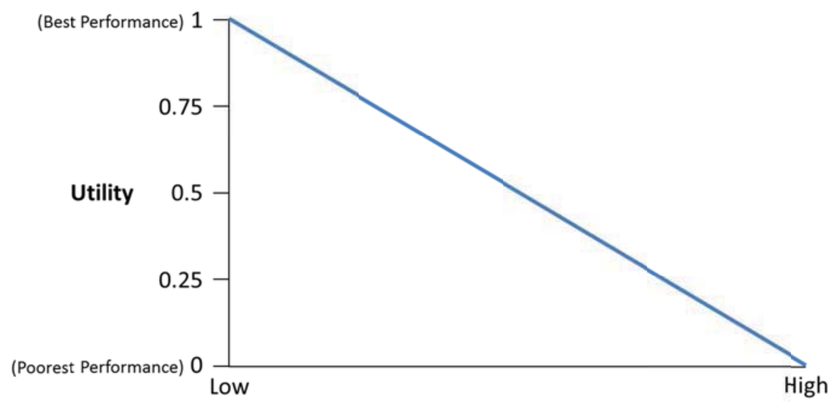


Description: This sub-factor measures the difference in initial capital cost of the alternative (bridge, traffic staging, staging area, and property costs). Those alternatives with the lowest capital cost are preferred. These costs do not include Engineering Costs.

Alternatives	$M		Utility Score
Alternative A2e Rapid Rehab/Existing Span	Structure 1.01 Staging 0.6 Property 0	1.61	1
Alternative A5e Conventional Rehab/Existing Span	Structure 1.01 Staging 1.25 Property 0	2.26	0.73
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Structure 2.24 Staging 1.2 Property 0	3.44	0.27
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Structure 2.84 Staging 1.2 Property 0	4.04	0

Mitigation: N/A

Future Life Cycle Cost



Description: This sub-factor measures the difference in future life cycle costs (maintenance, operating costs and long term replacement and rehabilitation in the 40 year planning horizon). Those alternatives with the lowest long term life cycle cost are preferred. A 5% discount rate was used.

Alternatives	$M	Utility Score
Alternative A2e Rapid Rehab/Existing Span	3.66	1
Alternative A5e Conventional Rehab/Existing Span	4.31	0.35
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	3.99	0.67
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	4.66	0

Mitigation: N/A

VERSION: November 11, 2014

APPENDIX E

SUB-FACTOR UTILITY FUNCTION DEFINITIONS AND MEASUREMENTS FOR SHORT LISTED EVALUATION CRITERIA

BAYSWATER AVENUE WESTBOUND BRIDGE

Preliminary Design and Environmental Assessment Study for the Rehabilitation/Replacement of Ottawa Queensway Mid-town Bridges from Holland Avenue to O'Connor Street
UTILITY FUNCTION DEFINITIONS AND MEASUREMENTS FOR SHORT LISTED EVALUATION CRITERIA
BAYSWATER AVENUE WESTBOUND BRIDGE
GWP #4075-11-00

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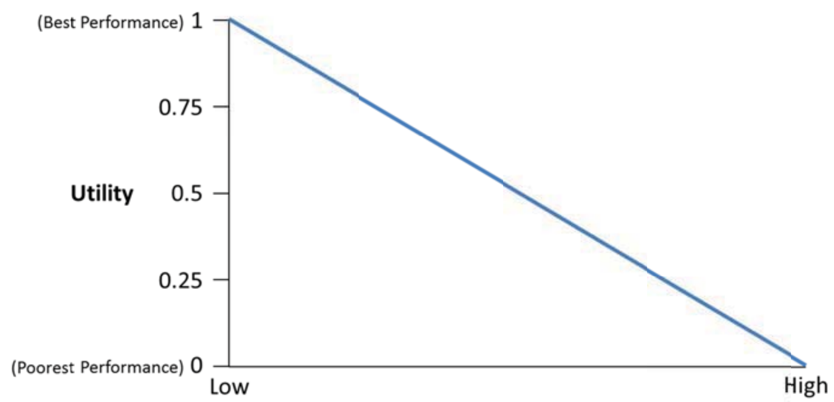
Potentially Contaminated Property 9
FACTOR GROUP: COST **10**
Capital Cost 10
Future Life Cycle Cost 11

There are no EB or WB Staging Area sites; therefore no RBR alternatives are carried forward.

Factor Group: Transportation

Maximum Peak Queue Length on Queensway



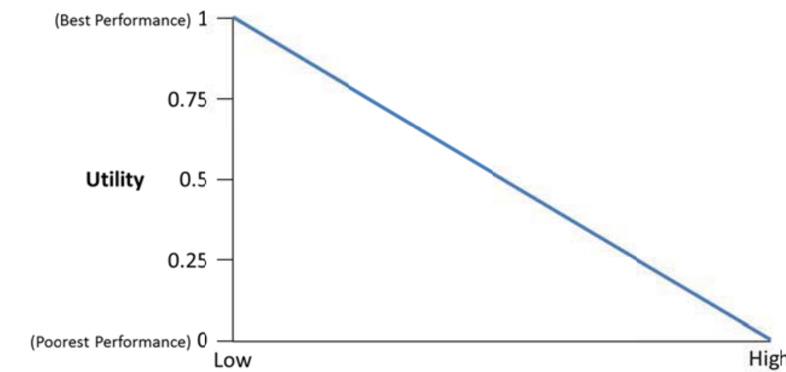
Description: This sub-factor measures the forecast queue length effect in the peak hour including measures to divert trips and induce transportation demand management during construction. The sub-factor measures the queue duration (days) and the forecast queue length (after the use of mitigation). This sub-factor is indicative of highway performance and safety, and is related to: effects on ramp operations, rear end collisions influenced by stop and go traffic, poor weaving conditions and traffic congestion.

(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	**km days (peak hour)**	**Utility Score**
Alternative A2e Rapid Rehab/Existing Span	41	1
Alternative A5e Conventional Rehab/Existing Span	780	0.59
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	1920	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	1920	0

Mitigation: The use of advance advertising and advising drivers of the scheduled lane closures through PVMS placement in advance of construction will be measures that will reduce demand by: changing the time of travel of commuters, use of transit as an alternate mode of travel, or by inducing diversion to the municipal road system as an alternate route.

Delays

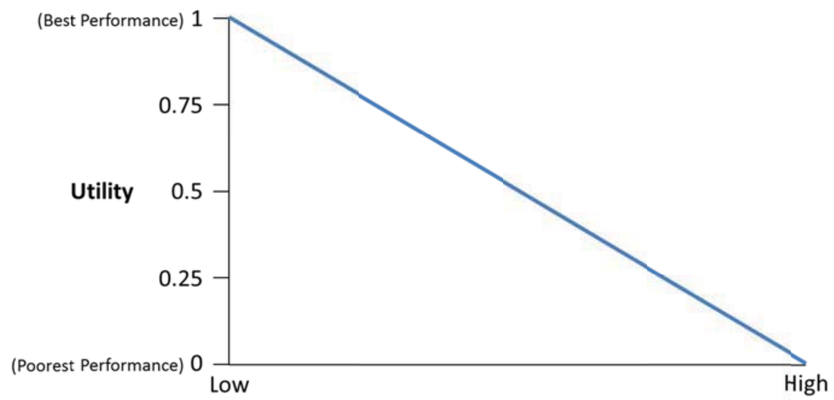


Description: This sub-factor measures the total lane closure peak period delay to drivers on the Queensway during the construction period. It includes the total peak period delay forecast for the duration of construction of the alternative. The delay sub-factor, although measuring vehicles on the Queensway, is also indicative of the delays for drivers diverted from the Queensway and operating on the municipal road system.
(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	**Veh h**	**Utility Score**
Alternative A2e Rapid Rehab/Existing Span	16,520	1
Alternative A5e Conventional Rehab/Existing Span	1,537,200	0.60
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	3,782,800	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	3,782,800	0

Mitigation: N/A

Highway Safety - Collision Potential

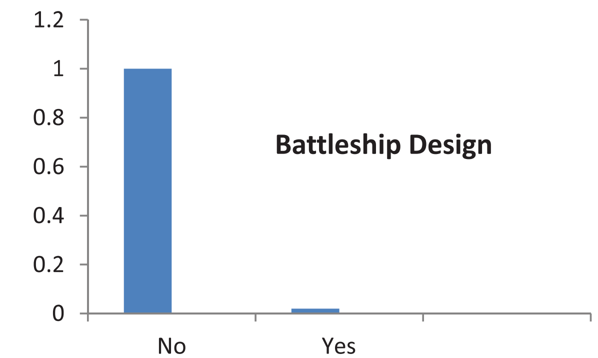


Description: This sub-factor measures the collision potential of the alternative by measuring the time duration that drivers will be required to transition through the construction zone.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	1
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0

Mitigation: N/A

Highway Safety – Design Consistency of Traffic Staging Design

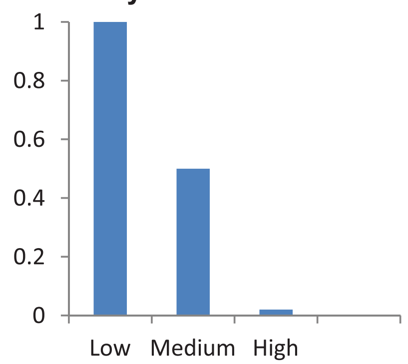


Description: This sub-factor measures the collision potential of the highway staging design. Those alternatives including a non-conventional battleship design (i.e. yes) are least preferred.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Yes	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Yes	0

Mitigation: Tow truck plan/incident plan.

Pedestrian – Delay and Out-of-way Travel

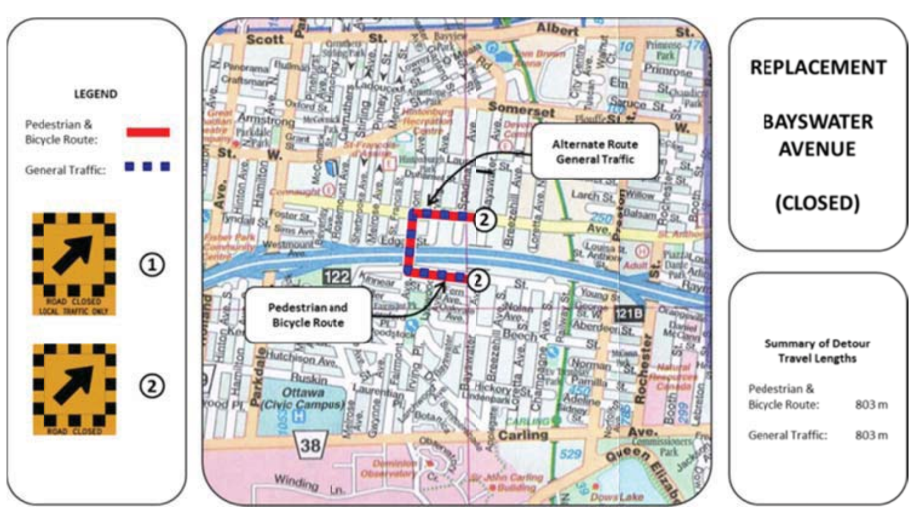


Description: This sub-factor measures the length and duration of pedestrian out-of-way travel on the side streets while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily sidewalk closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period. Pedestrians will be signed to use the opposite sidewalk from the adjacent signalized intersections.

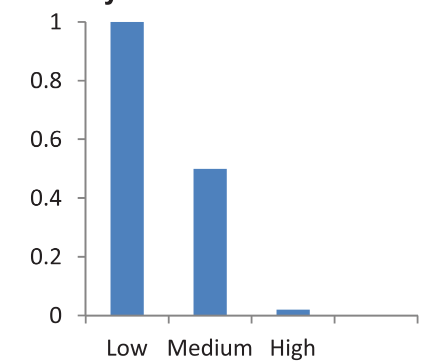
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure pedestrians will be directed to Fairmont Avenue, for a maximum out-of-way travel of 0.8 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0



Mitigation: Advance signage for pedestrians to travel to the alternate sidewalk route as well as pre-event information to the property owners.

Bicycle – Delay and Out-of-Way Travel

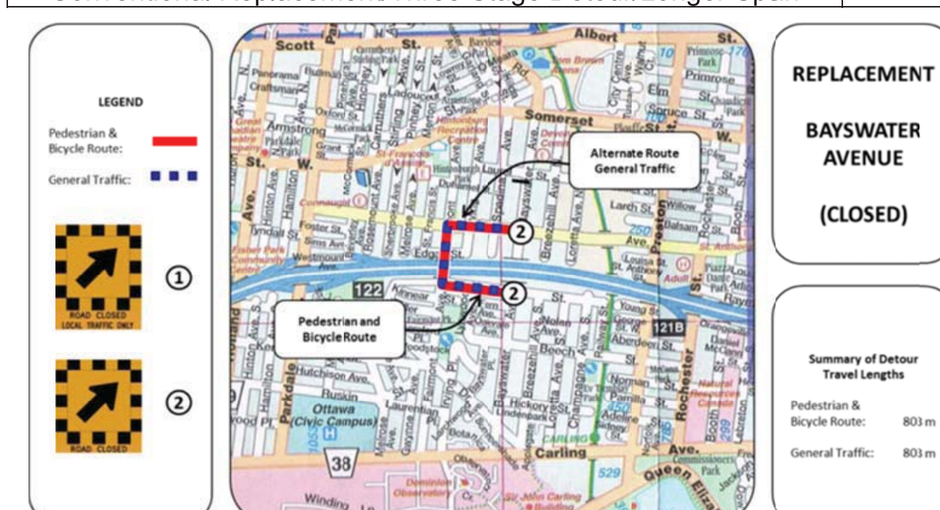


Description: This sub-factor measures the length and duration of bicycle delay and out-of-way travel on the side street while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily lane and bike lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

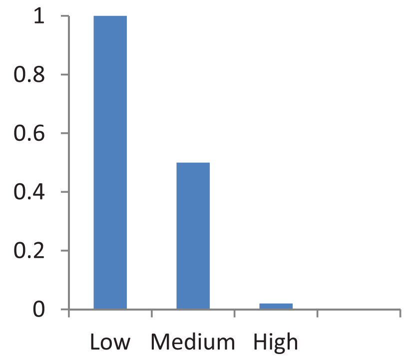
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure, bicyclists will be directed to Fairmont Avenue, for a maximum out-of-way travel of 0.8 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0



Mitigation: Advance signage for cyclists to choose an alternate route as well as pre-event information to the Regional cycling clubs.

General Traffic Municipal Street Delay



Description: This sub-factor measures the delay during construction that will affect general traffic operations. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period

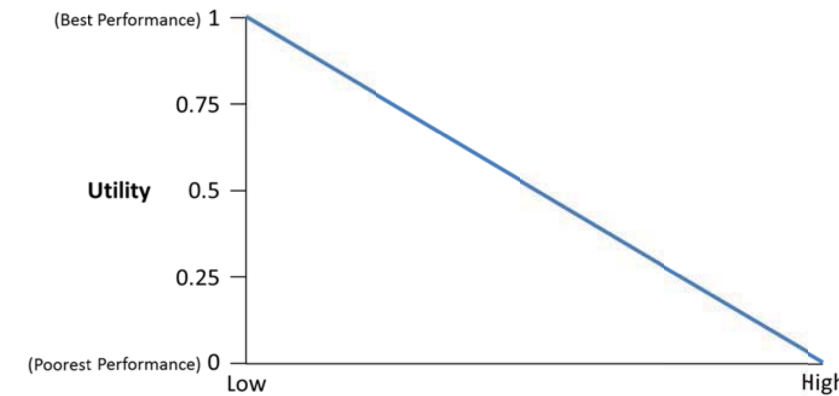
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure vehicles will be directed to Fairmont Avenue, for a maximum out-of-way travel of 0.8 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0

Mitigation: The use of advisory signage and potential use of variable message signage can be used to advise drivers before reaching the construction site.

Factor Group: Social and Cultural Environment

Impact to Emergency Response

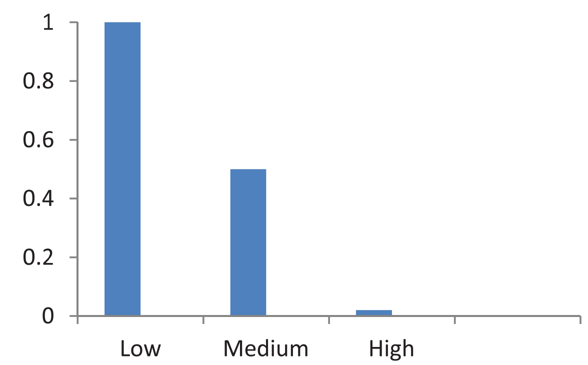


Description: This sub-factor measures the duration of Queensway closure that will affect emergency response service (police, ambulance and fire). Alternatives that reduce the length of time that there are lane closures on the Queensway are preferred.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	1
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0.0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0.0

Mitigation: Advanced warning of lane closures or detour routes.

Potentially Contaminated Property



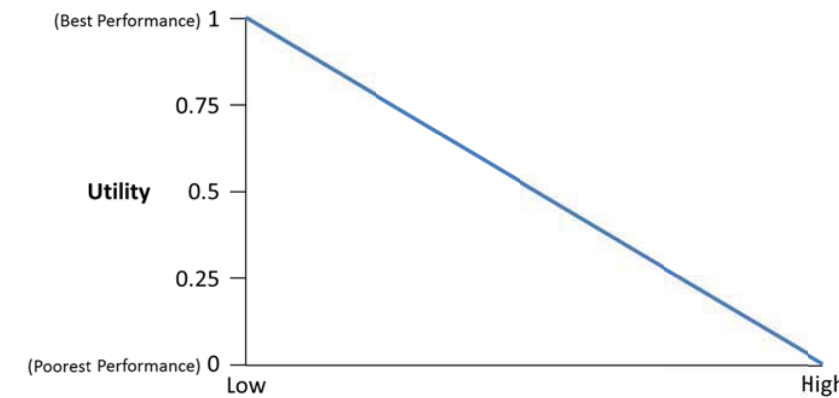
Description: This sub-factor measures whether there is potential to encounter potentially contaminated property during the construction of an alternative. Alternatives that minimize excavation are preferred. RBR staging sites have high potential (i.e. large footprint of excavation) to impact potentially contaminated property. Any alternative excavating in place has low potential to impact potentially contaminated property. The rehabilitation options have no potential to impact potentially contaminated property due to the small footprint of works.

Alternatives	Low/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0

Mitigation: Avoidance.

Factor Group: Cost

Capital Cost

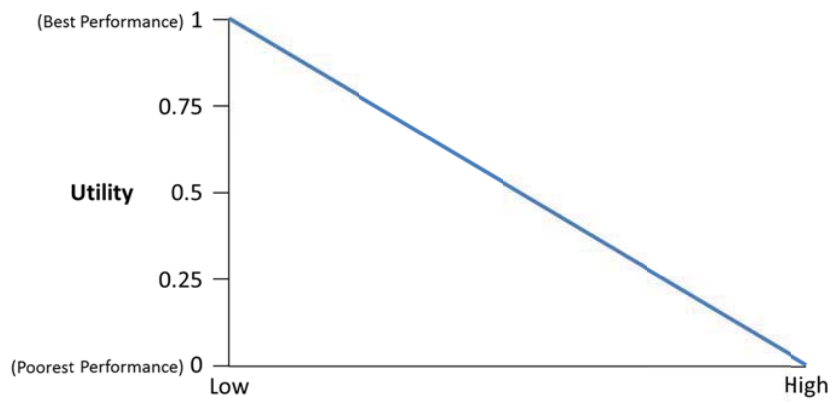


Description: This sub-factor measures the difference in initial capital cost of the alternative (bridge, traffic staging, staging area, and property costs). Those alternatives with the lowest capital cost are preferred. These costs do not include Engineering Costs.

Alternatives	$M		Utility Score
Alternative A2e Rapid Rehab/Existing Span	Structure 1.01 Staging 0.6 Property 0	1.61	1
Alternative A5e Conventional Rehab/Existing Span	Structure 1.01 Staging 1.25 Property 0	2.26	0.73
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Structure 2.24 Staging 1.2 Property 0	3.44	0.27
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Structure 2.84 Staging 1.2 Property 0	4.04	0

Mitigation: N/A

Future Life Cycle Cost



Description: This sub-factor measures the difference in future life cycle costs (maintenance, operating costs and long term replacement and rehabilitation in the 40 year planning horizon). Those alternatives with the lowest long term life cycle cost are preferred. A 5% discount rate was used.

Alternatives	$M	Utility Score
Alternative A2e Rapid Rehab/Existing Span	3.66	1
Alternative A5e Conventional Rehab/Existing Span	4.31	0.35
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	3.97	0.69
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	4.66	0

Mitigation: N/A

VERSION: December 11, 2014

APPENDIX E

SUB-FACTOR UTILITY FUNCTION DEFINITIONS AND MEASUREMENTS FOR SHORT LISTED EVALUATION CRITERIA

CPR/O-TRAIN

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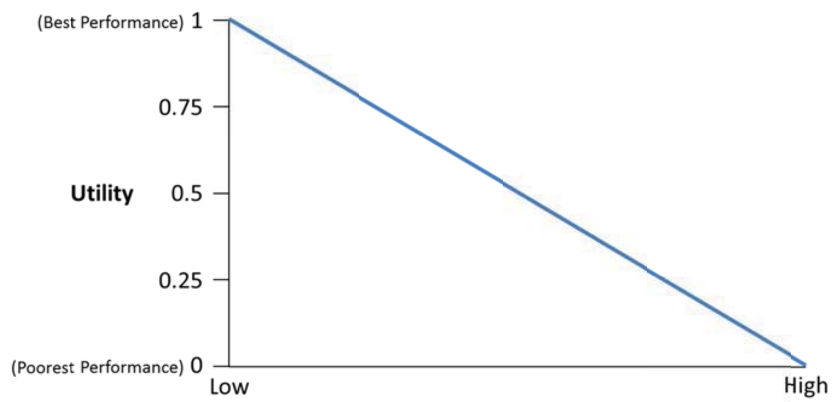
Factor Group: Transportation

Maximum Peak Queue Length on Queensway



Description: This sub-factor measures the forecast queue length effect in the peak hour including measures to divert trips and induce transportation demand management during construction. The sub-factor measures the queue duration (days) and the forecast queue length (after the use of mitigation). This sub-factor is indicative of highway performance and safety, and is related to effects on ramp operations, rear end collisions influenced by stop and go traffic, poor weaving conditions and traffic congestion.

(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Rigid Frame: Legend: e= Existing Path Alignment (Box Culvert) r = Relocate Path Alignment

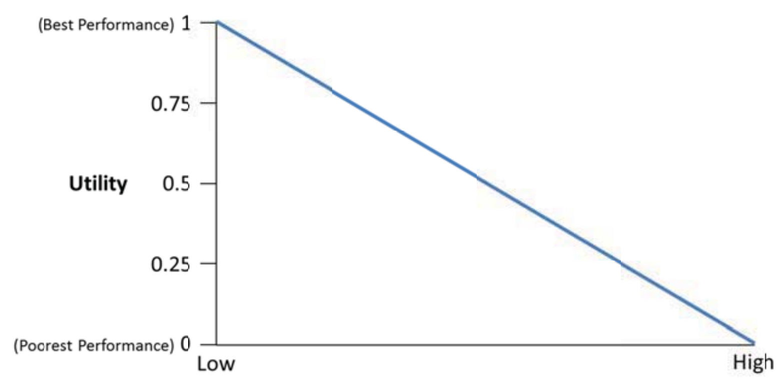
Alternatives	km days (peak hour)	Utility Score
Alt A2e / Alt A2r Single Span/Conventional Removal	281	0.61
Alt A5e / Alt A5r Single Span/Three Stage Removal	720	0
Alt B2e / Alt B2r Two Span/Conventional Removal	281	0.61
Alt B5e / Alt B5r Two Span/Three Stage Removal	720	0
Alt C2e Two Span/Conventional Removal/Existing Path Alignment (in end span)	281	0.61
Alt C5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	720	0
Alt D2e Three Span/Conventional Removal/Existing Path Alignment (in end span)	281	0.61
Alt D5e Three Span/Three Stage Removal/Existing Path Alignment (in end span)	720	0
Alt E2e / E2r Single Span/Conventional Removal	281	0.61
Alt E5e / E5r Single Span/Three Stage Removal	720	0
Alt F2e Two Span/Conventional Removal/Existing Path Alignment (in end span)	281	0.61
Alt F5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	720	0
Alt G2e Two Storey Single Span/Conv Removal/ (pedestrians on second storey)	281	0.61
Alt G5e Two Storey Single Span/Three Stage Removal/ (pedestrians on second storey)	720	0

Simply Supported - Jack & Slide:

Alternatives	Km days (peak hour)	Utility Score
Alt H6e Single Span/Full Closure/Existing Path Alignment	285	0.61
Alt H7e Single Span/2 lane detour/Existing Path Alignment	349	0.5
Alt I6e Three Span/Full Closure/Existing Alignment	6	1
Alt I7e Three Span/Two Lane Detour/Existing Alignment	349	0.5

Mitigation: The use of advance advertising and advising drivers of the scheduled lane closures through PVMS placement in advance of construction will be measures that will reduce demand by changing the time of travel of commuters or use of transit as an alternate mode of travel or by inducing diversion to the municipal road system as an alternate route.

Delays



Description: This sub-factor measures the total lane closure peak period delay to drivers on the Queensway during the construction period. It includes the total peak period delay forecast for the duration of construction of the alternative. The delay sub-factor, although measuring vehicles on the Queensway, is also indicative of the delays for drivers diverted from the Queensway and operating on the municipal road system.
(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum June 16, 2014)

Rigid Frame: Legend: e= Existing Path Alignment (Box Culvert) r = Relocate Path Alignment

Alternatives	Measure (Veh h)	Utility Score
Alt A2e / Alt A2r Single Span/Conventional Removal	253,200	0.82
Alt A5e / Alt A5r Single Span/Three Stage Removal	1,419,600	0
Alt B2e / Alt B2r Two Span/Conventional Removal	253,200	0.82
Alt B5e / Alt B5r Two Span/Three Stage Removal	1,419,600	0
Alt C2e Two Span/Conventional Removal/Existing Path Alignment (in end span)	253,200	0.82
Alt C5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	1,419,600	0
Alt D2e Three Span/Conventional Removal/Existing Path Alignment (in end span)	253,200	0.82
Alt D5e Three Span/Three Stage Removal/Existing Path Alignment (in end span)	1,419,600	0
Alt E2e / E2r Single Span/Conventional Removal	253,200	0.82
Alt E5e / E5r Single Span/Three Stage Removal	1,419,600	0
Alt F2e Two Span/Conventional Removal/Existing Path Alignment (in end span)	253,200	0.82

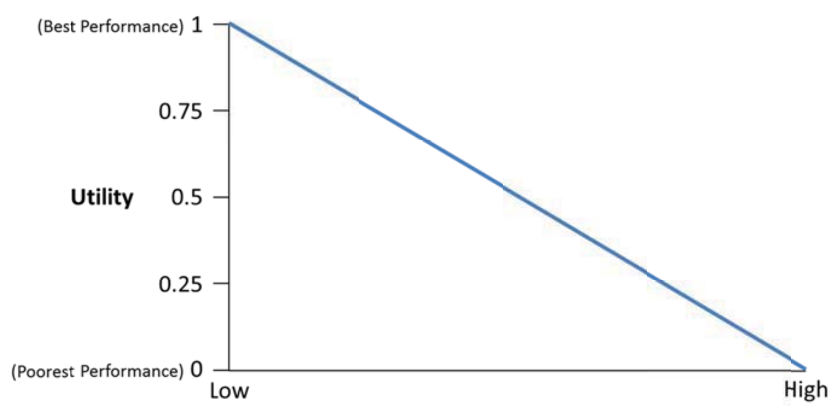
Alt F5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	1,419,600	0
Alt G2e Two Storey Single Span/Conv Removal/ (pedestrians on second storey)	253,200	0.82
Alt G5e Two Storey Single Span/Three Stage Removal/ (pedestrians on second storey)	1,419,600	0

Simply Supported - Jack & Slide:

Alternatives	Measure (Veh h)	Utility Score
Alt H6e Single Span/Full Closure/Existing Path Alignment	3120	1
Alt H7e Single Span/2 lane detour/Existing Path Alignment	945,200	0.33
Alt I6e Three Span/Full Closure/Existing Alignment	1560	1
Alt I7e Three Span/Two Lane Detour/Existing Alignment	945,200	0.33

Mitigation: N/A

Ramp Closures



Description: This sub-factor measures the impact to community access (business and residential) by quantifying the volume of peak hour ramp trips that will be removed from entering or exiting the Queensway. The sub-factor measures the peak hour ramp volume for each stage of the highway staging plan and quantifies the duration of the closure.
Data from Traffic Sub-factors Utility Functions Technical Memorandum June 17, 2014

Rigid Frame: Legend: e= Existing Path Alignment (Box Culvert) r = Relocate Path Alignment

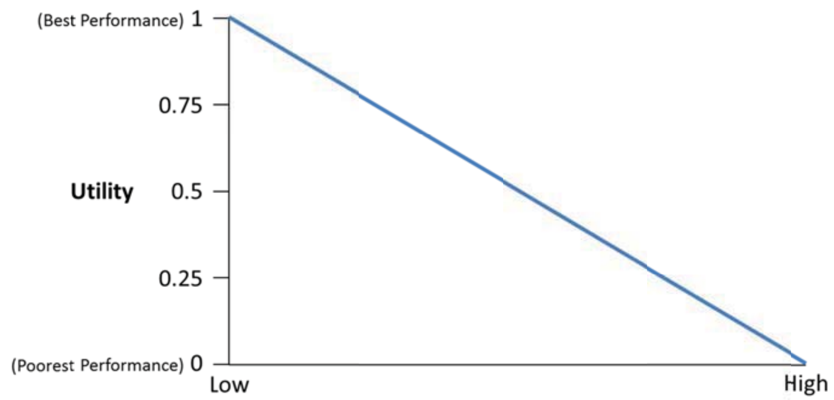
Alternatives	veh (peak hour)	Utility Score
Alt A2e / Alt A2r Single Span/Conventional Removal	61,409	0.53
Alt A5e / Alt A5r Single Span/Three Stage Removal	110,228	0
Alt B2e / Alt B2r Two Span/Conventional Removal	61,409	0.53
Alt B5e / Alt B5r Two Span/Three Stage Removal	110,228	0
Alt C2e Two Span/Conventional Removal/Existing Path Alignment (in end span)	61,409	0.53
Alt C5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	110,228	0
Alt D2e Three Span/Conventional Removal/Existing Path Alignment (in end span)	61,409	0.53
Alt D5e Three Span/Three Stage Removal/Existing Path Alignment (in end span)	110,228	0
Alt E2e / E2r Single Span/Conventional Removal	61,409	0.53
Alt E5e / E5r Single Span/Three Stage Removal	110,228	0
Alt F2e Two Span/Conventional Removal/Existing Path Alignment (in end span)	61,409	0.53
Alt F5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	110,228	0
Alt G2e Two Storey Single Span/Conv Removal/ (pedestrians on second storey)	61,409	0.53
Alt G5e Two Storey Single Span/Three Stage Removal/ (pedestrians on second storey)	110,228	0

Simply Supported - Jack & Slide:

Alternatives	Veh h	Utility Score
Alt H6e Single Span/Full Closure/Existing Path Alignment	17, 961	1
Alt H7e Single Span/2 lane detour/Existing Path Alignment	107,928	0.02
Alt I6e Three Span/Full Closure/Existing Alignment	17, 961	1
Alt I7e Three Span/Two Lane Detour/Existing Alignment	107,928	0.02

Mitigation: N/A

Highway Safety - Collision Potential



Description: This sub-factor measures the night-time collision potential of the alternative by measuring the length of time that drivers will be required to transition through the construction zone.

Data from Traffic Sub-factors Utility Functions Technical Memorandum June 17, 2014

Rigid Frame: Legend: e= Existing Path Alignment (Box Culvert) r = Relocate Path Alignment

Alternatives	Days	Utility Score
Alt A2e / Alt A2r Single Span/Conventional Removal	34/32	0.31/0.36
Alt A5e / Alt A5r Single Span/Three Stage Removal	48	0
Alt B2e / Alt B2r Two Span/Conventional Removal	34/32	0.31/0.36
Alt B5e / Alt B5r Two Span/Three Stage Removal	48	0
Alt C2e Two Span/Conventional Removal/Existing Path Alignment (in end span)	34/32	0.31/0.36
Alt C5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	48	0
Alt D2e Three Span/Conventional Removal/Existing Path Alignment (in end span)	34/32	0.31/0.36
Alt D5e Three Span/Three Stage Removal/Existing Path Alignment (in end span)	48	0
Alt E2e / E2r Single Span/Conventional Removal	34/32	0.31/0.36
Alt E5e / E5r Single Span/Three Stage Removal	48	0
Alt F2e	34/32	0.31/0.36

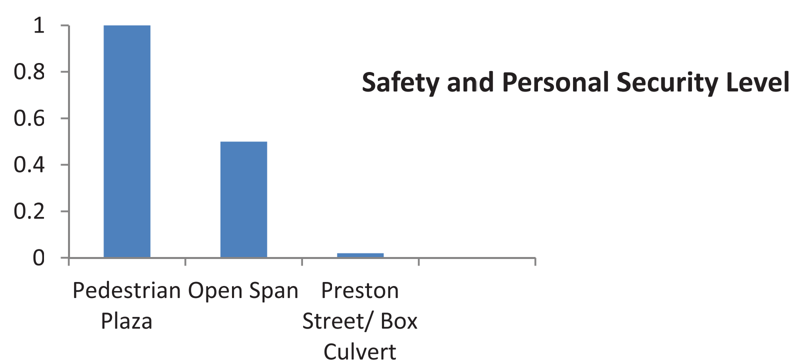
Two Span/Conventional Removal/Existing Path Alignment (in end span)		
Alt F5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	48	0
Alt G2e Two Storey Single Span/Conv Removal/ (pedestrians on second storey)	34/32	0.31/0.36
Alt G5e Two Storey Single Span/Three Stage Removal/ (pedestrians on second storey)	48	0

Simply Supported - Jack & Slide:

Alternatives	Days	Utility Score
Alt H6e Single Span/Full Closure/Existing Path Alignment	6	1
Alt H7e Single Span/2 lane detour/Existing Path Alignment	34	0.31
Alt I6e Three Span/Full Closure/Existing Alignment	6	1
Alt I7e Three Span/Two Lane Detour/Existing Alignment	34	0.31

Mitigation: N/A

Multi-use Pathway - Safety and Security of All Users



Description: This sub-factor measures the safety and personal security or alternatives. Those alternatives with either a small opening size of box culvert or a relocation to Preston Street are considered low. Those alternatives with an open span are considered medium. The option with a pedestrian plaza (Alternative G, 16.5 m or greater opening) is rated high (1.0).

Rigid Frame: Legend: e= Existing Path Alignment (Box Culvert) r = Relocate Path Alignment

Alternatives	High/Med/Low	Utility Score
Alt A2e / Alt A2r Single Span/Conventional Removal	Low	0
Alt A5e / Alt A5r Single Span/Three Stage Removal	Low	0
Alt B2e / Alt B2r Two Span/Conventional Removal	Low	0
Alt B5e / Alt B5r Two Span/Three Stage Removal	Low	0
Alt C2e Two Span/Conventional Removal/Existing Path Alignment (in end span)	Medium	0.5
Alt C5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	Medium	0.5
Alt D2e Three Span/Conventional Removal/Existing Path Alignment (in end span)	Medium	0.5
Alt D5e Three Span/Three Stage Removal/Existing Path Alignment (in end span)	Medium	0.5
Alt E2e / E2r Single Span/Conventional Removal	Low	0
Alt E5e / E5r Single Span/Three Stage Removal	Low	0
Alt F2e Two Span/Conventional Removal/Existing Path	Medium	0.5

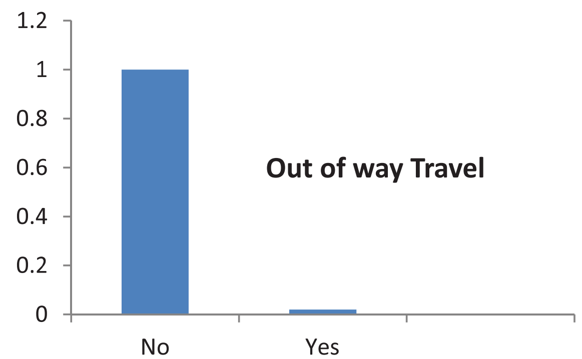
Alignment (in end span)		
Alt F5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	Medium	0.5
Alt G2e Two Storey Single Span/Conv Removal/ (pedestrians on second storey)	High	1
Alt G5e Two Storey Single Span/Three Stage Removal/ (pedestrians on second storey)	High	1

Simply Supported - Jack & Slide:

Alternatives	High/Med/Low	Utility Score
Alt H6e Single Span/Full Closure/Existing Path Alignment	High	1
Alt H7e Single Span/2 lane detour/Existing Path Alignment	High	1
Alt I6e Three Span/Full Closure/Existing Alignment	High	1
Alt I7e Three Span/Two Lane Detour/Existing Alignment	High	1

Mitigation: Increased lighting.

Multi-use Pathway Users – Out of Way Travel



Description: This sub-factor measures the length of out-of-way travel for active modes of transportation along the multi-use pathway. Alternatives which minimize the out-of-way travel are preferred. Alternatives that maintain the alignment parallel to the CPR/O-Train reduce walking distance by 290 m and avoid pedestrian conflicts on Preston Street and need for way finding signage. Alternatives which have no out-of-way travel are preferred.

Rigid Frame: Legend: e= Existing Path Alignment (Box Culvert) r = Relocate Path Alignment

Alternatives	Yes/No	Utility Score
Alt A2e / Alt A2r Single Span/Conventional Removal	No/Yes	1/0
Alt A5e / Alt A5r Single Span/Three Stage Removal	No/Yes	1/0
Alt B2e / Alt B2r Two Span/Conventional Removal	No/Yes	1/0
Alt B5e / Alt B5r Two Span/Three Stage Removal	No/Yes	1/0
Alt C2e Two Span/Conventional Removal/Existing Path Alignment (in end span)	No	1
Alt C5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	No	1
Alt D2e Three Span/Conventional Removal/Existing Path Alignment (in end span)	No	1
Alt D5e Three Span/Three Stage Removal/Existing Path Alignment (in end span)	No	1
Alt E2e / E2r Single Span/Conventional Removal	No/Yes	1/0
Alt E5e / E5r Single Span/Three Stage Removal	No/Yes	1/0
Alt F2e	No	1

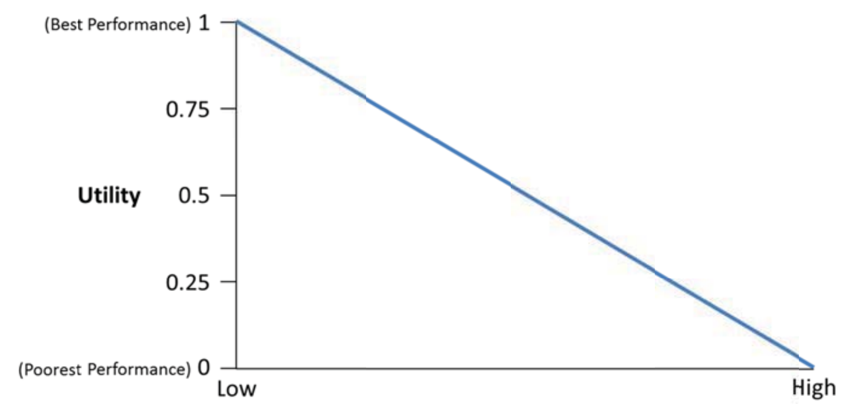
Two Span/Conventional Removal/Existing Path Alignment (in end span)		
Alt F5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	No	1
Alt G2e Two Storey Single Span/Conv Removal/ (pedestrians on second storey)	No	1
Alt G5e Two Storey Single Span/Three Stage Removal/ (pedestrians on second storey)	No	1

Simply Supported - Jack & Slide:

Alternatives	Yes/No	Utility Score
Alt H6e Single Span/Full Closure/Existing Path Alignment	No	1
Alt H7e Single Span/2 lane detour/Existing Path Alignment	No	1
Alt I6e Three Span/Full Closure/Existing Alignment	No	1
Alt I7e Three Span/Two Lane Detour/Existing Alignment	No	1

Mitigation: N/A

Transit (O-Train) Closure



Description: This sub-factor measures the duration of the closure of the CPR/O-Train service to accommodate the jack-and-slide operation for the removal of the existing bridge and installation of a new bridge.

Rigid Frame: Legend: e= Existing Path Alignment (Box Culvert) r = Relocate Path Alignment

Alternatives	Duration (days)	Utility Score
Alt A2e / Alt A2r Single Span/Conventional Removal	0	1
Alt A5e / Alt A5r Single Span/Three Stage Removal	0	1
Alt B2e / Alt B2r Two Span/Conventional Removal	0	1
Alt B5e / Alt B5r Two Span/Three Stage Removal	0	1
Alt C2e Two Span/Conventional Removal/Existing Path Alignment (in end span)	0	1
Alt C5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	0	1
Alt D2e Three Span/Conventional Removal/Existing Path Alignment (in end span)	0	1
Alt D5e Three Span/Three Stage Removal/Existing Path Alignment (in end span)	0	1
Alt E2e / E2r Single Span/Conventional Removal	0	1
Alt E5e / E5r Single Span/Three Stage Removal	0	1
Alt F2e	0	1

Two Span/Conventional Removal/Existing Path Alignment (in end span)		
Alt F5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	0	1
Alt G2e Two Storey Single Span/Conv Removal/ (pedestrians on second storey)	0	1
Alt G5e Two Storey Single Span/Three Stage Removal/ (pedestrians on second storey)	0	1

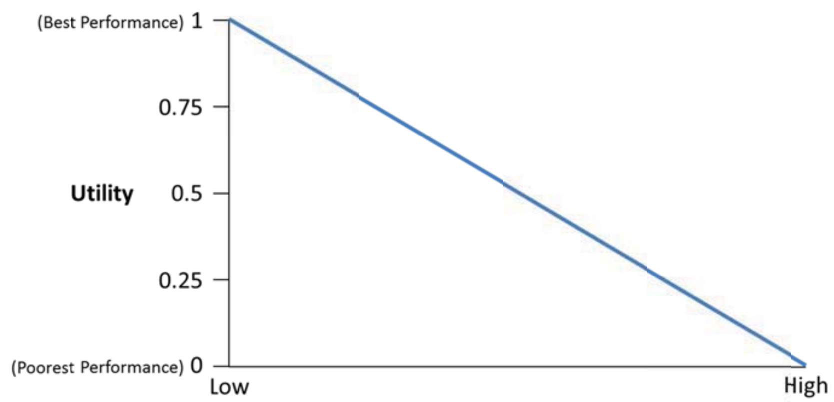
Simply Supported - Jack & Slide:

Alternatives	Duration	Utility Score
Alt H6e Single Span/Full Closure/Existing Path Alignment	6	0
Alt H7e Single Span/2 lane detour/Existing Path Alignment	6	0
Alt I6e Three Span/Full Closure/Existing Alignment	6	0
Alt I7e Three Span/Two Lane Detour/Existing Alignment	6	0

Mitigation: N/A

Factor Group: Social and Cultural Environment

Green Spaces Impacted



Description: This sub-factor measures the area of permanent lost community green space. Alternatives which maintain existing green space along the MUP are preferred. Impact is measured as relocated path (Yes = 0) and maintain path (No = 1).

Rigid Frame: Legend: e= Existing Path Alignment (Box Culvert) r = Relocate Path Alignment

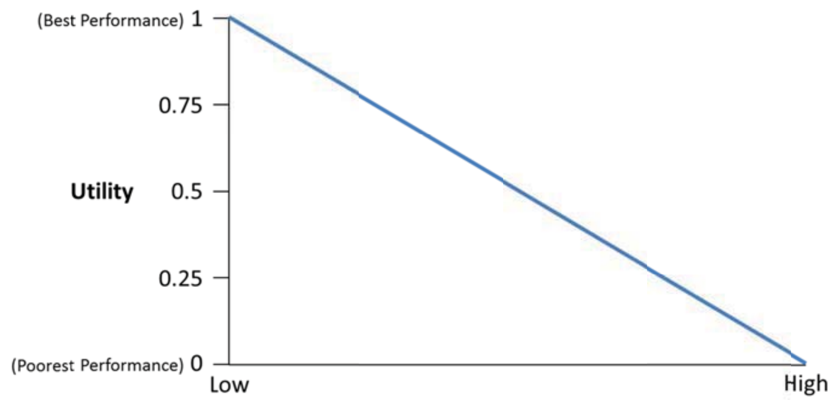
Alternatives	Yes/No	Utility Score
Alt A2e / Alt A2r Single Span/Conventional Removal	No/Yes	1/0
Alt A5e / Alt A5r Single Span/Three Stage Removal	No/Yes	1/0
Alt B2e / Alt B2r Two Span/Conventional Removal	No/Yes	1/0
Alt B5e / Alt B5r Two Span/Three Stage Removal	No/Yes	1/0
Alt C2e Two Span/Conventional Removal/Existing Path Alignment (in end span)	No	1
Alt C5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	No	1
Alt D2e Three Span/Conventional Removal/Existing Path Alignment (in end span)	No	1
Alt D5e Three Span/Three Stage Removal/Existing Path Alignment (in end span)	No	1
Alt E2e / E2r Single Span/Conventional Removal	No/Yes	1/0
Alt E5e / E5r Single Span/Three Stage Removal	No/Yes	1/0
Alt F2e Two Span/Conventional Removal/Existing Path Alignment (in end span)	No	1
Alt F5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	No	1
Alt G2e Two Storey Single Span/Conv Removal/ (pedestrians on second storey)	No	1
Alt G5e Two Storey Single Span/Three Stage Removal/ (pedestrians on second storey)	No	1

Simply Supported - Jack & Slide:

Alternatives	Yes/No	Utility Score
Alt H6e Single Span/Full Closure/Existing Path Alignment	No	1
Alt H7e Single Span/2 lane detour/Existing Path Alignment	No	1
Alt I6e Three Span/Full Closure/Existing Alignment	No	1
Alt I7e Three Span/Two Lane Detour/Existing Alignment	No	1

Mitigation: N/A

Emergency Response



Description: This sub-factor measures the effect to emergency response providers (ambulance, fire and police) who will be delayed when using the Queensway. This is measured in number of days of partial or full closure of the Queensway. Alternatives reducing the length of time there are lane closures on the Queensway are preferred.

Rigid Frame: Legend: e= Existing Path Alignment (Box Culvert) r = Relocate Path Alignment

Alternatives	Days	Utility Score
Alt A2e / Alt A2r Single Span/Conventional Removal	68	0.3
Alt A5e / Alt A5r Single Span/Three Stage Removal	96	0
Alt B2e / Alt B2r Two Span/Conventional Removal	68	0.3
Alt B5e / Alt B5r Two Span/Three Stage Removal	96	0
Alt C2e Two Span/Conventional Removal/Existing Path Alignment (in end span)	68	0.3
Alt C5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	96	0
Alt D2e Three Span/Conventional Removal/Existing Path Alignment (in end span)	68	0.3
Alt D5e Three Span/Three Stage Removal/Existing Path Alignment (in end span)	96	0
Alt E2e / E2r Single Span/Conventional Removal	68	0.3

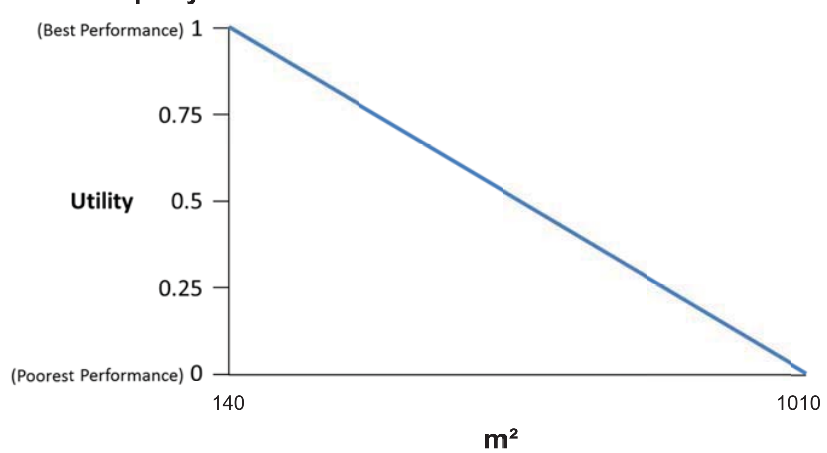
Alt E5e / E5r Single Span/Three Stage Removal	96	0
Alt F2e Two Span/Conventional Removal/Existing Path Alignment (in end span)	68	0.3
Alt F5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	96	0
Alt G2e Two Storey Single Span/Conv Removal/ (pedestrians on second storey)	68	0.3
Alt G5e Two Storey Single Span/Three Stage Removal/ (pedestrians on second storey)	96	0

Simply Supported - Jack & Slide:

Alternatives	Days	Utility Score
Alt H6e Single Span/Full Closure/Existing Path Alignment	6	1
Alt H7e Single Span/2 lane detour/Existing Path Alignment	74	0.2
Alt I6e Three Span/Full Closure/Existing Alignment	6	1
Alt I7e Three Span/Two Lane Detour/Existing Alignment	74	0.2

Mitigation: N/A

Potentially Contaminated Property



Description: This sub-factor measures whether there is potential to encounter potentially contaminated property during the construction of an alternative, measured by footing area. Alternatives with the smallest area footing, and therefore minimize excavation, are preferred.

Rigid Frame: Legend: e= Existing Path Alignment (Box Culvert) r = Relocate Path Alignment

Alternatives	Footing Area (m²)	Utility Score
Alt A2e / Alt A2r Single Span/Conventional Removal	630	0.44
Alt A5e / Alt A5r Single Span/Three Stage Removal	630	0.44
Alt B2e / Alt B2r Two Span/Conventional Removal	790	0.25
Alt B5e / Alt B5r Two Span/Three Stage Removal	790	0.25
Alt C2e Two Span/Conventional Removal/Existing Path Alignment (in end span)	480	0.61
Alt C5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	480	0.61
Alt D2e Three Span/Conventional Removal/Existing Path Alignment (in end span)	640	0.43
Alt D5e Three Span/Three Stage Removal/Existing Path Alignment (in end span)	640	0.43
Alt E2e / E2r Single Span/Conventional Removal	630	0.44
Alt E5e / E5r Single Span/Three Stage Removal	630	0.44
Alt F2e Two Span/Conventional Removal/Existing Path	480	0.61

Alignment (in end span)		
Alt F5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	480	0.61
Alt G2e Two Storey Single Span/Conv Removal/ (pedestrians on second storey)	840	0.2
Alt G5e Two Storey Single Span/Three Stage Removal/ (pedestrians on second storey)	840	0.2

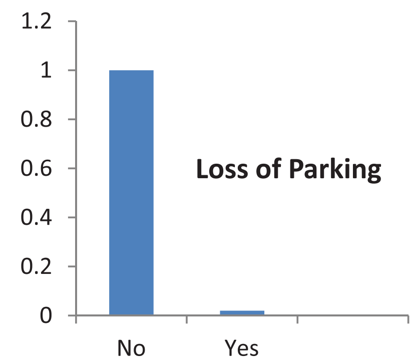
Simply Supported - Jack & Slide:

Alternatives	Low/High	Utility Score
Alt H6e Single Span/Full Closure/Existing Path Alignment	140	1
Alt H7e Single Span/2 lane detour/Existing Path Alignment	140	1
Alt I6e Three Span/Full Closure/Existing Alignment	1010	0
Alt I7e Three Span/Two Lane Detour/Existing Alignment	1010	0

Mitigation: N/A

Factor Group: Economic

Loss of Parking - Permanent



Description: Alternatives which relocate the pedestrian pathway to Preston Street and Louisa Street remove 15 existing parking stalls and will increase walking distances for the public. Measured effects are:

Relocated MUP = Yes loss of parking – not preferred

No MUP relocation = No loss of parking – preferred

Rigid Frame: Legend: e= Existing Path Alignment (Box Culvert) r = Relocate Path Alignment

Alternatives	Yes/No	Utility Score
Alt A2e / Alt A2r Single Span/Conventional Removal	No/Yes	1/0
Alt A5e / Alt A5r Single Span/Three Stage Removal	No/Yes	1/0
Alt B2e / Alt B2r Two Span/Conventional Removal	No/Yes	1/0
Alt B5e / Alt B5r Two Span/Three Stage Removal	No/Yes	1/0
Alt C2e Two Span/Conventional Removal/Existing Path Alignment (in end span)	No	1
Alt C5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	No	1
Alt D2e Three Span/Conventional Removal/Existing Path Alignment (in end span)	No	1
Alt D5e Three Span/Three Stage Removal/Existing Path Alignment (in end span)	No	1
Alt E2e / E2r Single Span/Conventional Removal	No/Yes	1/0

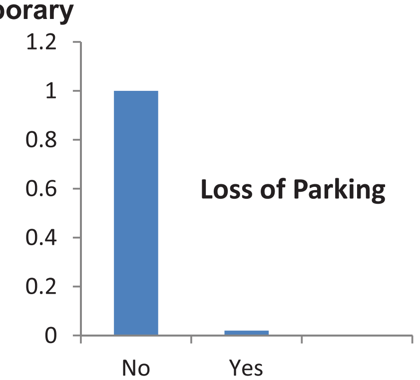
Alt E5e / E5r Single Span/Three Stage Removal	No/Yes	1/0
Alt F2e Two Span/Conventional Removal/Existing Path Alignment (in end span)	No	1
Alt F5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	No	1
Alt G2e Two Storey Single Span/Conv Removal/ (pedestrians on second storey)	No	1
Alt G5e Two Storey Single Span/Three Stage Removal/ (pedestrians on second storey)	No	1

Simply Supported - Jack & Slide:

Alternatives	Yes/No	Utility Score
Alt H6e Single Span/Full Closure/Existing Path Alignment	No	1
Alt H7e Single Span/2 lane detour/Existing Path Alignment	No	1
Alt I6e Three Span/Full Closure/Existing Alignment	No	1
Alt I7e Three Span/Two Lane Detour/Existing Alignment	No	1

Mitigation: N/A

Loss of Parking - Temporary



Description: This sub-factor measures the temporary loss of parking for the staging areas of the jack-and-slide construction sites. Loss of parking includes: Young Street (15 stalls), Young Street West (10 stalls), and St. Anthony Street (25 parking spaces). Alternatives that do not remove parking stalls/spaces are preferred.

Rigid Frame: Legend: e= Existing Path Alignment (Box Culvert) r = Relocate Path Alignment

Alternatives	Yes/No	Utility Score
Alt A2e / Alt A2r Single Span/Conventional Removal	No	1
Alt A5e / Alt A5r Single Span/Three Stage Removal	No	1
Alt B2e / Alt B2r Two Span/Conventional Removal	No	1
Alt B5e / Alt B5r Two Span/Three Stage Removal	No	1
Alt C2e Two Span/Conventional Removal/Existing Path Alignment (in end span)	No	1
Alt C5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	No	1
Alt D2e Three Span/Conventional Removal/Existing Path Alignment (in end span)	No	1
Alt D5e Three Span/Three Stage Removal/Existing Path Alignment (in end span)	No	1
Alt E2e / E2r Single Span/Conventional Removal	No	1
Alt E5e / E5r Single Span/Three Stage Removal	No	1
Alt F2e Two Span/Conventional Removal/Existing Path	No	1

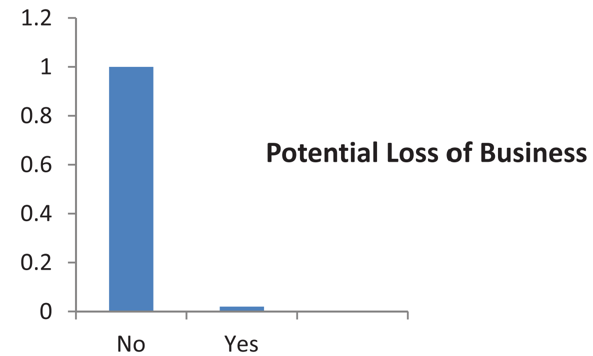
Alignment (in end span)		
Alt F5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	No	1
Alt G2e Two Storey Single Span/Conv Removal/ (pedestrians on second storey)	No	1
Alt G5e Two Storey Single Span/Three Stage Removal/ (pedestrians on second storey)	No	1

Simply Supported - Jack & Slide:

Alternatives	Yes/No	Utility Score
Alt H6e Single Span/Full Closure/Existing Path Alignment	No	1
Alt H7e Single Span/2 lane detour/Existing Path Alignment	No	1
Alt I6e Three Span/Full Closure/Existing Alignment	Yes	0
Alt I7e Three Span/Two Lane Detour/Existing Alignment	Yes	0

Mitigation: N/A

Preston Street Business Effects



Description: This sub-factor measures the permanent business effects for alternatives that relocate the MUP and remove parking on Preston Street. This sub-factor measures business impact for the immediate Preston Street businesses, in the vicinity of the widened roadway. Alternatives that do not relocate the MUP are preferred under this sub-factor.

Rigid Frame: Legend: e= Existing Path Alignment (Box Culvert) r = Relocate Path Alignment

Alternatives	Yes/No	Utility Score
Alt A2e / Alt A2r Single Span/Conventional Removal	No/Yes	1/0
Alt A5e / Alt A5r Single Span/Three Stage Removal	No/Yes	1/0
Alt B2e / Alt B2r Two Span/Conventional Removal	No/Yes	1/0
Alt B5e / Alt B5r Two Span/Three Stage Removal	No/Yes	1/0
Alt C2e Two Span/Conventional Removal/Existing Path Alignment (in end span)	No	1
Alt C5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	No	1
Alt D2e Three Span/Conventional Removal/Existing Path Alignment (in end span)	No	1
Alt D5e Three Span/Three Stage Removal/Existing Path Alignment (in end span)	No	1
Alt E2e / E2r Single Span/Conventional Removal	No/Yes	1/0
Alt E5e / E5r Single Span/Three Stage Removal	No/Yes	1/0
Alt F2e Two Span/Conventional Removal/Existing Path	No	1

Alignment (in end span)		
Alt F5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	No	1
Alt G2e Two Storey Single Span/Conv Removal/ (pedestrians on second storey)	No	1
Alt G5e Two Storey Single Span/Three Stage Removal/ (pedestrians on second storey)	No	1

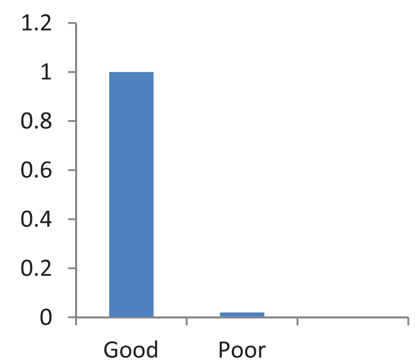
Simply Supported - Jack & Slide:

Alternatives	Yes/No	Utility Score
Alt H6e Single Span/Full Closure/Existing Path Alignment	No	1
Alt H7e Single Span/2 lane detour/Existing Path Alignment	No	1
Alt I6e Three Span/Full Closure/Existing Alignment	No	1
Alt I7e Three Span/Two Lane Detour/Existing Alignment	No	1

Mitigation: N/A

Factor Group: Land Use & Property

Environmental Impacts along CPR/O-Train Corridor



Description: This sub-factor measures the incremental environmental effects (compared to the approved North-South LRT EA plan) to widen the CPR/O-Train corridor should the CPR/O-Train bridge be replaced with separate spans to accommodate the future twin tracking. By using separate spans, it will widen the right-of-way and increase the land required for the future twinning of the rail line. The wider alignment has property impacts to Railway Street as well as NCC and City of Ottawa lands.

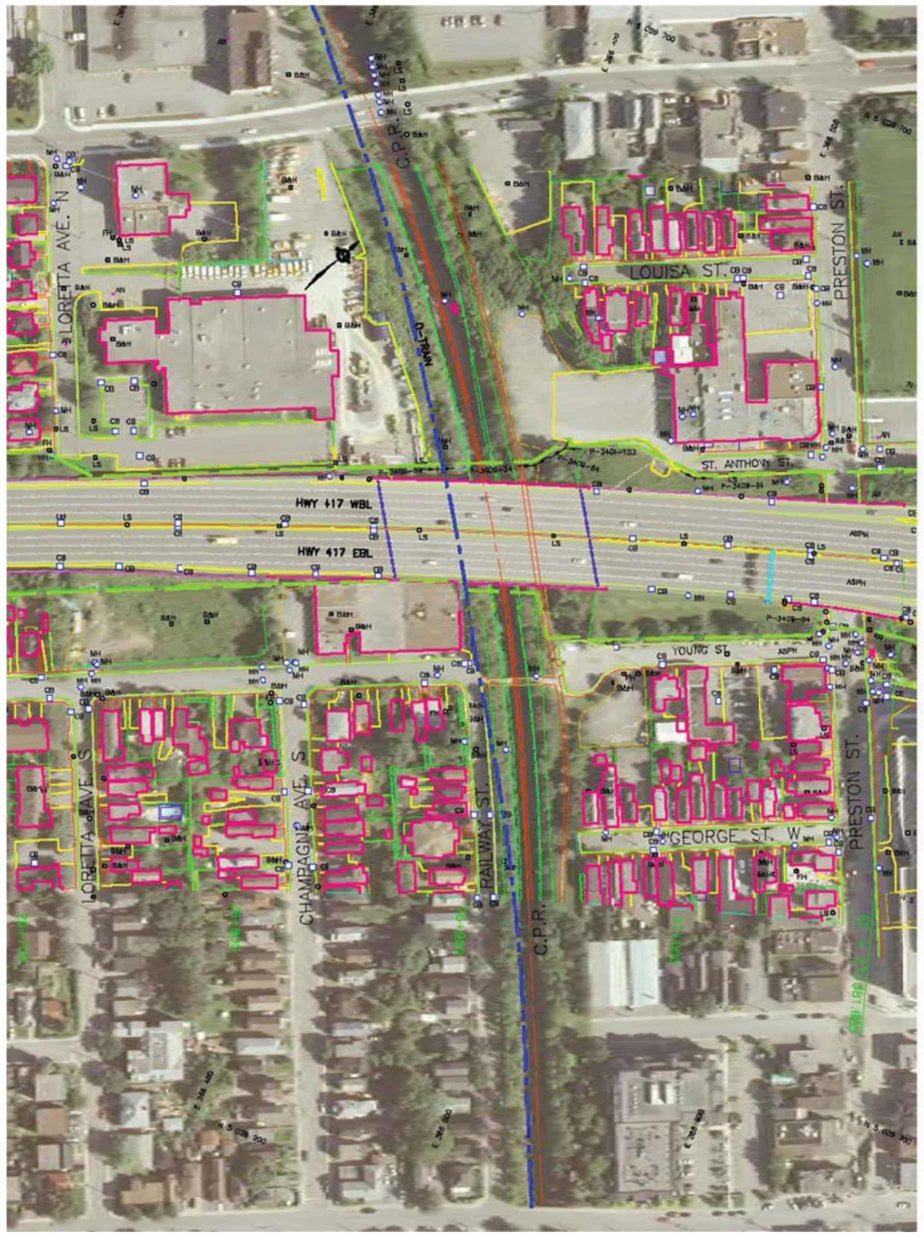
Rigid Frame: Legend: e= Existing Path Alignment (Box Culvert) r = Relocate Path Alignment

Alternatives	Poor/Good	Utility Score
Alt A2e / Alt A2r Single Span/Conventional Removal	Good	1
Alt A5e / Alt A5r Single Span/Three Stage Removal	Good	1
Alt B2e / Alt B2r Two Span/Conventional Removal	Poor	0
Alt B5e / Alt B5r Two Span/Three Stage Removal	Poor	0
Alt C2e Two Span/Conventional Removal/Existing Path Alignment (in end span)	Good	1
Alt C5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	Good	1
Alt D2e Three Span/Conventional Removal/Existing Path Alignment (in end span)	Poor	0
Alt D5e Three Span/Three Stage Removal/Existing Path Alignment (in end span)	Poor	0
Alt E2e / E2r Single Span/Conventional Removal	Good	1

Alt E5e / E5r Single Span/Three Stage Removal	Good	1
Alt F2e Two Span/Conventional Removal/Existing Path Alignment (in end span)	Good	1
Alt F5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	Good	1
Alt G2e Two Storey Single Span/Conv Removal/ (pedestrians on second storey)	Good	1
Alt G5e Two Storey Single Span/Three Stage Removal/ (pedestrians on second storey)	Good	1

Simply Supported - Jack & Slide:

Alternatives	Poor/Good	Utility Score
Alt H6e Single Span/Full Closure/Existing Path Alignment	Good	1
Alt H7e Single Span/2-lane detour/Existing Path Alignment	Good	1
Alt I6e Three Span/Full Closure/Existing Alignment	Good	1
Alt I7e Three Span/Two Lane Detour/Existing Alignment	Good	1



Mitigation: N/A

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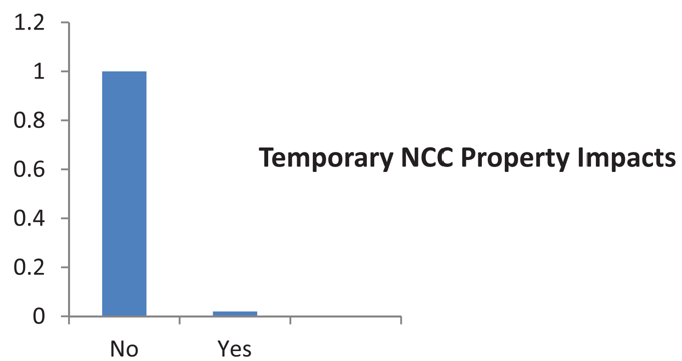
Temporary Property Impacts – Federal (NCC)



This sub-factor measure the temporary loss of the NCC lands currently being used by the City of Ottawa for their works yard on Loretta Street, and City of Ottawa lands currently being used for municipal parking. This will include the temporary loss of up to approximately 300 m² for Alternative I. This area is used for general storage. Alternatives which do not impact the works yard are preferred. The effects to the St. Anthony's property are measured under the temporary parking sub-factor.

Rigid Frame: Legend: e= Existing Path Alignment (Box Culvert) r = Relocate Path Alignment

Alternatives	Yes/No	Utility Score
Alt A2e / Alt A2r Single Span/Conventional Removal	No	1
Alt A5e / Alt A5r Single Span/Three Stage Removal	No	1
Alt B2e / Alt B2r Two Span/Conventional Removal	No	1
Alt B5e / Alt B5r Two Span/Three Stage Removal	No	1
Alt C2e Two Span/Conventional Removal/Existing Path Alignment (in end span)	No	1
Alt C5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	No	1
Alt D2e Three Span/Conventional Removal/Existing Path Alignment (in end span)	No	1
Alt D5e Three Span/Three Stage Removal/Existing Path Alignment (in end span)	No	1
Alt E2e / E2r Single Span/Conventional Removal	No	1
Alt E5e / E5r Single Span/Three Stage Removal	No	1
Alt F2e Two Span/Conventional Removal/Existing Path Alignment (in end span)	No	1
Alt F5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	No	1
Alt G2e Two Storey Single Span/Conv Removal/ (pedestrians on second storey)	No	1
Alt G5e Two Storey Single Span/Three Stage Removal/ (pedestrians on second storey)	No	1

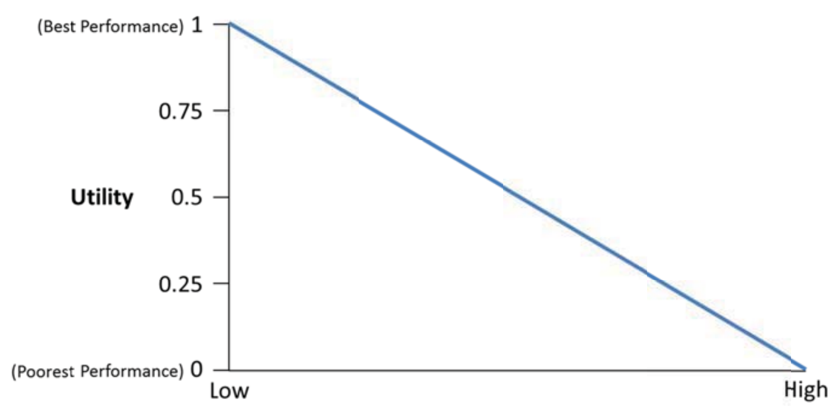
Simply Supported - Jack & Slide:

Alternatives	Yes/No	Utility Score
Alt H6e Single Span/Full Closure/Existing Path Alignment	No	1
Alt H7e Single Span/2 lane detour/Existing Path Alignment	No	1
Alt I6e Three Span/Full Closure/Existing Alignment	Yes	0
Alt I7e Three Span/Two Lane Detour/Existing Alignment	No	1

Mitigation: N/A

Factor Group: Cost

Capital Cost



Description: This sub-factor measures the capital cost of each alternative. It reflects current Provincial policy of asset preservation and reducing current government spending. Those alternatives with the lowest capital cost (including structural, removal and traffic staging) are preferred. Costs do not consider any cost sharing contributions from the municipality.

A value of $500k has been used for options that relocate the path to Preston Street, to account for road reconstruction.

Rigid Frame: Legend: e= Existing Path Alignment (Box Culvert) r = Relocate Path Alignment

Alternatives	Cost		Utility Score	
Alt A2e / Alt A2r Single Span/Conventional Removal	19.78	20.34	0.99	0.95
Alt A5e / Alt A5r Single Span/Three Stage Removal	20.08	20.64	0.96	0.92
Alt B2e / Alt B2r Two Span/Conventional Removal	23.4	24.0	0.72	0.68
Alt B5e / Alt B5r Two Span/Three Stage Removal	23.7	24.2	0.7	0.66
Alt C2e Two Span/Conventional Removal/Existing Path Alignment (in end span)	20.8		0.91	
Alt C5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	21.2		0.88	
Alt D2e Three Span/Conventional Removal/Existing Path Alignment (in end span)	23.2		0.74	
Alt D5e Three Span/Three Stage Removal/Existing	23.4		0.72	

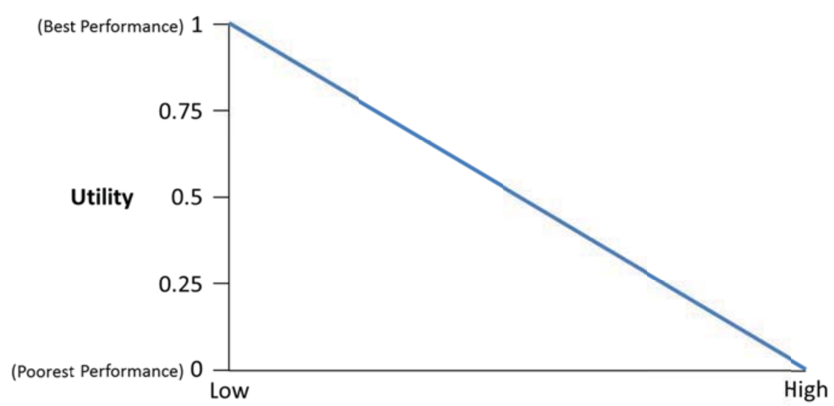
Path Alignment (in end span)				
Alt E2e / E2r Single Span/Conventional Removal	19.6	20.1	1	0.96
Alt E5e / E5r Single Span/Three Stage Removal	19.9	20.4	0.98	0.94
Alt F2e Two Span/Conventional Removal/Existing Path Alignment (in end span)	21.0		0.9	
Alt F5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	21.2		0.88	
Alt G2e Two Storey Single Span/Conv Removal/ (pedestrians on second storey)	26.0		0.53	
Alt G5e Two Storey Single Span/Three Stage Removal/ (pedestrians on second storey)	26.3		0.51	

Simply Supported - Jack & Slide:

Alternatives	Cost	Utility Score
Alt H6e Single Span/Full Closure/Existing Path Alignment	23.9	0.68
Alt H7e Single Span/2 lane detour/Existing Path Alignment	24.5	0.64
Alt I6e Three Span/Full Closure/Existing Alignment	32.4	0.06
Alt I7e Three Span/Two Lane Detour/Existing Alignment	33.2	0.0

Mitigation: N/A

Life Cycle Cost



Description: This sub-factor measures the total future cost of an alternative including future rehabilitation costs. This cost does not consider any cost sharing contributions from the municipality.

Rigid Frame: Legend: e= Existing Path Alignment (Box Culvert) r = Relocate Path Alignment

Alternatives	Cost $M	Utility Score
Alt A2e / Alt A2r Single Span/Conventional Removal	10.06*2/10.38*2	0.98/0.94
Alt A5e / Alt A5r Single Span/Three Stage Removal	10.21*2/10.49*2	0.96/0.92
Alt B2e / Alt B2r Two Span/Conventional Removal	11.89*2/12.17*2	0.73/0.69
Alt B5e / Alt B5r Two Span/Three Stage Removal	12.04*2/12.32*2	0.71/0.67
Alt C2e Two Span/Conventional Removal/Existing Path Alignment (in end span)	10.60*2	0.91
Alt C5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	10.75*2	0.89
Alt D2e Three Span/Conventional Removal/Existing Path Alignment (in end span)	11.75*2	0.75
Alt D5e Three Span/Three Stage Removal/Existing Path Alignment (in end span)	11.9*2	0.73
Alt E2e / E2r Single Span/Conventional Removal	9.95*2/10.23*2	1/0.96
Alt E5e / E5r Single Span/Three Stage Removal	10.10*2/10.38*2	0.98/0.94
Alt F2e Two Span/Conventional Removal/Existing Path	10.63*2	0.9

Alignment (in end span)		
Alt F5e Two Span/Three Stage Removal/Existing Path Alignment (in end span)	10.78*2	0.88
Alt G2e Two Storey Single Span/Conv Removal/ (pedestrians on second storey)	13.2*2	0.54
Alt G5e Two Storey Single Span/Three Stage Removal/ (pedestrians on second storey)	13.35*2	0.52

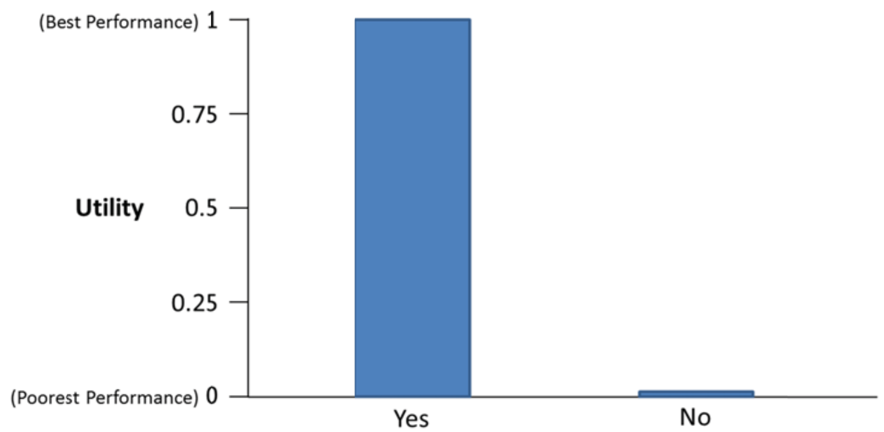
Simply Supported - Jack & Slide:

Alternatives	Cost	Utility Score
Alt H6e Single Span/Full Closure/Existing Path Alignment	12.26*2	0.68
Alt H7e Single Span/2 lane detour/Existing Path Alignment	12.56*2	0.63
Alt I6e Three Span/Full Closure/Existing Alignment	16.66*2	0.06
Alt I7e Three Span/Two Lane Detour/Existing Alignment	17.06*2	0.00

Mitigation: N/A

Factor Group: Schedule Uncertainty

Potential



Description: This sub-factor measure the risk of completing all works within a 3 day weekend based on construction industry input. Those alternatives where there is risk in not completing all works within a weekend closure potentially may risk not opening the Queensway. Those that have certainty are preferred.

Rigid Frame:

Alternatives	Yes/No	Utility Score
Alt A3e Single Span/Conventional Removal/Existing Trail Alignment (Box Culvert)	Yes	1
Alt A3r Single Span/Conventional Removal/Relocate Trail Alignment (Box Culvert)	Yes	1
Alt B3e Two Span/Conventional Removal/Existing Trail Alignment (Box Culvert)	Yes	1
Alt B3r Two Span/Conventional Removal/Relocate Trail Alignment	Yes	1
Alt C3e Two Span/Conventional Removal/Existing Trail Alignment (in end span)	Yes	1
Alt D3e Three Span/Conventional Removal/Existing Trail Alignment (in end span)	Yes	1
Alt E3e Single Span/Conventional Removal/Existing Trail Alignment (box culvert)	Yes	1
Alt E3r Single Span/Conventional Removal/Relocate	Yes	1

Trail Alignment		
Alt F3e Two Span/Conventional Removal/Existing Trail Alignment (in end span)	Yes	1

Simply Supported - Jack & Slide:

Alternatives		Utility Score
Alt H6e Single Span/Full Closure/Existing Trail Alignment	Yes	1
Alt H7e Single Span/Two Lane Detour/Existing Trail Alignment	Yes	1
Alt I5e Three Span/Full Closure/Existing Alignment	No	0
Alt I6e Three Span/Two Lane Detour/Existing Alignment	No	0

Mitigation: N/A

VERSION: November 11, 2014

APPENDIX E

SUB-FACTOR UTILITY FUNCTION DEFINITIONS AND MEASUREMENTS FOR SHORT LISTED EVALUATION CRITERIA

PRESTON STREET EASTBOUND BRIDGE

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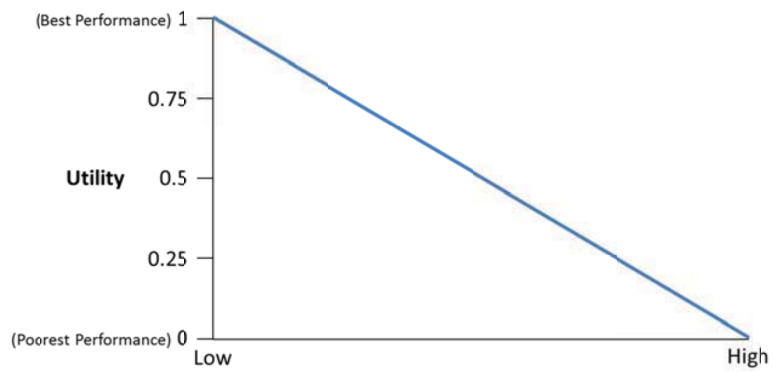
Factor Group: Transportation

Maximum Peak Queue Length on Queensway



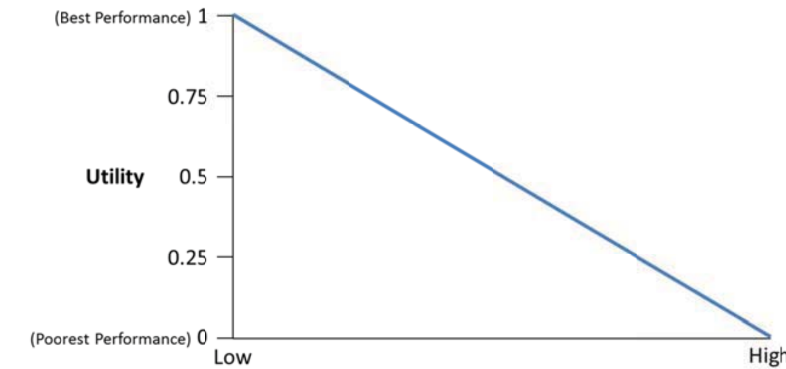
Description: This sub-factor measures the forecast queue length effect in the peak hour including measures to divert trips and induce transportation demand management during construction. The sub-factor measures the queue duration (days) and the forecast queue length (after the use of mitigation). This sub-factor is indicative of highway performance and safety, and is related to: effects on ramp operations, rear end collisions influenced by stop and go traffic, poor weaving conditions and traffic congestion.

(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	km days (peak hour)	Utility Score
Alternative A2e Rapid Rehab/Existing Span	41	0.98
Alternative A5e Conventional Rehab/Existing Span	780	0.59
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	1920	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	1920	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	2	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	240	0.9
Alternative C6l Rapid Replacement/Full Closure/Longer Span	2	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	240	0.9
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	2	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	240	0.9

Mitigation: The use of advance advertising and advising drivers of the scheduled lane closures through PVMS placement in advance of construction will be measures that will reduce demand by: changing the time of travel of commuters, use of transit as an alternate mode of travel or by inducing diversion to the municipal road system as an alternate route.

Delays

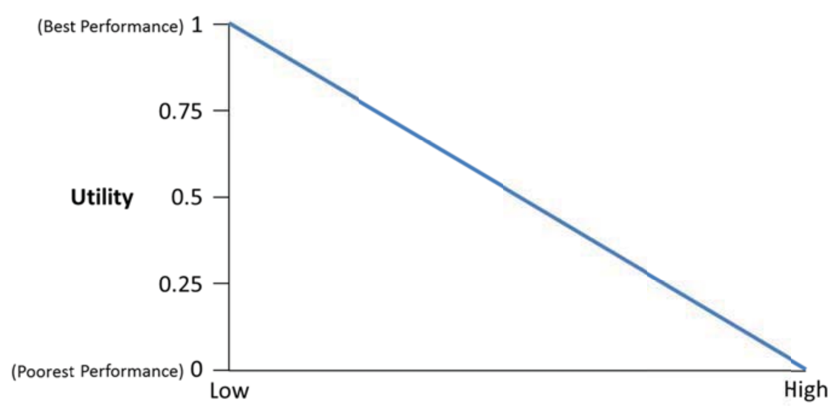


Description: This sub-factor measures the total lane closure peak period delay to drivers on the Queensway during the construction period. It includes the total peak period delay forecast for the duration of construction of the alternative. The delay sub-factor, although measuring vehicles on the Queensway, is also indicative of the delays for drivers diverted from the Queensway and operating on the municipal road system.
(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	Veh h	Utility Score
Alternative A2e Rapid Rehab/Existing Span	16,520	1
Alternative A5e Conventional Rehab/Existing Span	1,537,200	0.60
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	3,782,800	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	3,782,800	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	520	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	472,600	0.9
Alternative C6l Rapid Replacement/Full Closure/Longer Span	780	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	472,600	0.9
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	780	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	472,600	0.9

Mitigation: N/A

Ramp Closures

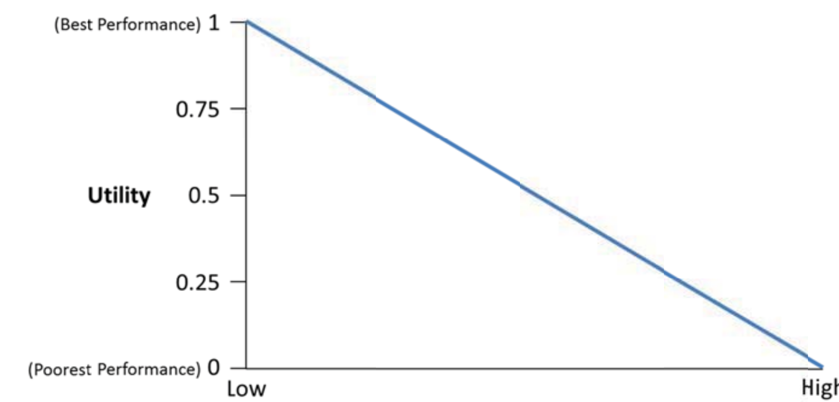


Description: This sub-factor measures the impact to community access by quantifying the volume of peak hour ramp trips that will be removed from entering or exiting from the Queensway. The sub-factor measures the peak hour ramp volume for each stage of the highway staging plan for the duration of the closure.

Alternatives	Veh (peak hour)	Utility Score
Alternative A2e Rapid Rehab/Existing Span	15,988	0.93
Alternative A5e Conventional Rehab/Existing Span	115,552	0.01
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	116,324	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	116,324	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	8,058	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	30,432	0.79
Alternative C6l Rapid Replacement/Full Closure/Longer Span	8,058	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	30,432	0.79
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	8,058	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	30,432	0.79

Mitigation: Ramps may be closed by time of day to allow access in non-peak hours.

Highway Safety - Collision Potential

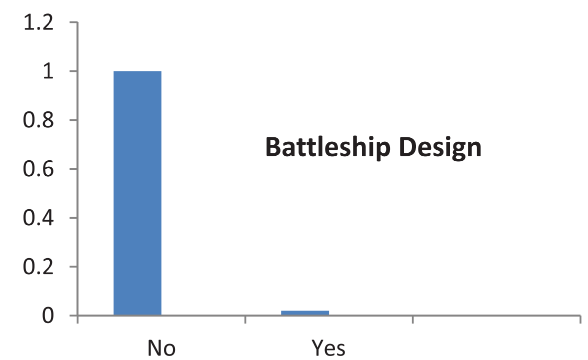


Description: This sub-factor measures the collision potential of the alternative by measuring the time duration that drivers will be required to transition through the construction zone.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	0.9
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	0	2	2	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	20	12	32	0.9
Alternative C6l Rapid Replacement/Full Closure/Longer Span	0	2	2	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	20	12	32	0.9
Alternative D6 Rapid Replacement Semi-integral/Full Closure/Longer Span	0	2	2	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	20	12	32	0.9

Mitigation: N/A

Highway Safety – Design Consistency of Traffic Staging Design

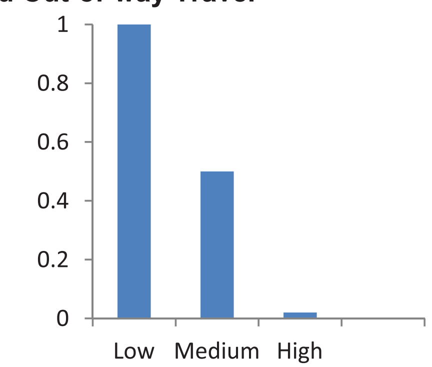


Description: This sub-factor measures the collision potential of the highway staging design. Those alternatives including a non-conventional battleship design (i.e. yes) are least preferred.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Yes	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Yes	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	No	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	No	1
Alternative C6l Rapid Replacement/Full Closure/Longer Span	No	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	No	1
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	No	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	No	1

Mitigation: Tow truck plan/incident plan.

Pedestrian – Delay and Out-of-way Travel



Description: This sub-factor measures the length and duration of pedestrian out-of-way travel on the side streets while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily sidewalk closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period. Pedestrians will be signed to use the opposite sidewalk from the adjacent signalized intersections.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. Pedestrians will use a single sidewalk and cross the street at the temporary signals. The duration of the temporary signals will be 6 weeks.

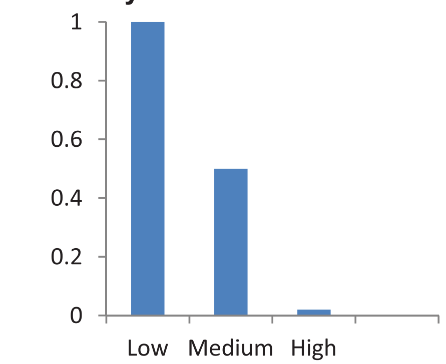
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure pedestrians will be directed to Rochester Street, for a maximum out-of-way travel of 0.8 km. This sub-factor measures a one-way trip only. For the detour route, refer to the Preliminary Highway Engineering Traffic Staging Alternatives Report, dated August 5, 2014.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0

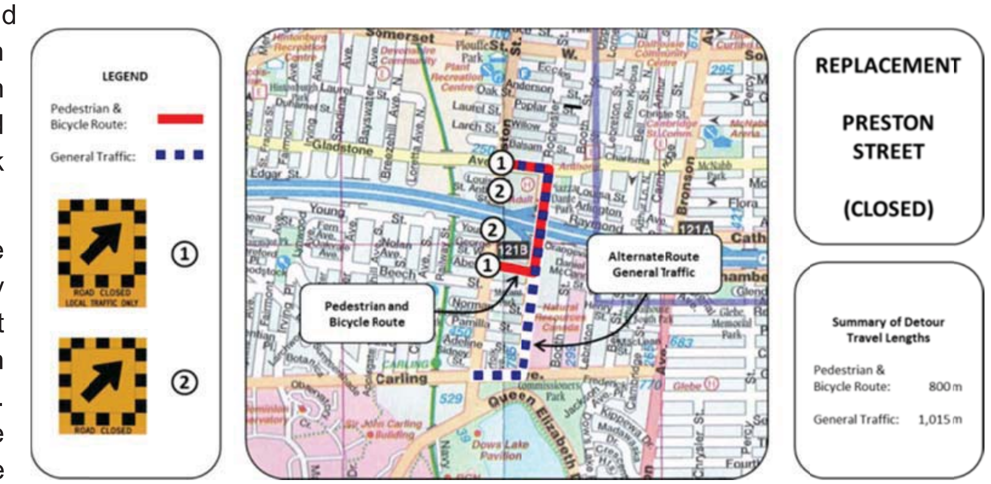
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: Advance signage for pedestrians to travel to the alternate sidewalk route as well as pre-event information to the property owners.

Bicycle – Delay and Out-of-Way Travel



Description: This sub-factor measures the length and duration of bicycle delay and out-of-way travel on the side street while work is completed to rehabilitate or replace the structure. Categories of effects include:



Low impacts – daily lane and bike lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. Bicyclists will use the single lane detour through the temporary signals. The duration of the temporary signals will be 6 weeks.

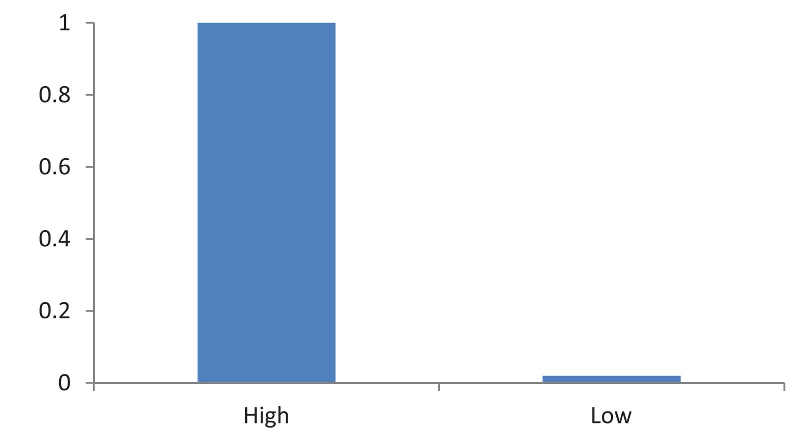
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure, bicyclists will be directed to Rochester Street, for a maximum out-of-way travel of 0.8 km. This sub-factor measures a one-way trip only. For the detour route, refer to the Preliminary Highway Engineering Traffic Staging Alternatives Report, dated August 5, 2014.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e	Medium	0.5

Rapid Replacement/Full Closure/Existing Span		
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: Advance signage for cyclists to choose an alternate route as well as pre-event information to the Regional cycling clubs.

Pedestrian/Bicycle Safety

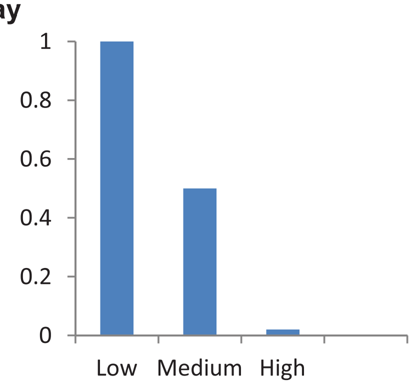


Description: This sub-factor measures if an alternative provides greater lateral space to increase pedestrian and bicycle safety. Those alternatives providing the largest span are preferred (high potential) and those alternatives matching the existing span are not preferred (i.e. low potential).

Alternatives	High/Low	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	0
Alternative A5e Conventional Rehab/Existing Span	Low	0
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Low	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	1
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Low	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Low	0
Alternative C6l Rapid Replacement/Full Closure/Longer Span	High	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	High	1
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	High	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	High	1

Mitigation: None.

Transit Operations Delay



Description: This sub-factor measures the delay during construction that will affect transit operations. Bus route affected: No. 85. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. The duration of the temporary signals will be 6 weeks.

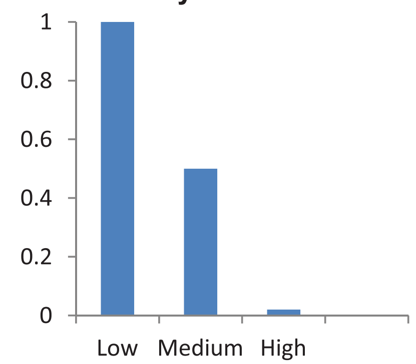
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure transit will be directed to Rochester Street, for a maximum out-of-way travel of 1.7 km. This sub-factor measures a one-way trip only. For the detour route, refer to the Preliminary Highway Engineering Traffic Staging Alternatives Report, dated August 5, 2014.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0

Alternative C6e Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: Advance information to OC Transpo and temporary bus stop relocations if required.

General Traffic Municipal Street Delay

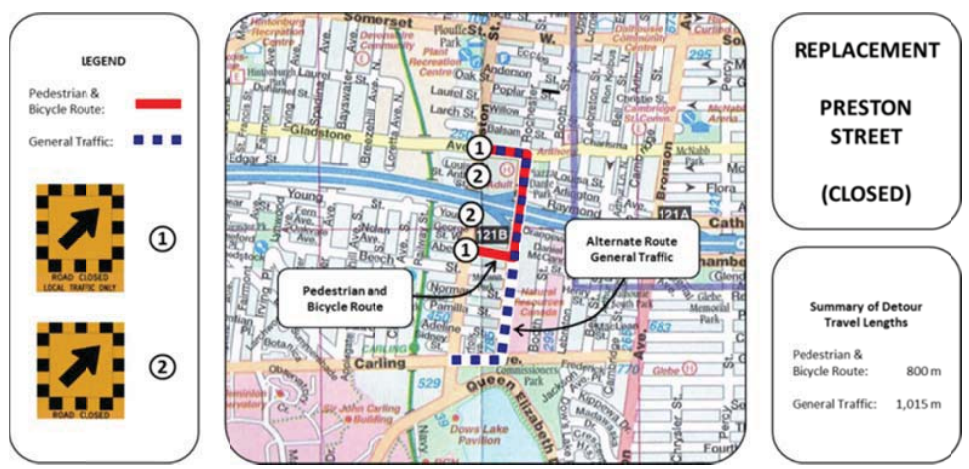


Description: This sub-factor measures the delay during construction that will affect general traffic operations. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. The duration of the temporary signals will be 6 weeks.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure vehicles will be directed to Rochester Street, for a maximum out-of-way travel of 1.0 km. This sub-factor measures a one-way trip only. For the detour route, refer to the Preliminary Highway Engineering Traffic Staging Alternatives Report, dated August 5, 2014.



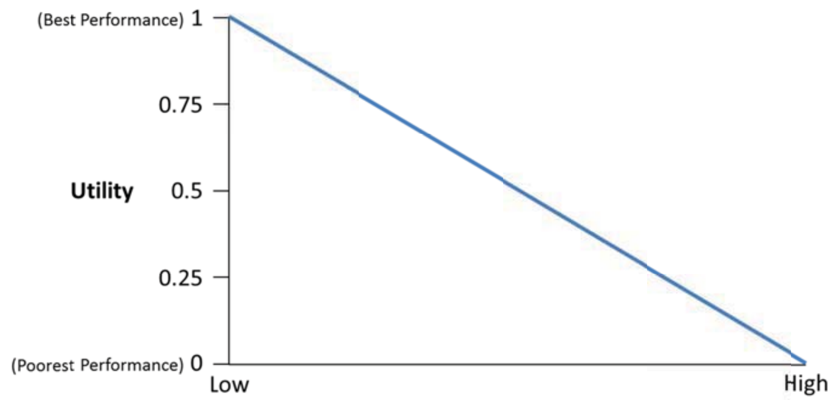
Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Medium	0.5

Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: The use of advisory signage and potential use of variable message signage can be used to advise drivers before reaching the construction site.

Factor Group: Social and Cultural Environment

Impact to Emergency Response

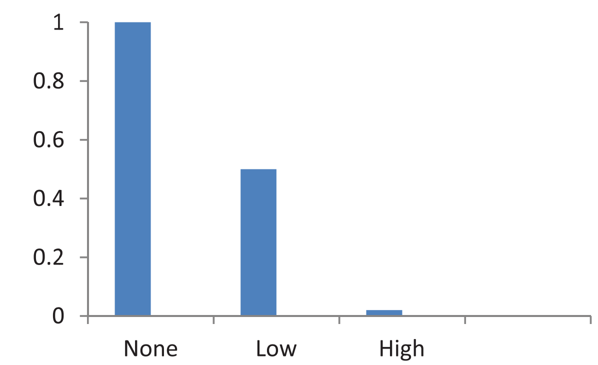


Description: This sub-factor measures the duration of Queensway closure that will affect emergency response service (police, ambulance and fire). Alternatives that reduce the length of time that there are lane closures on the Queensway are preferred.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	0.9
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0.0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0.0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	0	2	2	1.0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	20	12	32	0.9
Alternative C6l Rapid Replacement/Full Closure/Longer Span	0	2	2	1.0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	20	12	32	0.9
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	0	2	2	1.0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	20	12	32	0.9

Mitigation: Advanced warning of lane closures or detour routes.

Potentially Contaminated Property



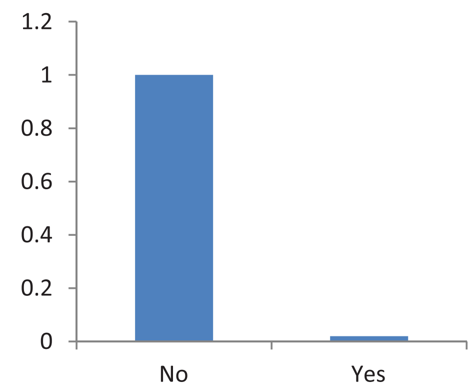
Description: This sub-factor measures whether there is potential to encounter potentially contaminated property during the construction of an alternative. Alternatives that minimize excavation are preferred. RBR staging sites have high potential (i.e. large footprint of excavation) to impact potentially contaminated property. Any alternative excavating in place has low potential to impact potentially contaminated property. The rehabilitation options have no potential to impact potentially contaminated property due to the small footprint of works.

Alternatives	No/Low/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Low	0.5
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Low	0.5
Alternative C6e Rapid Replacement/Full Closure/Existing Span	High	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	High	0
Alternative C6l Rapid Replacement/Full Closure/Longer Span	High	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	High	0
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	High	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	High	0

Mitigation: Avoidance.

Factor Group: Land Use and Property

Temporary Property Impacts



Description: This sub-factor measures whether property (i.e. parking lot at Beech/Rochester/Aberdeen) is required for temporary use as a bridge staging area, as per the RBR Structure Staging Sites memo.

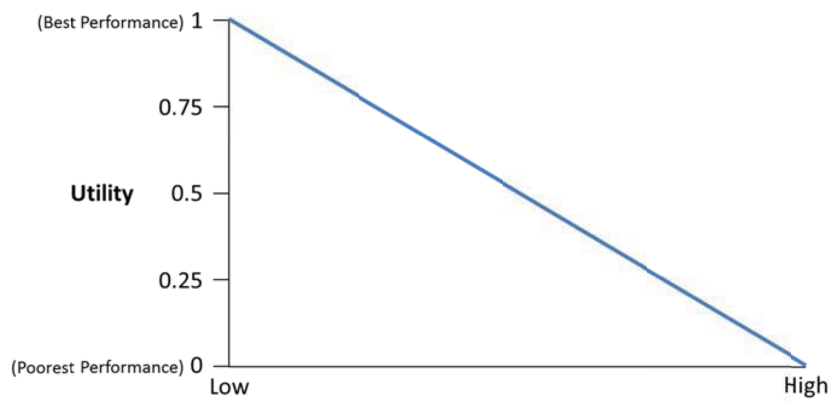
Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	No	1
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	No	1

Alternative C6e Rapid Replacement/Full Closure/Existing Span	Yes	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Yes	0
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Yes	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Yes	0
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Yes	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Yes	0

Mitigation: N/A

Factor Group: Cost

Capital Cost

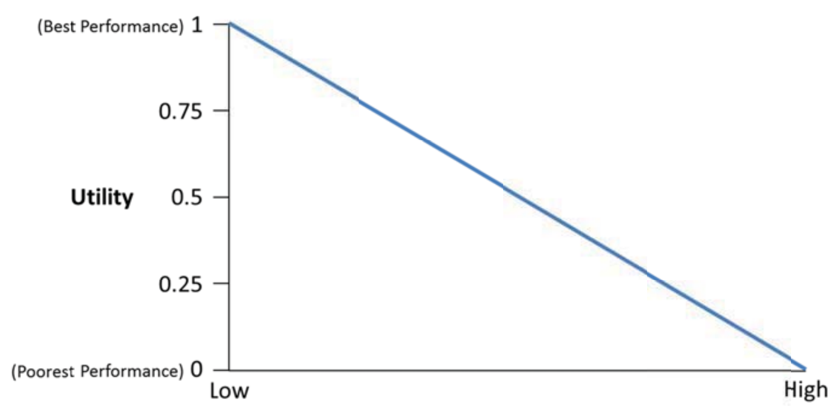


Description: This sub-factor measures the difference in initial capital cost of the alternative (bridge, traffic staging, staging area, and property costs). Those alternatives with the lowest capital cost are preferred. These costs do not include Engineering Costs.

Alternatives	$M		Utility Score
Alternative A2e Rapid Rehab/Existing Span	Structure 0.73 Staging 0.6 Property 0	1.33	1
Alternative A5e Conventional Rehab/Existing Span	Structure 0.73 Staging 1.25 Property 0	1.98	0.9
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Structure 2.88 Staging 1.2 Property 0	4.08	0.5
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Structure 3.61 Staging 1.2 Property 0	4.81	0.4
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Structure 5.20 Staging 0.60 Property 0	5.8	0.2
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Structure 5.20 Staging 0.60 Property 0	5.8	0.2
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Structure 6.66 Staging 0.60 Property 0	7.26	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Structure 6.66 Staging 0.60 Property 0	7.26	0
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Structure 6.31 Staging 0.60 Property 0	6.91	0.1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Structure 6.31 Staging 0.60 Property 0	6.91	0.1

Mitigation: N/A

Future Life Cycle Cost



Description: This sub-factor measures the difference in future life cycle costs (maintenance, operating costs and long term replacement and rehabilitation in the 40 year planning horizon). Those alternatives with the lowest long term life cycle cost are preferred. A 5% discount rate was used.

Alternatives	$M	Utility Score
Alternative A2e Rapid Rehab/Existing Span	3.72	1
Alternative A5e Conventional Rehab/Existing Span	4.38	0.9
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	4.72	0.8
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	5.54	0.6
Alternative C6e Rapid Replacement/Full Closure/Existing Span	6.72	0.4
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	7.27	0.3
Alternative C6l Rapid Replacement/Full Closure/Longer Span	8.36	0.1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	8.91	0
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	7.97	0.2
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	8.52	0.1

Mitigation: N/A

VERSION: November 11, 2014

APPENDIX E

SUB-FACTOR UTILITY FUNCTION DEFINITIONS AND MEASUREMENTS FOR SHORT LISTED EVALUATION CRITERIA

PRESTON STREET WESTBOUND BRIDGE

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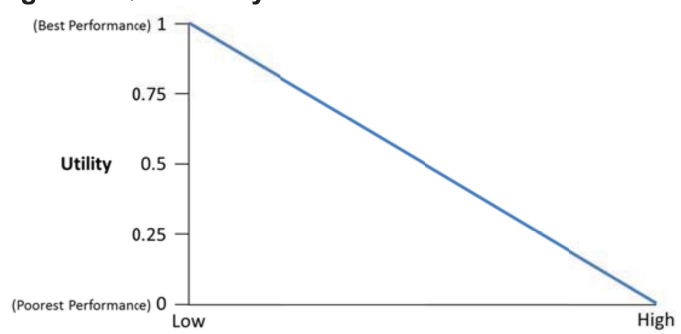
Factor Group: Transportation

Maximum Peak Queue Length on Queensway



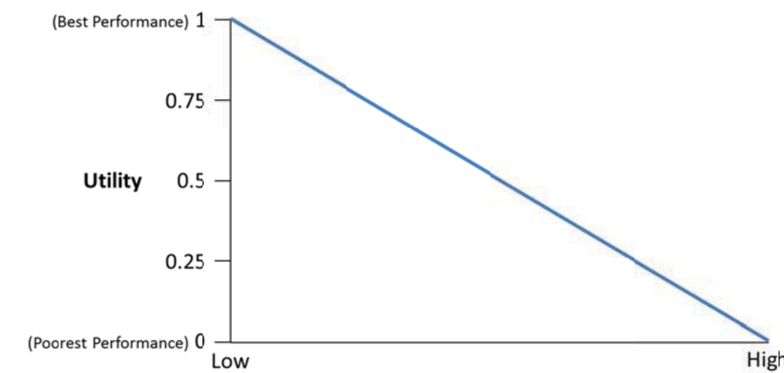
Description: This sub-factor measures the forecast queue length effect in the peak hour including measures to divert trips and induce transportation demand management during construction. The sub-factor measures the queue duration (days) and the forecast queue length (after the use of mitigation). This sub-factor is indicative of highway performance and safety, and is related to effects: on ramp operations, rear end collisions influenced by stop and go traffic, poor weaving conditions and traffic congestion.

(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	km days (peak hour)	Utility Score
Alternative A2e Rapid Rehab/Existing Span	41	0.98
Alternative A5e Conventional Rehab/Existing Span	780	0.59
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	1920	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	1920	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	2	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	240	0.9
Alternative C6l Rapid Replacement/Full Closure/Longer Span	2	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	240	0.9
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	2	1
Alternative D7l Rapid Replacement Semi-Integral/Two Lane Detour/Longer Span	240	0.9

Mitigation: The use of advance advertising and advising drivers of the scheduled lane closures through PVMS placement in advance of construction will be measures that will reduce demand by: changing the time of travel of commuters, use of transit as an alternate mode of travel or by inducing diversion to the municipal road system as an alternate route.

Delays

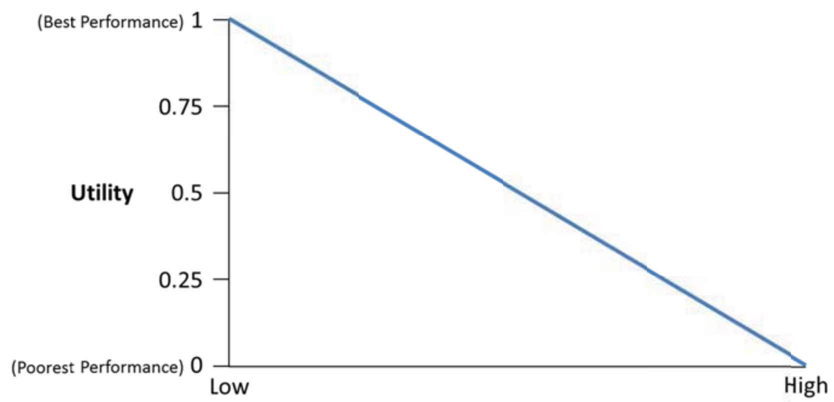


Description: This sub-factor measures the total lane closure peak period delay to drivers on the Queensway during the construction period. It includes the total peak period delay forecast for the duration of construction of the alternative. The delay sub-factor, although measuring vehicles on the Queensway, is also indicative of the delays for drivers diverted from the Queensway and operating on the municipal road system.
(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	Veh h	Utility Score
Alternative A2e Rapid Rehab/Existing Span	16,520	1
Alternative A5e Conventional Rehab/Existing Span	1,537,200	0.60
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	3,782,800	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	3,782,800	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	520	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	472,600	0.9
Alternative C6l Rapid Replacement/Full Closure/Longer Span	520	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	472,600	0.9
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	520	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	472,600	0.9

Mitigation: N/A

Ramp Closures

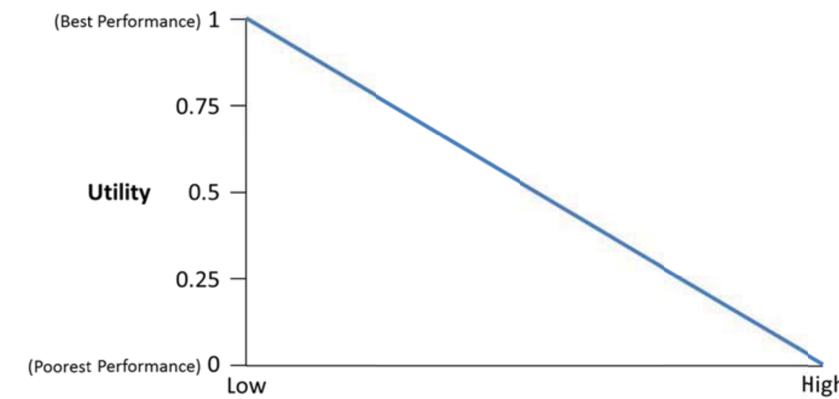


Description: This sub-factor measures the impact to community access by quantifying the volume of peak hour ramp trips that will be removed from entering or exiting from the Queensway. The sub-factor measures the peak hour ramp volume for each stage of the highway staging plan for the duration of the closure.

Alternatives	Veh (peak hour)	Utility Score
Alternative A2e Rapid Rehab/Existing Span	13,198	0.91
Alternative A5e Conventional Rehab/Existing Span	95,840	0
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	93,044	0.03
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	93,044	0.03
Alternative C6e Rapid Replacement/Full Closure/Existing Span	5,216	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	41,496	0.6
Alternative C6l Rapid Replacement/Full Closure/Longer Span	5,216	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	41,496	0.6
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	5,216	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	41,496	0.6

Mitigation: Ramps may be closed by time of day to allow access in non-peak hours.

Highway Safety - Collision Potential

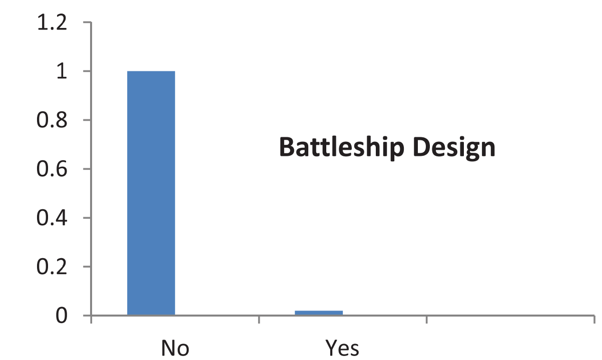


Description: This sub-factor measures the collision potential of the alternative by measuring the time duration that drivers will be required to transition through the construction zone.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	0.9
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	0	2	2	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	20	12	32	0.9
Alternative C6l Rapid Replacement/Full Closure/Longer Span	0	2	2	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	20	12	32	0.9
Alternative D6 Rapid Replacement Semi-integral/Full Closure/Longer Span	0	2	2	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	20	12	32	0.9

Mitigation: N/A

Highway Safety – Design Consistency of Traffic Staging Design

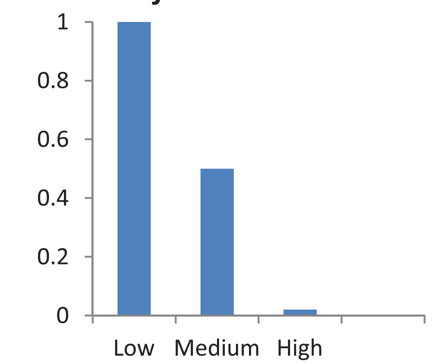


Description: This sub-factor measures the collision potential of the highway staging design. Those alternatives including a non-conventional battleship design (i.e. yes) are least preferred.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Yes	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Yes	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	No	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	No	1
Alternative C6l Rapid Replacement/Full Closure/Longer Span	No	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	No	1
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	No	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	No	1

Mitigation: Tow truck plan/incident plan.

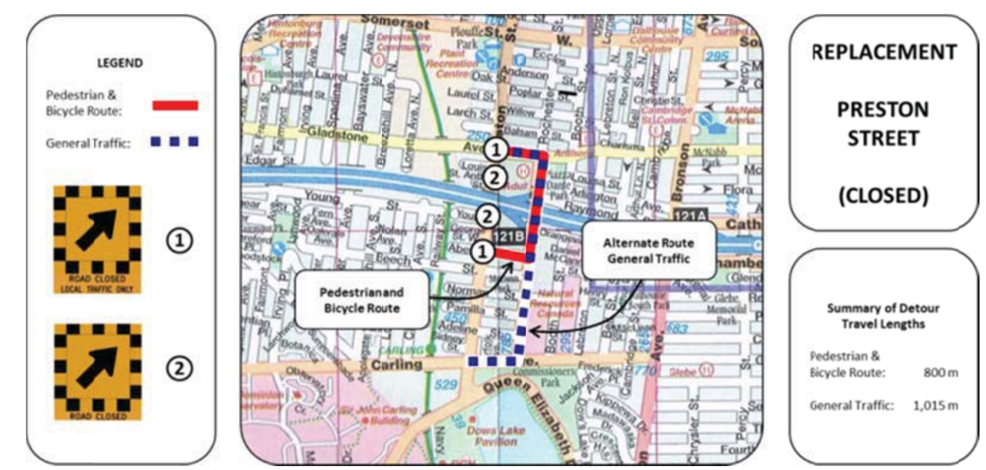
Pedestrian – Delay and Out-of-way Travel



Description: This sub-factor measures the length and duration of pedestrian out-of-way travel on the side streets while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily sidewalk closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period. Pedestrians will be signed to use the opposite sidewalk from the adjacent signalized intersections.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. Pedestrians will use a single sidewalk and cross the street at the temporary signals. The duration of the temporary signals will be 6 weeks.



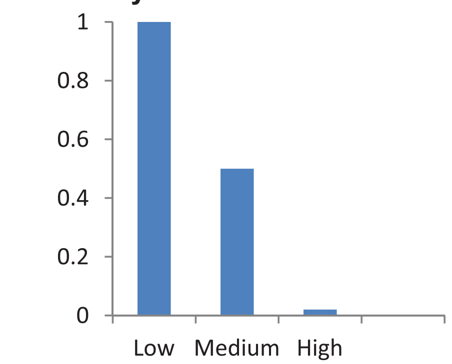
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure pedestrians will be directed to Rochester Street, for a maximum out-of-way travel of 0.8 km. This sub-factor measures a one-way trip only. For the detour route, refer to the Preliminary Highway Engineering Traffic Staging Alternatives Report, dated August 5, 2014.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0

Alternative C6e Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

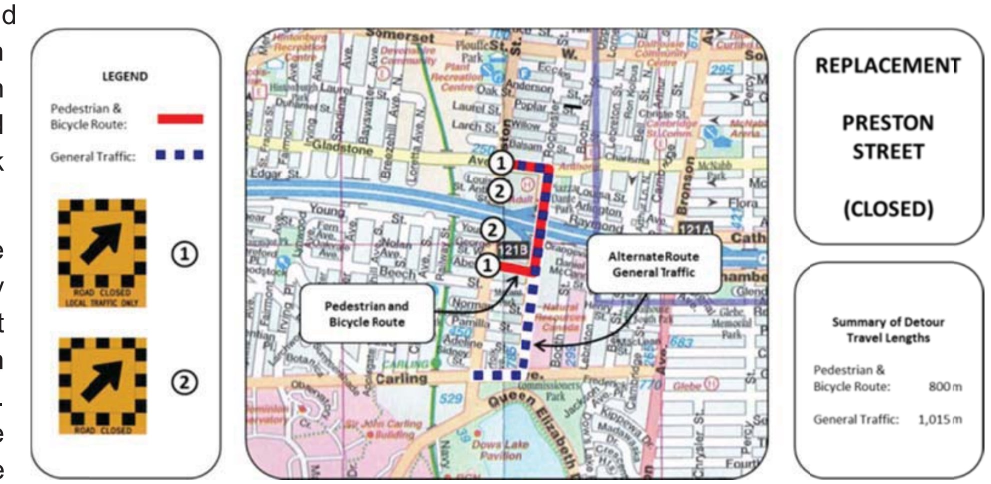
Mitigation: Advance signage for pedestrians to travel to the alternate sidewalk route as well as pre-event information to the property owners.

Bicycle – Delay and Out-of-Way Travel



Description: This sub-factor measures the length and duration of bicycle delay and out-of-way travel on the side street while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily lane and bike lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.



Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. Bicyclists will use the single lane detour through the temporary signals. The duration of the temporary signals will be 6 weeks.

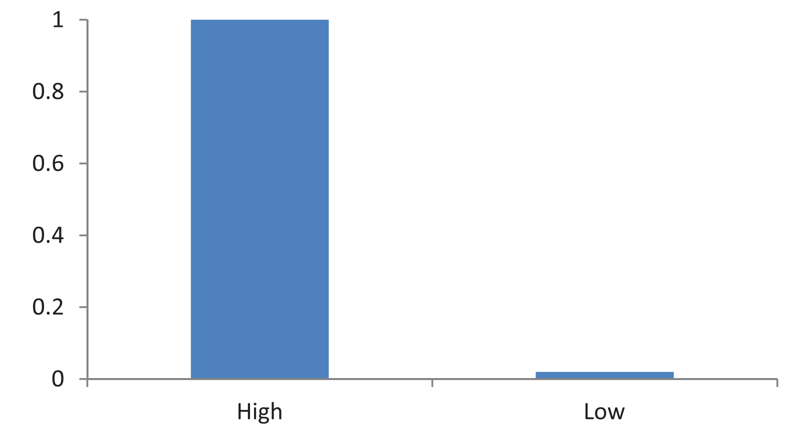
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure, bicyclists will be directed to Rochester Street, for a maximum out-of-way travel of 0.8 km. This sub-factor measures a one-way trip only. For the detour route, refer to the Preliminary Highway Engineering Traffic Staging Alternatives Report, dated August 5, 2014.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e	Medium	0.5

Rapid Replacement/Full Closure/Existing Span		
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: Advance signage for cyclists to choose an alternate route as well as pre-event information to the Regional cycling clubs.

Pedestrian/Bicycle Safety

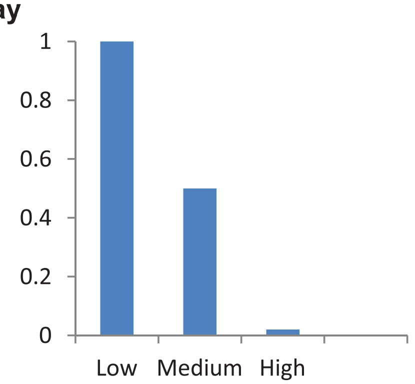


Description: This sub-factor measures if an alternative provides greater lateral space to increase pedestrian and bicycle safety. Those alternatives providing the largest span are preferred (high potential) and those alternatives matching the existing span are not preferred (i.e. low potential).

Alternatives	High/Low	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	0
Alternative A5e Conventional Rehab/Existing Span	Low	0
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Low	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	1
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Low	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Low	0
Alternative C6l Rapid Replacement/Full Closure/Longer Span	High	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	High	1
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	High	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	High	1

Mitigation: None.

Transit Operations Delay



Description: This sub-factor measures the delay during construction that will affect transit operations. Bus route affected: No. 85. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. The duration of the temporary signals will be 6 weeks.

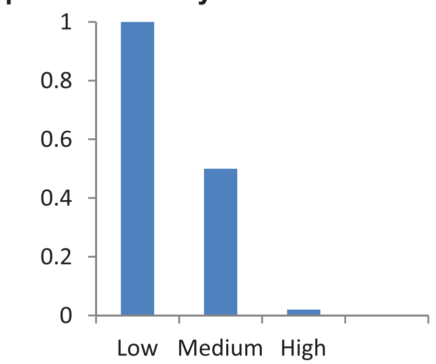
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure transit will be directed to Rochester Street, for a maximum out-of-way travel of 1.7 km. This sub-factor measures a one-way trip only. For the detour route, refer to the Preliminary Highway Engineering Traffic Staging Alternatives Report, dated August 5, 2014.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0

Alternative C6e Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: Advance information to OC Transpo and temporary bus stop relocations if required.

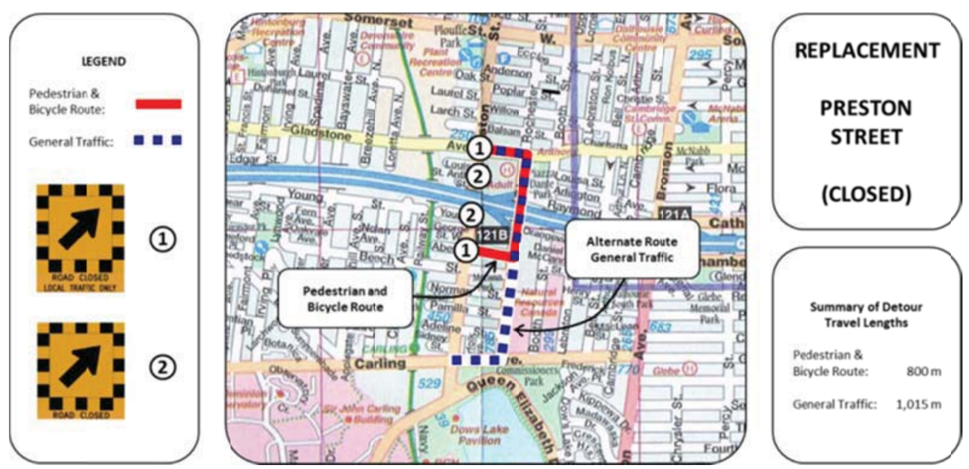
General Traffic Municipal Street Delay



Description: This sub-factor measures the delay during construction that will affect general traffic operations. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. The duration of the temporary signals will be 6 weeks.



High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure vehicles will be directed to Rochester Street, for a maximum out-of-way travel of 1.0 km. This sub-factor measures a one-way trip only. For the detour route, refer to the Preliminary Highway Engineering Traffic Staging Alternatives Report, dated August 5, 2014.

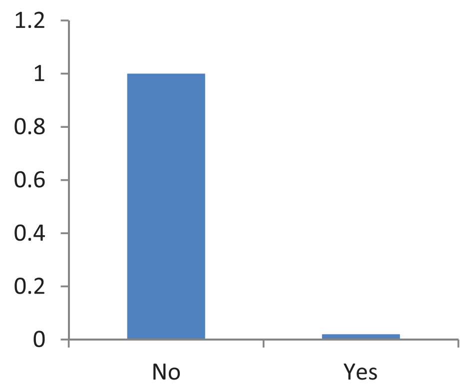
Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Medium	0.5

Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: The use of advisory signage and potential use of variable message signage can be used to advise drivers before reaching the construction site.

Factor Group: Social and Cultural Environment

Community Green Spaces Impacts

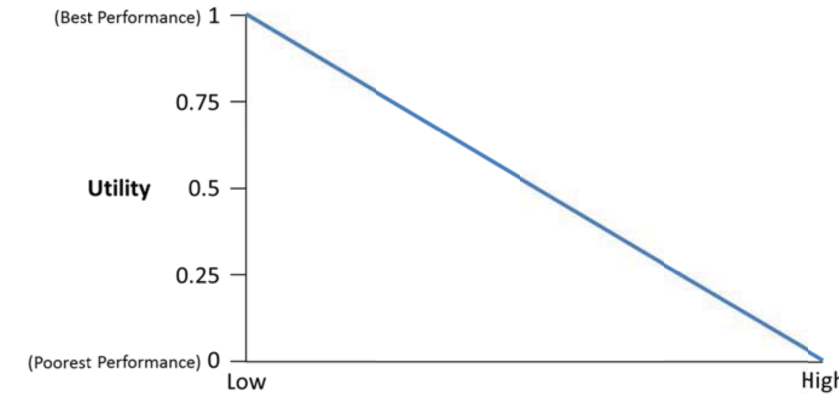


Description: This sub-factor measures the temporary impacts to Community Green Space, the St. Anthony's soccer field which may be used as the construction and staging area for RBR bridges. Alternatives that do not impact parks or playground green spaces are preferred. The duration of the loss of park space is estimated to be 8 months.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	No	1
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	No	1
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Yes	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Yes	0
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Yes	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Yes	0
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Yes	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Yes	0

Mitigation: Avoidance.

Impact to Emergency Response

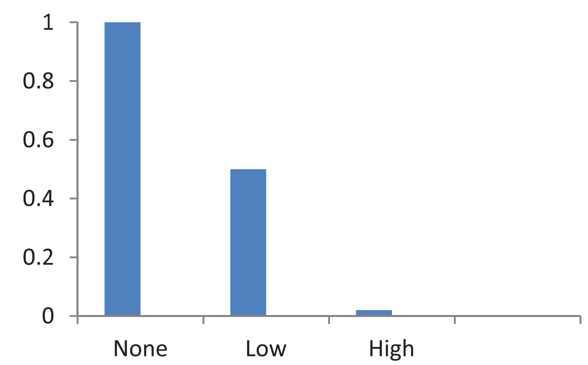


Description: This sub-factor measures the duration of Queensway closure that will affect emergency response service (police, ambulance and fire). Alternatives that reduce the length of time that there are lane closures on the Queensway are preferred.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	0.9
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0.0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0.0
Alternative C6e SINGLE REPLACEMENT Rapid Replacement/Full Closure/Existing Span	0	2	2	1.0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	20	12	32	0.9
Alternative C6l SINGLE REPLACEMENT Rapid Replacement/Full Closure/Longer Span	0	2	2	1.0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	20	12	32	0.9
Alternative D6l SINGLE REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	0	2	2	1.0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	20	12	32	0.9

Mitigation: Advanced warning of lane closures or detour routes.

Potentially Contaminated Property



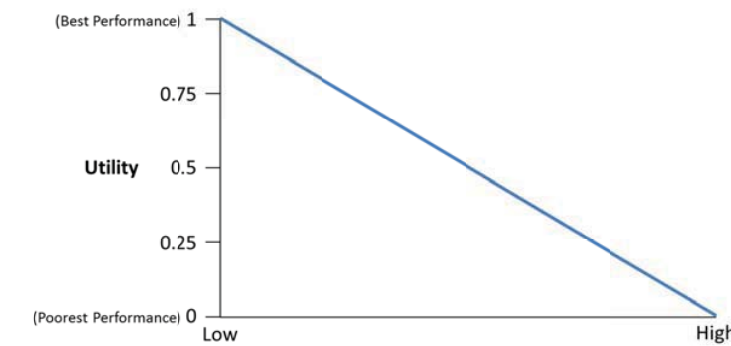
Description: This sub-factor measures whether there is potential to encounter potentially contaminated property during the construction of an alternative. Alternatives that minimize excavation are preferred. RBR staging sites have high potential (i.e. large footprint of excavation) to impact potentially contaminated property. Any alternative excavating in place has low potential to impact potentially contaminated property. The rehabilitation options have no potential to impact potentially contaminated property due to the small footprint of works.

Alternatives	No/Low/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Low	0.5
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Low	0.5
Alternative C6e Rapid Replacement/Full Closure/Existing Span	High	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	High	0
Alternative C6l Rapid Replacement/Full Closure/Longer Span	High	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	High	0
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	High	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	High	0

Mitigation: Avoidance.

Factor Group: Cost

Capital Cost

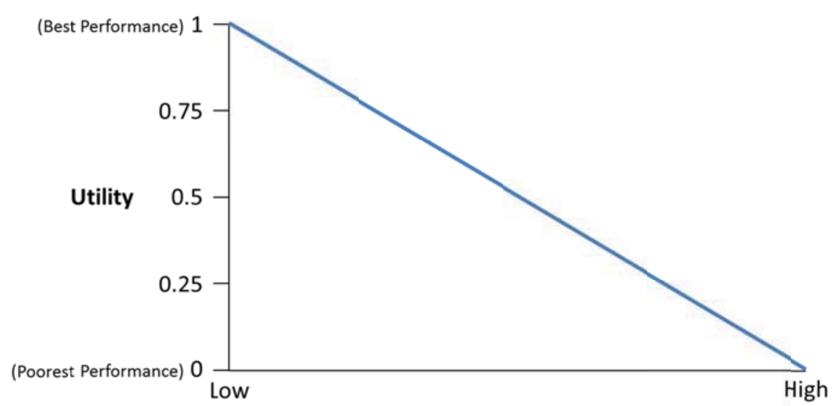


Description: This sub-factor measures the difference in initial capital cost of the alternative (bridge, traffic staging, staging area, and property costs). Those alternatives with the lowest capital cost are preferred. These costs do not include Engineering Costs.

Alternatives	$M		Utility Score
Alternative A2e Rapid Rehab/Existing Span	Structure 0.9 Staging 0.6 Property 0	1.5	1
Alternative A5e Conventional Rehab/Existing Span	Structure 0.9 Staging 1.25 Property 0	2.15	0.9
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Structure 2.88 Staging 1.2 Property 0	4.08	0.6
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Structure 3.61 Staging 1.2 Property 0	4.81	0.4
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Structure 5.20 Staging 0.60 Property 0	5.8	0.3
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Structure 5.20 Staging 0.60 Property 0	5.8	0.3
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Structure 6.66 Staging 0.60 Property 0	7.26	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Structure 6.66 Staging 0.60 Property 0	7.26	0
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Structure 6.31 Staging 0.60 Property 0	6.91	0.1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Structure 6.31 Staging 0.60 Property 0	6.91	0.1

Mitigation: N/A

Future Life Cycle Cost



Description: This sub-factor measures the difference in future life cycle costs (maintenance, operating costs and long term replacement and rehabilitation in the 40 year planning horizon). Those alternatives with the lowest long term life cycle cost are preferred. A 5% discount rate was used.

Alternatives	$M	Utility Score
Alternative A2e Rapid Rehab/Existing Span	3.72	1
Alternative A5e Conventional Rehab/Existing Span	4.38	0.9
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	4.72	0.9
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	5.54	0.6
Alternative C6e Rapid Replacement/Full Closure/Existing Span	6.72	0.4
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	7.27	0.2
Alternative C6l Rapid Replacement/Full Closure/Longer Span	8.36	0.1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	8.91	0
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	7.97	0.2
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	8.52	0.1

Mitigation: N/A

VERSION: November 11, 2014

APPENDIX E

SUB-FACTOR UTILITY FUNCTION DEFINITIONS AND MEASUREMENTS FOR SHORT LISTED EVALUATION CRITERIA

ROCHESTER STREET EASTBOUND BRIDGE

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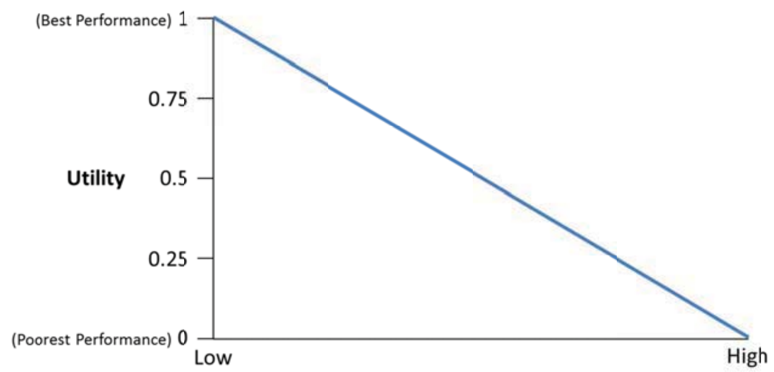
Factor Group: Transportation

Maximum Peak Queue Length on Queensway



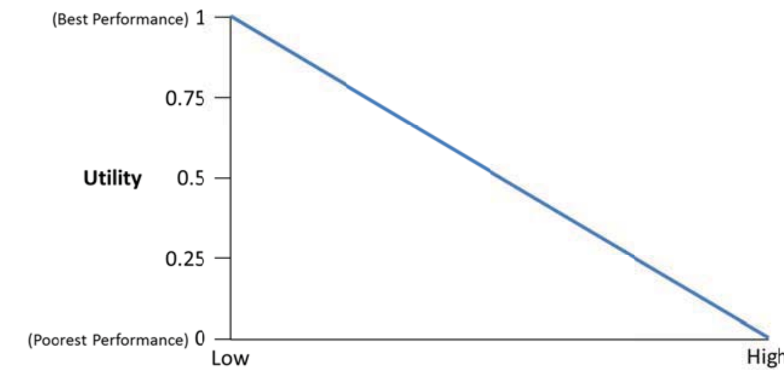
Description: This sub-factor measures the forecast queue length effect in the peak hour including measures to divert trips and induce transportation demand management during construction. The sub-factor measures the queue duration (days) and the forecast queue length (after the use of mitigation). This sub-factor is indicative of highway performance and safety, and is related to: effects on ramp operations, rear end collisions influenced by stop and go traffic, poor weaving conditions and traffic congestion.

(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	km days (peak hour)	Utility Score
Alternative A2e Rapid Rehab/Existing Span	41	0.98
Alternative A5e Conventional Rehab/Existing Span	780	0.59
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	1920	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	1920	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	2	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	240	0.9
Alternative C6l Rapid Replacement/Full Closure/Longer Span	2	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	240	0.9
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	2	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	240	0.9

Mitigation: The use of advance advertising and advising drivers of the scheduled lane closures through PVMS placement in advance of construction will be measures that will reduce demand by changing the time of travel of commuters, use of transit as an alternate mode of travel, or by inducing diversion to the municipal road system as an alternate route.

Delays

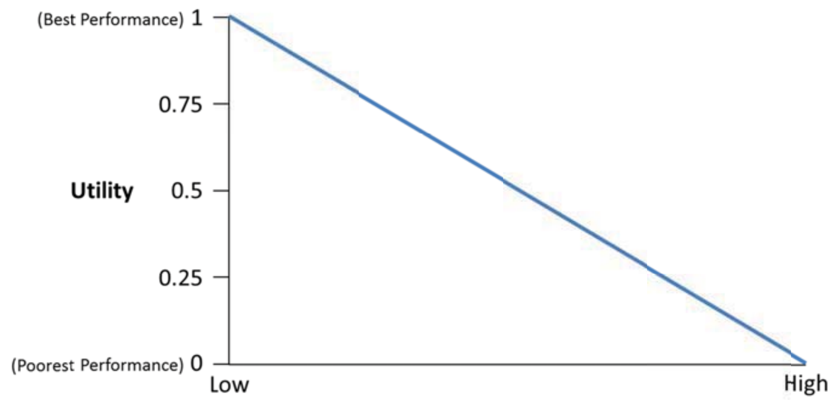


Description: This sub-factor measures the total lane closure peak period delay to drivers on the Queensway during the construction period. It includes the total peak period delay forecast for the duration of construction of the alternative. The delay sub-factor, although measuring vehicles on the Queensway, is also indicative of the delays for drivers diverted from the Queensway and operating on the municipal road system.
(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	Veh h	Utility Score
Alternative A2e Rapid Rehab/Existing Span	16,520	1
Alternative A5e Conventional Rehab/Existing Span	1,537,200	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	3,782,800	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	3,782,800	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	520	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	472,600	0.9
Alternative C6l Rapid Replacement/Full Closure/Longer Span	520	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	472,600	0.9
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	520	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	472,600	0.9

Mitigation: N/A

Ramp Closures

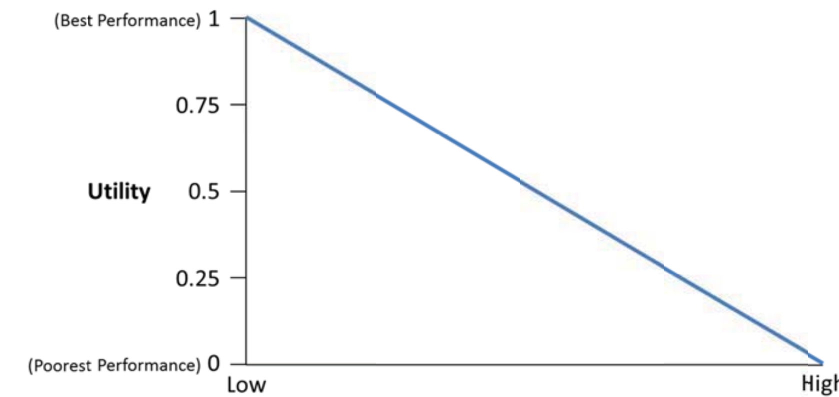


Description: This sub-factor measures the impact to community access by quantifying the volume of peak hour ramp trips that will be removed from entering or exiting from the Queensway. The sub-factor measures the peak hour ramp volume for each stage of the highway staging plan for the duration of the closure.

Alternatives	Veh (peak hour)	Utility Score
Alternative A2e Rapid Rehab/Existing Span	0	1
Alternative A5e Conventional Rehab/Existing Span	0	1
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	0	1
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	0	1
Alternative C6e Rapid Replacement/Full Closure/Existing Span	8058	0.55
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	0	1
Alternative C6l Rapid Replacement/Full Closure/Longer Span	8058	0.55
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	0	1
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	8058	0.55
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	0	1

Mitigation: Ramps may be closed by time of day to allow access in non-peak hours.

Highway Safety - Collision Potential

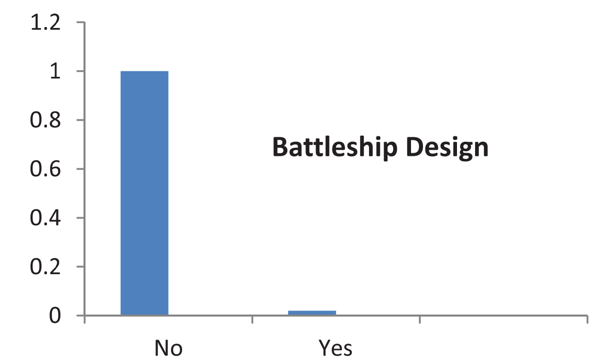


Description: This sub-factor measures the collision potential of the alternative by measuring the time duration that drivers will be required to transition through the construction zone.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	0.9
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	0	2	2	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	20	12	32	0.9
Alternative C6l Rapid Replacement/Full Closure/Longer Span	0	2	2	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	20	12	32	0.9
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	0	2	2	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	20	12	32	0.9

Mitigation: N/A

Highway Safety – Design Consistency of Traffic Staging Design

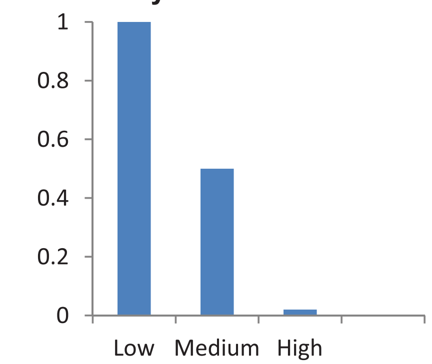


Description: This sub-factor measures the collision potential of the highway staging design. Those alternatives including a non-conventional battleship design (i.e. yes) are least preferred.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Yes	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Yes	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	No	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	No	1
Alternative C6l Rapid Replacement/Full Closure/Longer Span	No	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	No	1
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	No	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	No	1

Mitigation: Tow truck plan/incident plan.

Pedestrian – Delay and Out-of-way Travel

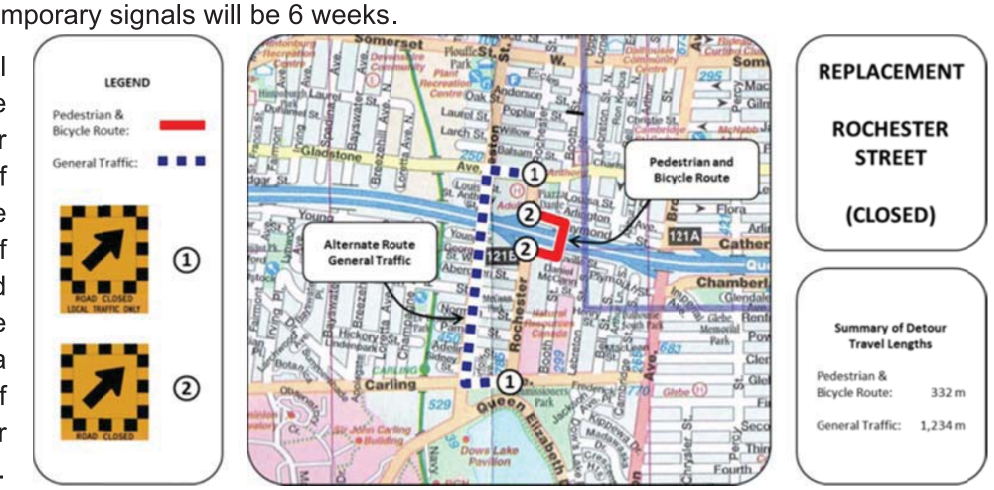


Description: This sub-factor measures the length and duration of pedestrian out-of-way travel on the side streets while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily sidewalk closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period. Pedestrians will be signed to use the opposite sidewalk from the adjacent signalized intersections.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. Pedestrians will use a single sidewalk and cross the street at the temporary signals. The duration of the temporary signals will be 6 weeks.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure pedestrians will be directed to Booth Street, for a maximum out-of-way travel of 0.3 km. This sub-factor measures a one-way trip only.

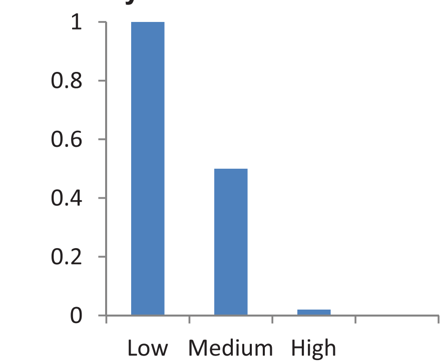


Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0

Alternative C6e Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: Advance signage for pedestrians to travel to the alternate sidewalk route as well as pre-event information to the property owners.

Bicycle – Delay and Out-of-Way Travel

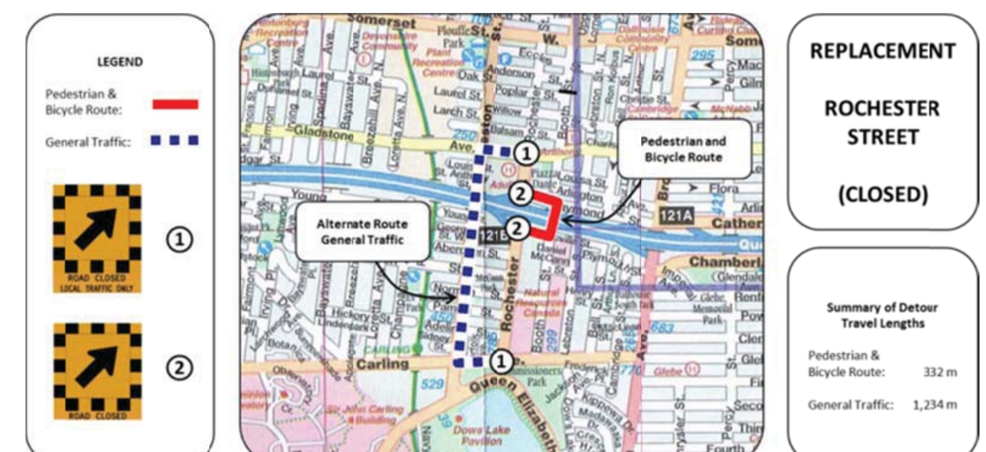


Description: This sub-factor measures the length and duration of bicycle delay and out-of-way travel on the side street while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily lane and bike lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. Bicyclists will use the single lane detour through the temporary signals. The duration of the temporary signals will be 6 weeks.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure, bicyclists will be directed to Booth Street, for a maximum out-of-way travel of 0.3 km. This sub-factor measures a one-way trip only.

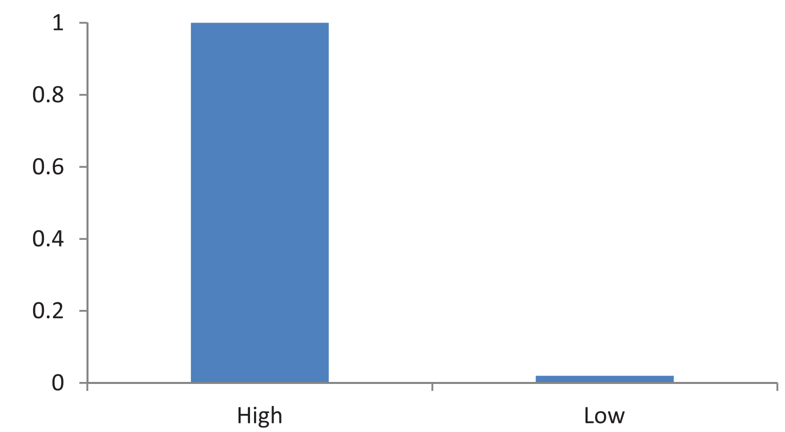


Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C7e	Medium	0.5

Rapid Replacement/Two Lane Detour/Existing Span		
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: Advance signage for cyclists to choose an alternate route as well as pre-event information to the Regional cycling clubs.

Pedestrian/Bicycle Safety

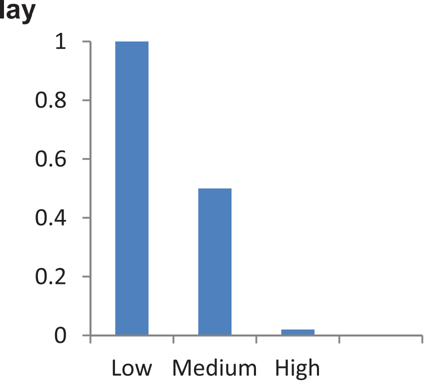


Description: This sub-factor measures if an alternative provides greater lateral space to increase pedestrian and bicycle safety. Those alternatives providing the largest span are preferred (high potential) and those alternatives matching the existing span are not preferred (i.e. low potential).

Alternatives	High/Low	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	0
Alternative A5e Conventional Rehab/Existing Span	Low	0
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Low	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	1
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Low	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Low	0
Alternative C6l Rapid Replacement/Full Closure/Longer Span	High	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	High	1
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	High	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	High	1

Mitigation: None.

Transit Operations Delay



Description: This sub-factor measures the delay during construction that will affect transit operations. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

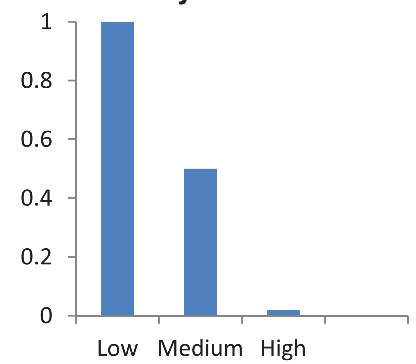
Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. The duration of the temporary signals will be 6 weeks.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. There is no transit detour required, therefore the replacement alternatives are rated low instead of high.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Low	1
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Low	1
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Medium	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0

Mitigation: Advance information to OC Transpo and temporary relocation of bus stops if required.

General Traffic Municipal Street Delay

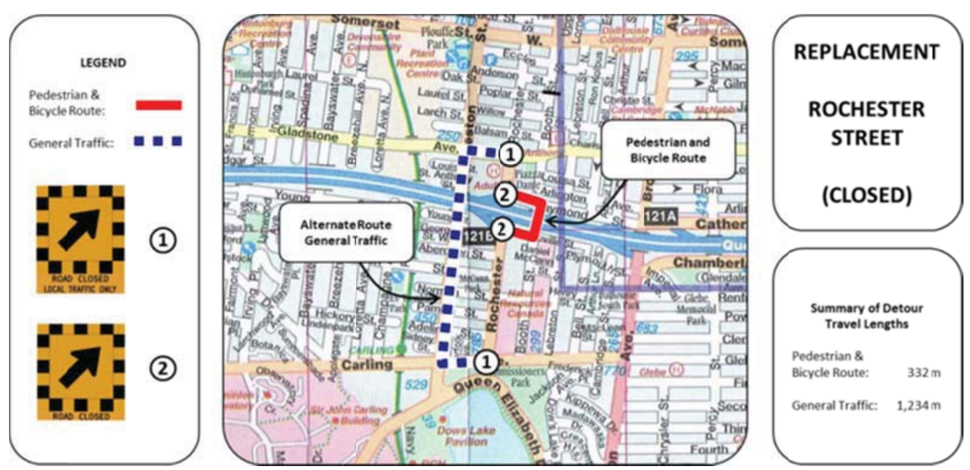


Description: This sub-factor measures the delay during construction that will affect general traffic operations. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. The duration of the temporary signals will be 6 weeks.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure vehicles will be directed to Booth Street, for a maximum out-of-way travel of 1.2 km. This sub-factor measures a one-way trip only.



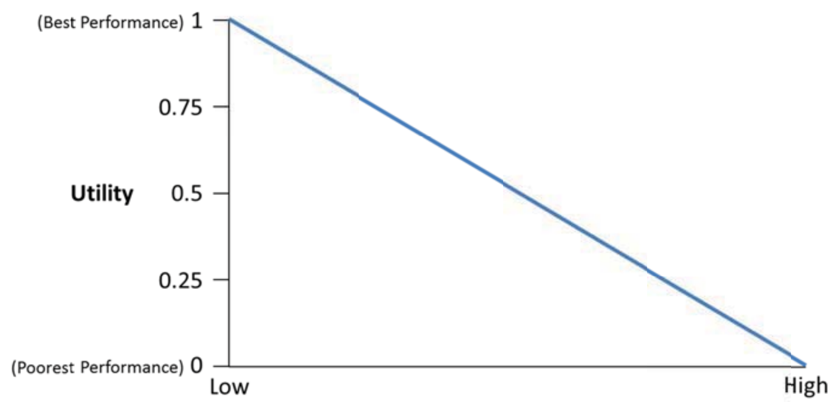
Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5

Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: The use of advisory signage and potential use of variable message signage can be used to advise drivers before reaching the construction site.

Factor Group: Social and Cultural Environment

Impact to Emergency Response

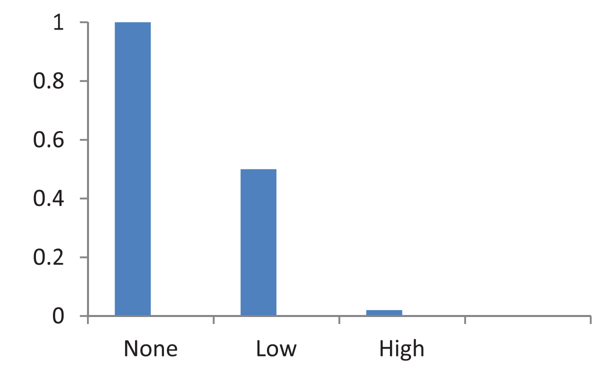


Description: This sub-factor measures the duration of Queensway closure that will affect emergency response service (police, ambulance and fire). Alternatives that reduce the length of time that there are lane closures on the Queensway are preferred.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	0.9
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0.0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0.0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	0	2	2	1.0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	20	12	32	0.9
Alternative C6l Rapid Replacement/Full Closure/Longer Span	0	2	2	1.0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	20	12	32	0.9
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	0	2	2	1.0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	20	12	32	0.9

Mitigation: Advanced warning of lane closures or detour routes.

Potentially Contaminated Property



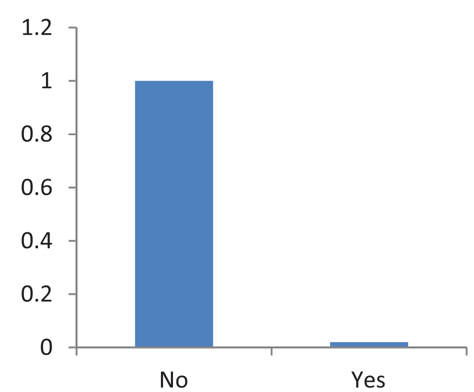
Description: This sub-factor measures whether there is potential to encounter potentially contaminated property during the construction of an alternative. Alternatives that minimize excavation are preferred. RBR staging sites have high potential (i.e. large footprint of excavation) to impact potentially contaminated property. Any alternative excavating in place has low potential to impact potentially contaminated property. The rehabilitation options have no potential to impact potentially contaminated property due to the small footprint of works.

Alternatives	No/Low/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Low	0.5
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Low	0.5
Alternative C6e Rapid Replacement/Full Closure/Existing Span	High	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	High	0
Alternative C6l Rapid Replacement/Full Closure/Longer Span	High	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	High	0
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	High	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	High	0

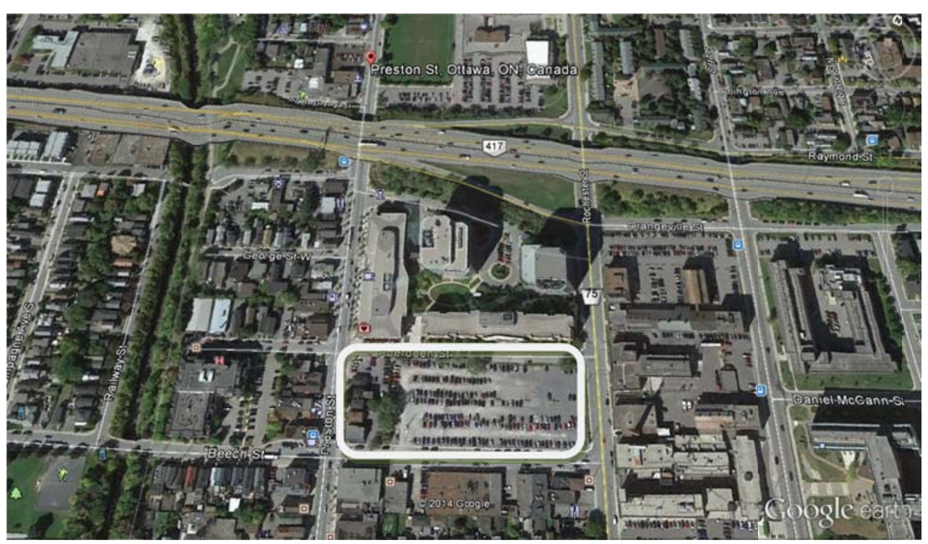
Mitigation: Avoidance.

Factor Group: Land Use and Property

Temporary Property Impacts



Description: This sub-factor measures whether property (i.e. parking lot at Beech/Rochester/Aberdeen) is required for temporary use as a bridge staging area, as per the RBR Structure Staging Sites memo.



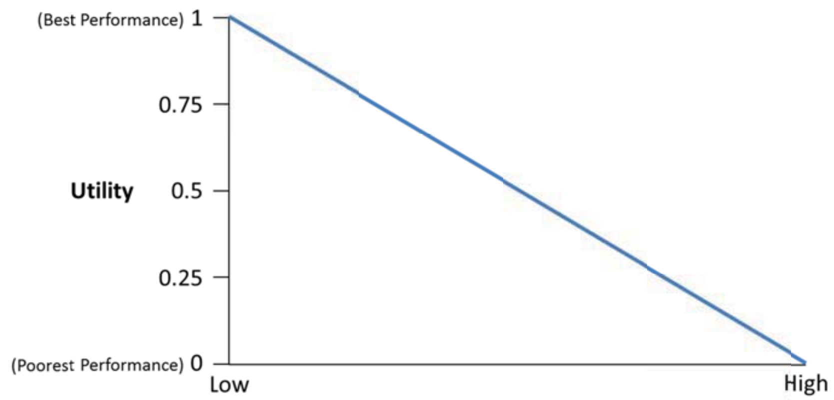
Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	No	1
Alternative B9l	No	1

Conventional Replacement/Three Stage Detour/Longer Span		
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Yes	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Yes	0
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Yes	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Yes	0
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Yes	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Yes	0

Mitigation: N/A

Factor Group: Cost

Capital Cost

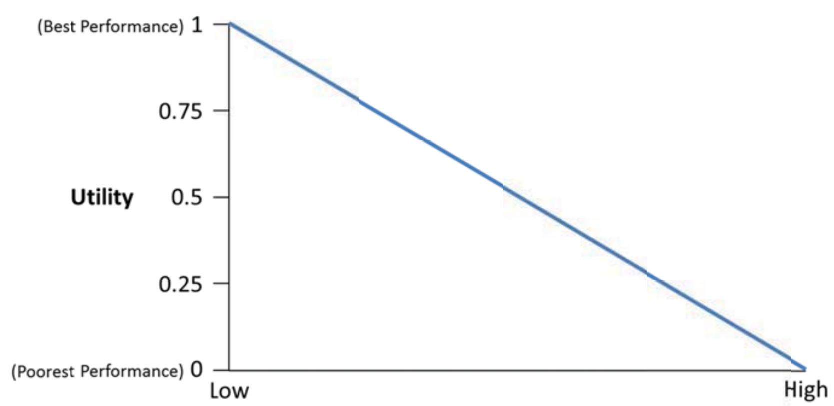


Description: This sub-factor measures the difference in initial capital cost of the alternative (bridge, traffic staging, staging area, and property costs). Those alternatives with the lowest capital cost are preferred. These costs do not include Engineering Costs.

Alternatives	$M		Utility Score
Alternative A2e Rapid Rehab/Existing Span	Structure 0.66 Staging 0.6 Property 0	1.26	1
Alternative A5e Conventional Rehab/Existing Span	Structure 0.66 Staging 1.25 Property 0	1.25	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Structure 2.30 Staging 1.2 Property 0	4.16	0.5
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Structure 2.93 Staging 1.2 Property 0	4.13	0.5
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Structure 4.62 Staging 0.60 Property 0.20	5.42	0.3
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Structure 6.14 Staging 0.60 Property 0.20	6.94	0
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Structure 6.14 Staging 0.60 Property 0.20	6.94	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Structure 6.14 Staging 0.60 Property 0.20	6.94	0
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Structure 6.14 Staging 0.60 Property 0.20	6.94	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Structure 6.14 Staging 0.60 Property 0.20	6.94	0

Mitigation: N/A

Future Life Cycle Cost



Description: This sub-factor measures the difference in future life cycle costs (maintenance, operating costs and long term replacement and rehabilitation in the 40 year planning horizon). Those alternatives with the lowest long term life cycle cost are preferred. A 5% discount rate was used.

Alternatives	$M	Utility Score
Alternative A2e Rapid Rehab/Existing Span	3.26	1
Alternative A5e Conventional Rehab/Existing Span	3.92	0.9
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	4.06	0.9
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	4.76	0.8
Alternative C6e Rapid Replacement/Full Closure/Existing Span	6.06	0.4
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	6.61	0.3
Alternative C6l Rapid Replacement/Full Closure/Longer Span	7.77	0.1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	8.32	0
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	7.35	0.2
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	7.90	0.1

Mitigation: N/A

VERSION: November 11, 2014

APPENDIX E

SUB-FACTOR UTILITY FUNCTION DEFINITIONS AND MEASUREMENTS FOR SHORT LISTED EVALUATION CRITERIA

ROCHESTER STREET WESTBOUND BRIDGE

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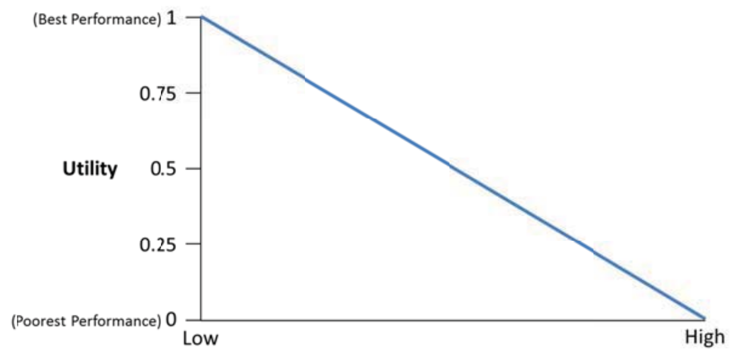
Factor Group: Transportation

Maximum Peak Queue Length on Queensway



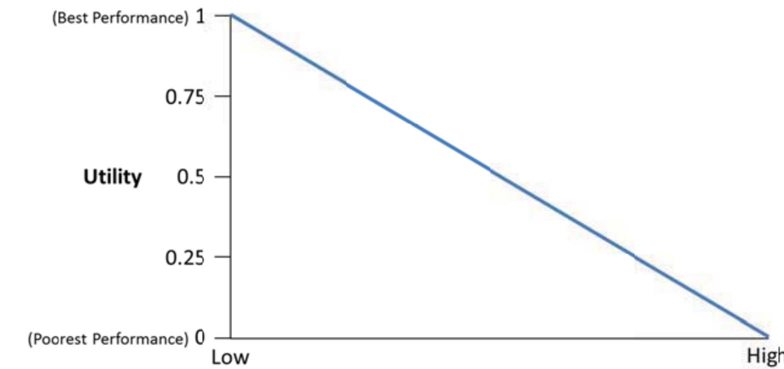
Description: This sub-factor measures the forecast queue length effect in the peak hour including measures to divert trips and induce transportation demand management during construction. The sub-factor measures the queue duration (days) and the forecast queue length (after the use of mitigation). This sub-factor is indicative of highway performance and safety, and is related to: effects on ramp operations, rear end collisions influenced by stop and go traffic, poor weaving conditions and traffic congestion.

(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	km days (peak hour)	Utility Score
Alternative A2e Rapid Rehab/Existing Span	41	0.98
Alternative A5e Conventional Rehab/Existing Span	780	0.59
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	1920	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	1920	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	2	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	240	0.9
Alternative C6l Rapid Replacement/Full Closure/Longer Span	2	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	240	0.9
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	2	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	240	0.9

Mitigation: The use of advance advertising and advising drivers of the scheduled lane closures through PVMS placement in advance of construction will be measures that will reduce demand by: changing the time of travel of commuters, use of transit as an alternate mode of travel or by inducing diversion to the municipal road system as an alternate route.

Delays

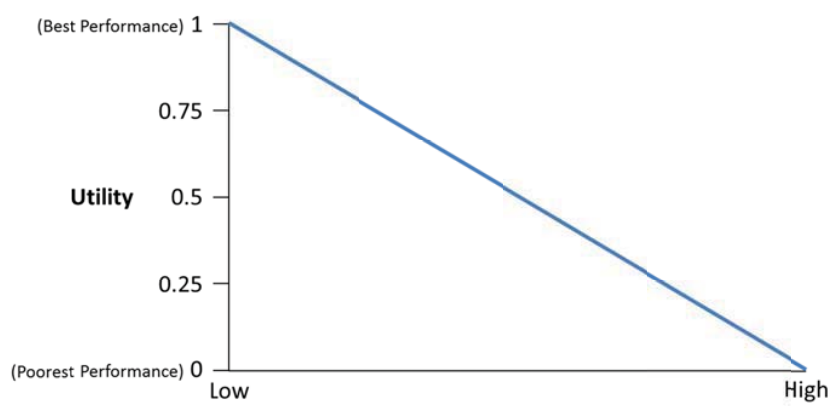


Description: This sub-factor measures the total lane closure peak period delay to drivers on the Queensway during the construction period. It includes the total peak period delay forecast for the duration of construction of the alternative. The delay sub-factor, although measuring vehicles on the Queensway, is also indicative of the delays for drivers diverted from the Queensway and operating on the municipal road system.
(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	Veh h	Utility Score
Alternative A2e Rapid Rehab/Existing Span	16,520	1
Alternative A5e Conventional Rehab/Existing Span	1,537,200	0.6
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	3,782,800	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	3,782,800	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	520	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	472,600	0.9
Alternative C6l Rapid Replacement/Full Closure/Longer Span	520	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	472,600	0.9
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	520	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	472,600	0.9

Mitigation: N/A

Ramp Closures

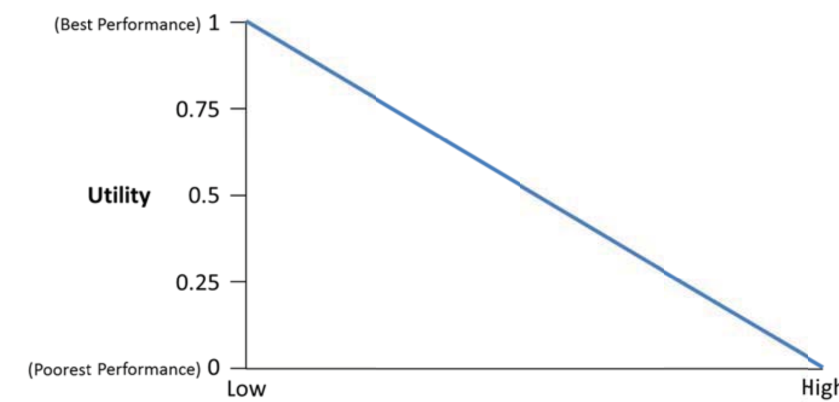


Description: This sub-factor measures the impact to community access by quantifying the volume of peak hour ramp trips that will be removed from entering or exiting from the Queensway. The sub-factor measures the peak hour ramp volume for each stage of the highway staging plan for the duration of the closure.

Alternatives	Veh (peak hour)	Utility Score
Alternative A2e Rapid Rehab/Existing Span	0	1
Alternative A5e Conventional Rehab/Existing Span	0	1
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	0	1
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	0	1
Alternative C6e Rapid Replacement/Full Closure/Existing Span	8058	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	0	1
Alternative C6l Rapid Replacement/Full Closure/Longer Span	8058	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	0	1
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	8058	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	0	1

Mitigation: Ramps may be closed by time of day to allow access in non-peak hours.

Highway Safety - Collision Potential

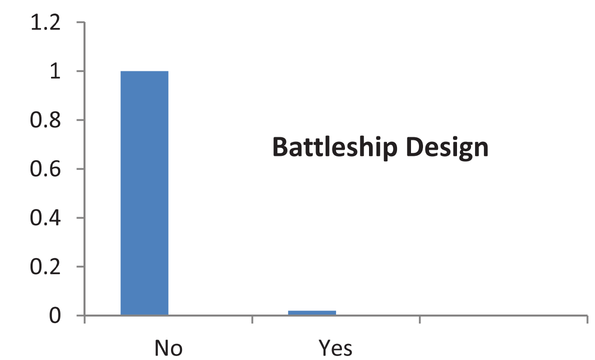


Description: This sub-factor measures the collision potential of the alternative by measuring the time duration that drivers will be required to transition through the construction zone.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	0.8
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.5
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	0	2	2	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	20	12	32	0.9
Alternative C6l Rapid Replacement/Full Closure/Longer Span	0	2	2	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	20	12	32	0.9
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	0	2	2	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	20	12	32	0.9

Mitigation: N/A

Highway Safety – Design Consistency of Traffic Staging Design

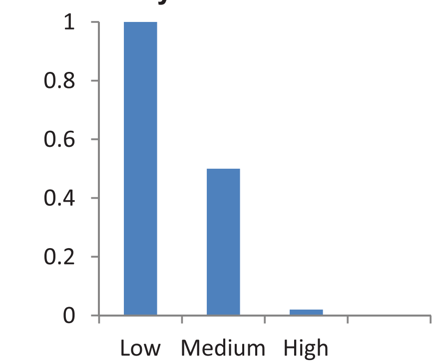


Description: This sub-factor measures the collision potential of the highway staging design. Those alternatives including a non-conventional battleship design (i.e. yes) are least preferred.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Yes	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Yes	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	No	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	No	1
Alternative C6l Rapid Replacement/Full Closure/Longer Span	No	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	No	1
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	No	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	No	1

Mitigation: Tow truck plan/incident plan.

Pedestrian – Delay and Out-of-way Travel

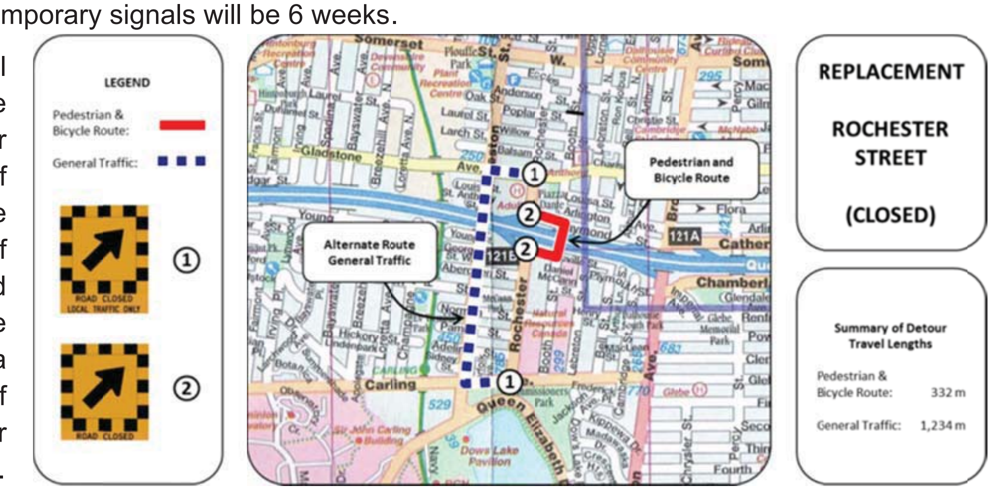


Description: This sub-factor measures the length and duration of pedestrian out-of-way travel on the side streets while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily sidewalk closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period. Pedestrians will be signed to use the opposite sidewalk from the adjacent signalized intersections.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. Pedestrians will use a single sidewalk and cross the street at the temporary signals. The duration of the temporary signals will be 6 weeks.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure pedestrians will be directed to Booth Street, for a maximum out-of-way travel of 0.3 km. This sub-factor measures a one-way trip only.

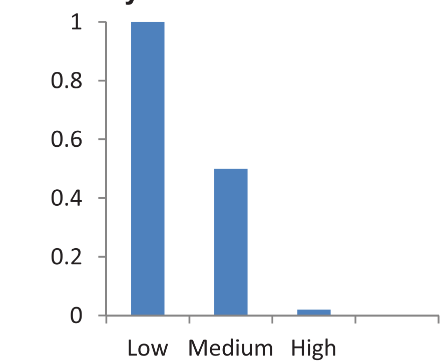


Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0

Alternative C6e Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: Advance signage for pedestrians to travel to the alternate sidewalk route as well as pre-event information to the property owners.

Bicycle – Delay and Out-of-Way Travel

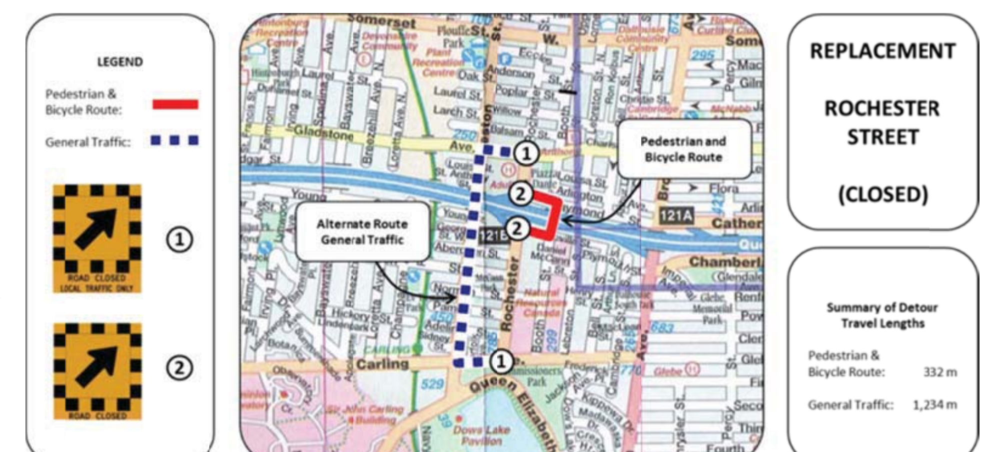


Description: This sub-factor measures the length and duration of bicycle delay and out-of-way travel on the side street while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily lane and bike lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. Bicyclists will use the single lane detour through the temporary signals. The duration of the temporary signals will be 6 weeks.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure, bicyclists will be directed to Booth Street, for a maximum out-of-way travel of 0.3 km. This sub-factor measures a one-way trip only.

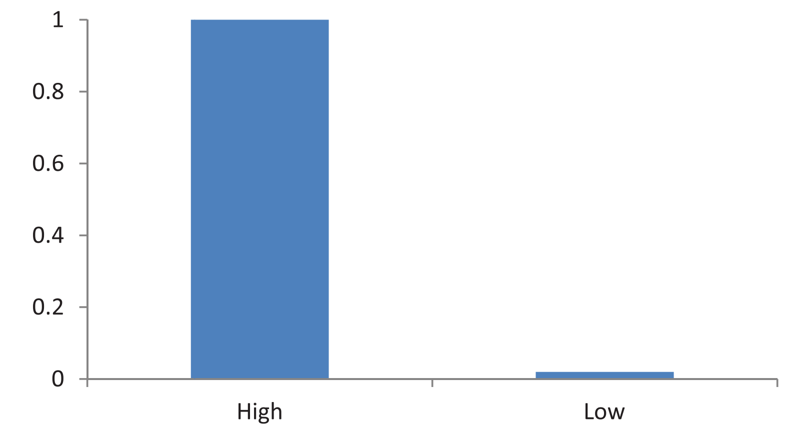


Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C7e	Medium	0.5

Rapid Replacement/Two Lane Detour/Existing Span		
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: Advance signage for cyclists to choose an alternate route as well as pre-event information to the Regional cycling clubs.

Pedestrian/Bicycle Safety

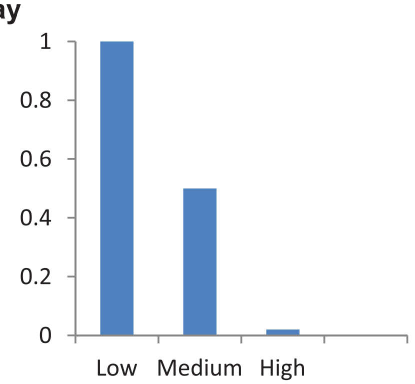


Description: This sub-factor measures if an alternative provides greater lateral space to increase pedestrian and bicycle safety. Those alternatives providing the largest span are preferred (high potential) and those alternatives matching the existing span are not preferred (i.e. low potential).

Alternatives	High/Low	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	0
Alternative A5e Conventional Rehab/Existing Span	Low	0
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Low	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	1
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Low	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Low	0
Alternative C6l Rapid Replacement/Full Closure/Longer Span	High	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	High	1
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	High	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	High	1

Mitigation: None.

Transit Operations Delay



Description: This sub-factor measures the delay during construction that will affect transit operations. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

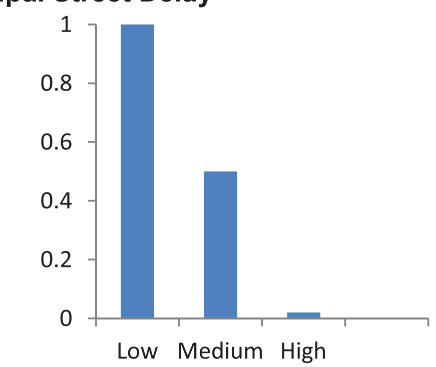
Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. The duration of the temporary signals will be 6 weeks.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. There is no transit detour required, therefore the replacement alternatives are rated low instead of high.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Low	1
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Low	1
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Medium	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0

Mitigation: Advance information to OC Transpo and temporary relocation of bus stops if required.

General Traffic Municipal Street Delay

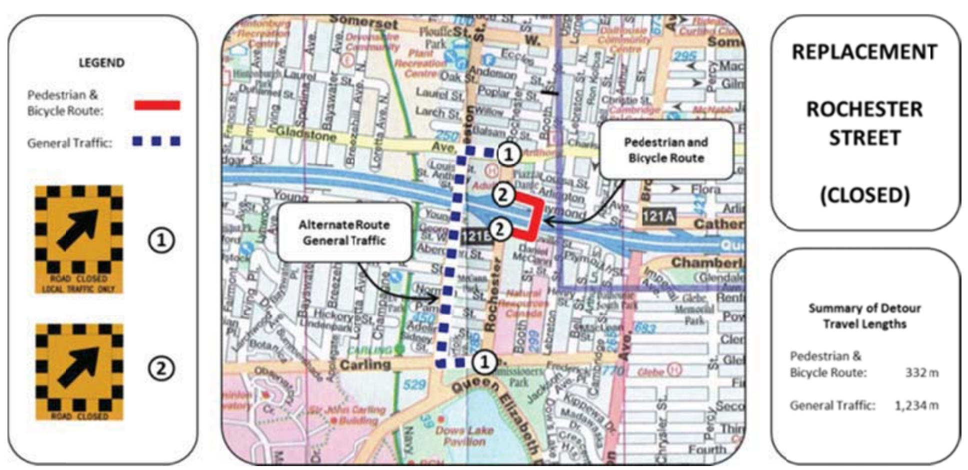


Description: This sub-factor measures the delay during construction that will affect general traffic operations. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. The duration of the temporary signals will be 6 weeks.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure vehicles will be directed to Booth Street, for a maximum out-of-way travel of 1.2 km. This sub-factor measures a one-way trip only.



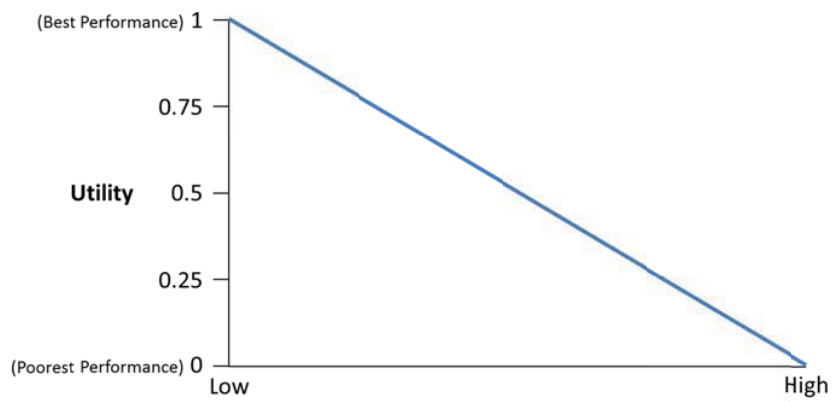
Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5

Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: The use of advisory signage and potential use of variable message signage can be used to advise drivers before reaching the construction site.

Factor Group: Social and Cultural Environment

Impact to Emergency Response

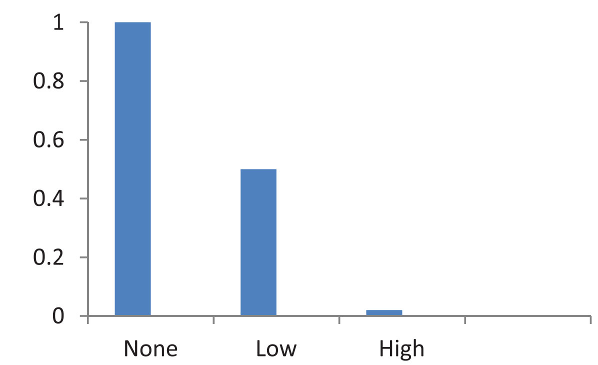


Description: This sub-factor measures the duration of Queensway closure that will affect emergency response service (police, ambulance and fire). Alternatives that reduce the length of time that there are lane closures on the Queensway are preferred.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	0.9
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0.0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0.0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	0	2	2	1.0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	20	12	32	0.9
Alternative C6l Rapid Replacement/Full Closure/Longer Span	0	2	2	1.0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	20	12	32	0.9
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	0	2	2	1.0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	20	12	32	0.9

Mitigation: Advanced warning of lane closures or detour routes.

Potentially Contaminated Property



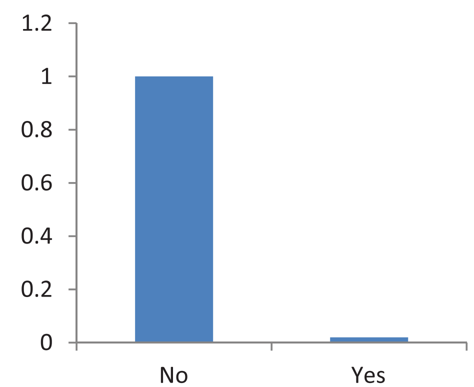
Description: This sub-factor measures whether there is potential to encounter potentially contaminated property during the construction of an alternative. Alternatives that minimize excavation are preferred. RBR staging sites have high potential (i.e. large footprint of excavation) to impact potentially contaminated property. Any alternative excavating in place has low potential to impact potentially contaminated property. The rehabilitation options have no potential to impact potentially contaminated property due to the small footprint of works.

Alternatives	No/Low/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Low	0.5
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Low	0.5
Alternative C6e Rapid Replacement/Full Closure/Existing Span	High	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	High	0
Alternative C6l Rapid Replacement/Full Closure/Longer Span	High	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	High	0
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	High	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	High	0

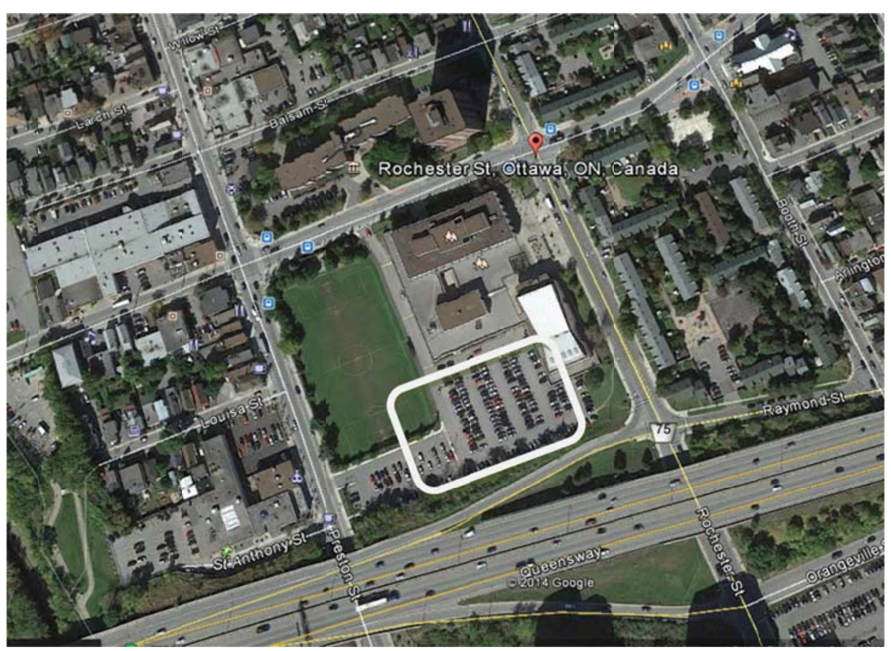
Mitigation: Avoidance.

Factor Group: Land Use and Property

Temporary Property Impacts



Description: This sub-factor measures whether property (i.e. parking lot at Raymond/Rochester) is required for temporary use as a bridge staging area (RO-01), as per the RBR Structure Staging Sites memo.

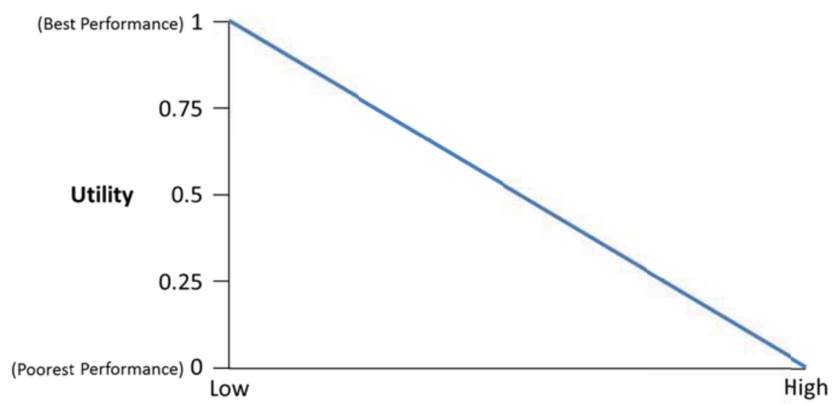


Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	No	1
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	No	1
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Yes	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Yes	0
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Yes	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Yes	0
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Yes	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Yes	0

Mitigation: N/A

Factor Group: Cost

Capital Cost



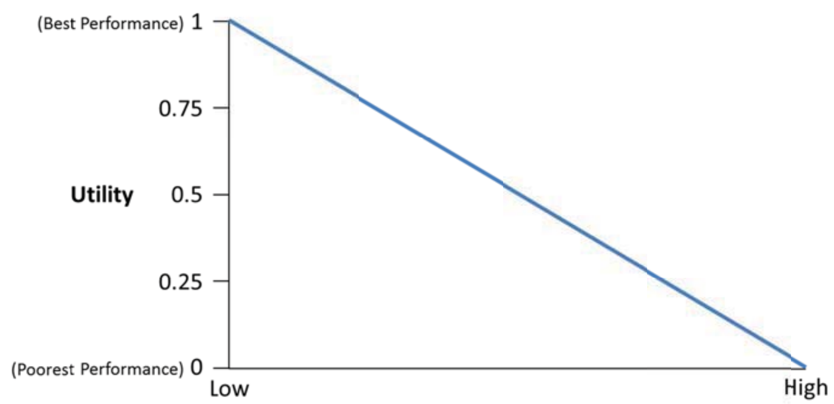
Description: This sub-factor measures the difference in initial capital cost of the alternative (bridge, traffic staging, staging area, and property costs). Those alternatives with the lowest capital cost are preferred. These costs do not include Engineering Costs.

Alternatives	$M		Utility Score
Alternative A2e Rapid Rehab/Existing Span	Structure 0.64 Staging 0.6 Property 0	1.24	1
Alternative A5e Conventional Rehab/Existing Span	Structure 0.64 Staging 1.25 Property 0	1.89	0.9
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Structure 2.30 Staging 1.2 Property 0	3.5	0.8
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Structure 2.93 Staging 1.2 Property 0	4.13	0.7
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Structure 4.62 Staging 0.60 Property 0.20	5.42	0.3
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Structure 4.62 Staging 0.60 Property 0.20	5.42	0.3
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Structure 6.14 Staging 0.60 Property 0.20	6.94	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Structure 6.14 Staging 0.60 Property 0.20	6.94	0
Alternative D6l Rapid Replacement Semi-integral/Full	Structure 5.77 Staging 0.60	6.57	0.1

Closure/Longer Span	Property 0.20		
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Structure 5.77 Staging 0.60 Property 0.20	6.57	0.1

Mitigation: N/A

Future Life Cycle Cost



Description: This sub-factor measures the difference in future life cycle costs (maintenance, operating costs and long term replacement and rehabilitation in the 40 year planning horizon). Those alternatives with the lowest long term life cycle cost are preferred. A 5% discount rate was used.

Alternatives	$M	Utility Score
Alternative A2e Rapid Rehab/Existing Span	3.24	1
Alternative A5e Conventional Rehab/Existing Span	3.89	0.9
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	4.06	0.8
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	4.76	0.7
Alternative C6e Rapid Replacement/Full Closure/Existing Span	6.06	0.4
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	6.61	0.3
Alternative C6l Rapid Replacement/Full Closure/Longer Span	7.77	0.1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	8.32	0
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	7.35	0.2
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	7.90	0.1

Mitigation: N/A

VERSION: November 11, 2014

APPENDIX E

SUB-FACTOR UTILITY FUNCTION DEFINITIONS AND MEASUREMENTS FOR SHORT LISTED EVALUATION CRITERIA

BOOTH STREET EASTBOUND BRIDGE

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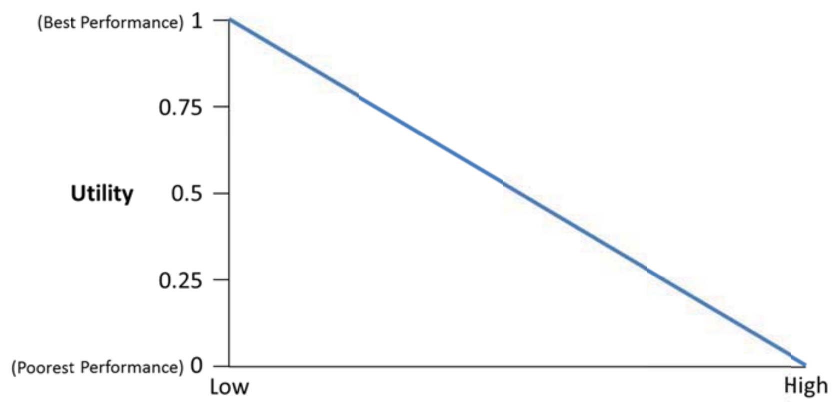
Factor Group: Transportation

Maximum Peak Queue Length on Queensway



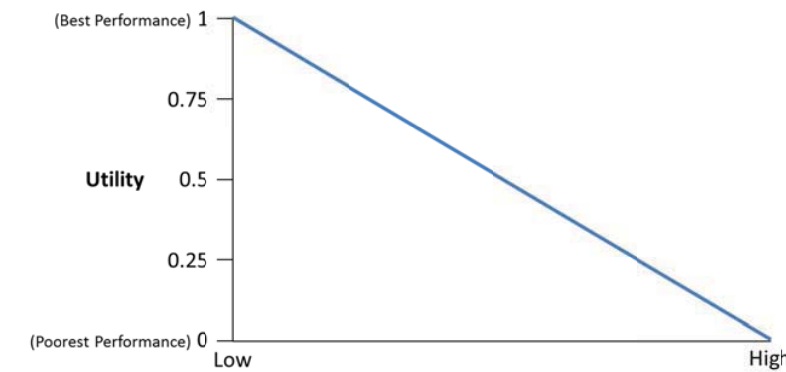
Description: This sub-factor measures the forecast queue length effect in the peak hour including measures to divert trips and induce transportation demand management during construction. The sub-factor measures the queue duration (days) and the forecast queue length (after the use of mitigation). This sub-factor is indicative of highway performance and safety, and is related to: effects on ramp operations, rear end collisions influenced by stop and go traffic, poor weaving conditions and traffic congestion.

(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	km days (peak hour)	Utility Score
Alternative A2e Rapid Rehab/Existing Span	41	0.98
Alternative A5e Conventional Rehab/Existing Span	780	0.59
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	1920	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	1920	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	2	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	240	0.9
Alternative C6l Rapid Replacement/Full Closure/Longer Span	2	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	240	0.9
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	2	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	240	0.9

Mitigation: The use of advance advertising and advising drivers of the scheduled lane closures through PVMS placement in advance of construction will be measures that will reduce demand by: changing the time of travel of commuters, use of transit as an alternate mode of travel or by inducing diversion to the municipal road system as an alternate route.

Delays

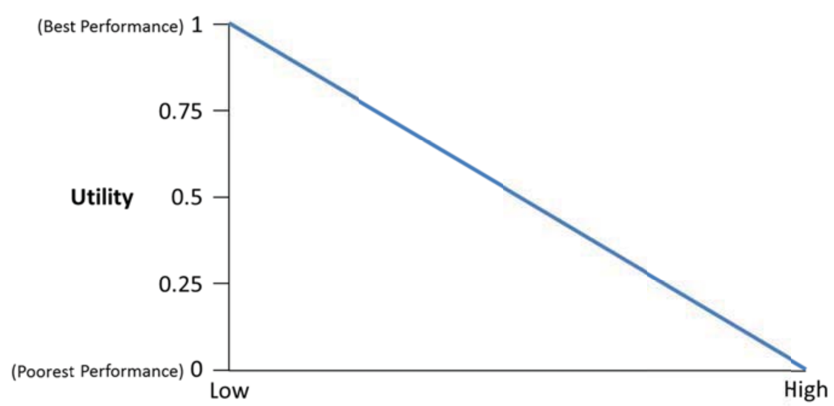


Description: This sub-factor measures the total lane closure peak period delay to drivers on the Queensway during the construction period. It includes the total peak period delay forecast for the duration of construction of the alternative. The delay sub-factor, although measuring vehicles on the Queensway, is also indicative of the delays for drivers diverted from the Queensway and operating on the municipal road system.
(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	Veh h	Utility Score
Alternative A2e Rapid Rehab/Existing Span	16,520	1
Alternative A5e Conventional Rehab/Existing Span	1,537,200	0.60
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	3,782,800	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	3,782,800	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	520	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	472,600	0.9
Alternative C6l Rapid Replacement/Full Closure/Longer Span	520	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	472,600	0.9
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	520	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	472,600	0.9

Mitigation: N/A

Ramp Closures

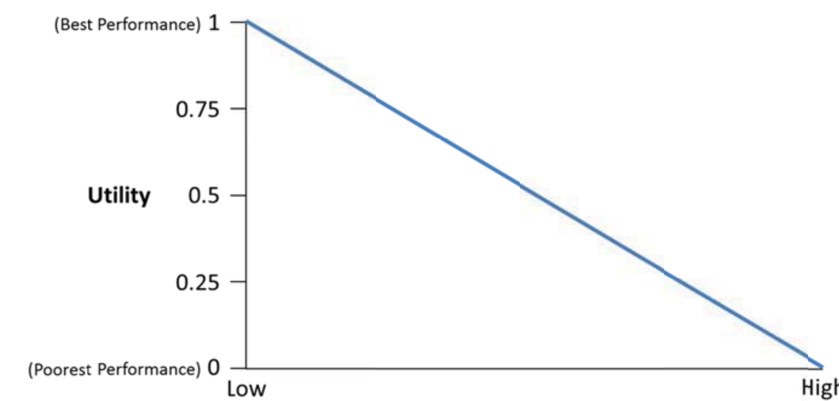


Description: This sub-factor measures the impact to community access by quantifying the volume of peak hour ramp trips that will be removed from entering or exiting from the Queensway. The sub-factor measures the peak hour ramp volume for each stage of the highway staging plan for the duration of the closure.

Alternatives	Veh (peak hour)	Utility Score
Alternative A2e Rapid Rehab/Existing Span	0	1
Alternative A5e Conventional Rehab/Existing Span	28,135	0.26
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	0	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	0	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	8,058	0.79
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	38,240	0
Alternative C6l Rapid Replacement/Full Closure/Longer Span	8,058	0.79
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	38,240	0
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	8,058	0.79
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	38,240	0

Mitigation: Ramps may be closed by time of day to allow access in non-peak hours.

Highway Safety - Collision Potential

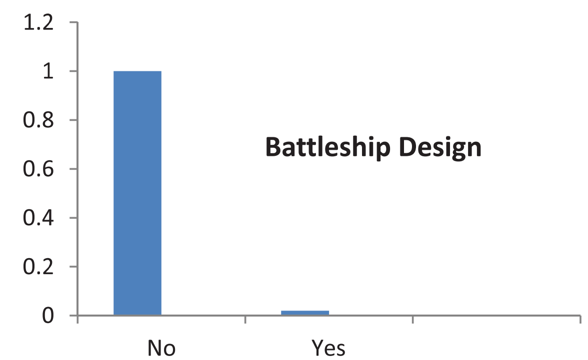


Description: This sub-factor measures the collision potential of the alternative by measuring the time duration that drivers will be required to transition through the construction zone.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	0.9
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0
Alternative C6e SINGLE REPLACEMENT Rapid Replacement/Full Closure/Existing Span	0	2	2	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	20	12	32	0.9
Alternative C6l SINGLE REPLACEMENT Rapid Replacement/Full Closure/Longer Span	0	2	2	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	20	12	32	0.9
Alternative D6l SINGLE REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	0	2	2	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	20	12	32	0.9

Mitigation: N/A

Highway Safety – Design Consistency of Traffic Staging Design

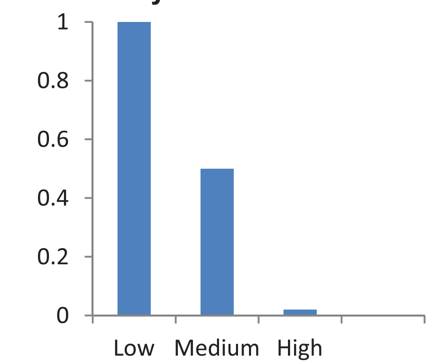


Description: This sub-factor measures the collision potential of the highway staging design. Those alternatives including a non-conventional battleship design (i.e. yes) are least preferred.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Yes	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Yes	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	No	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	No	1
Alternative C6l Rapid Replacement/Full Closure/Longer Span	No	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	No	1
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	No	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	No	1

Mitigation: Tow truck plan/incident plan.

Pedestrian – Delay and Out-of-way Travel

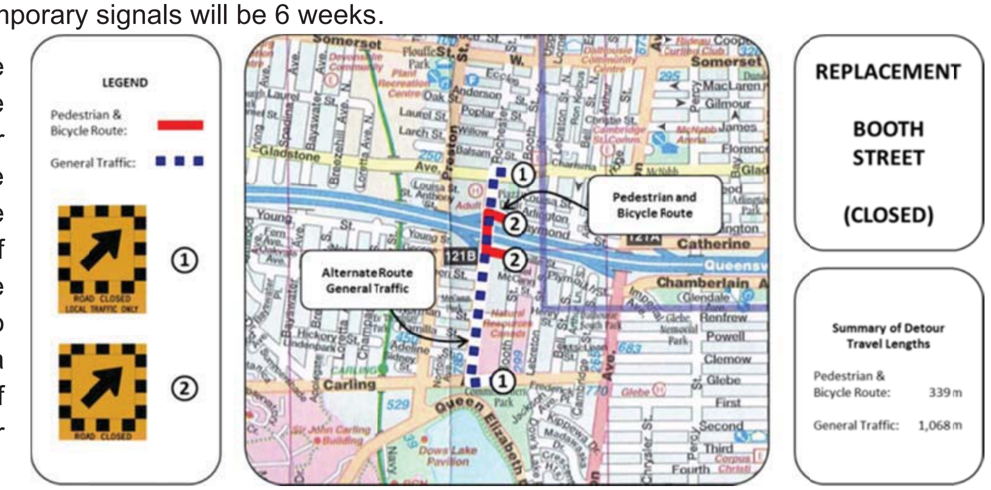


Description: This sub-factor measures the length and duration of pedestrian out-of-way travel on the side streets while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily sidewalk closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period. Pedestrians will be signed to use the opposite sidewalk from the adjacent signalized intersections.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. Pedestrians will use a single sidewalk and cross the street at the temporary signals. The duration of the temporary signals will be 6 weeks.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure pedestrians will be directed to Rochester Street, for a maximum out-of-way travel of 0.3 km. This sub-factor measures a one-way trip only.

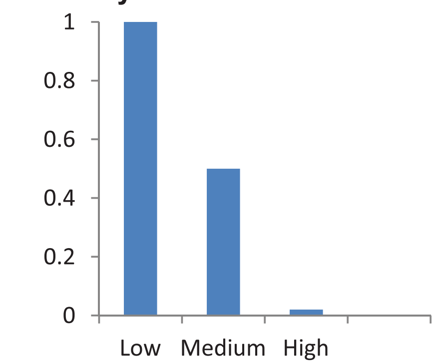


Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0

Alternative C6e Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: Advance signage for pedestrians to travel to the alternate sidewalk route as well as pre-event information to the property owners.

Bicycle – Delay and Out-of-Way Travel

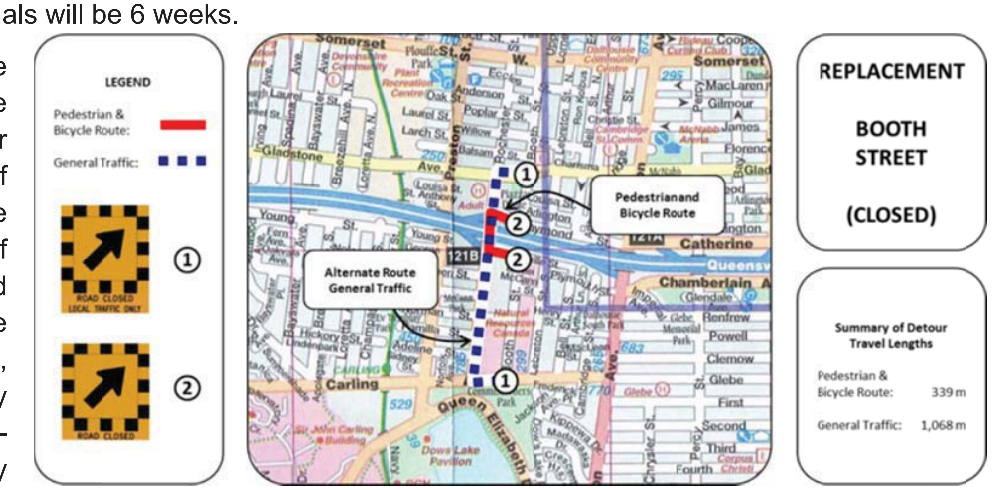


Description: This sub-factor measures the length and duration of bicycle delay and out-of-way travel on the side street while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily lane and bike lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. Bicyclists will use the single lane detour through the temporary signals. The duration of the temporary signals will be 6 weeks.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure, bicyclists will be directed to Rochester Street, for a maximum out-of-way travel of 0.3 km. This sub-factor measures a one-way trip only.

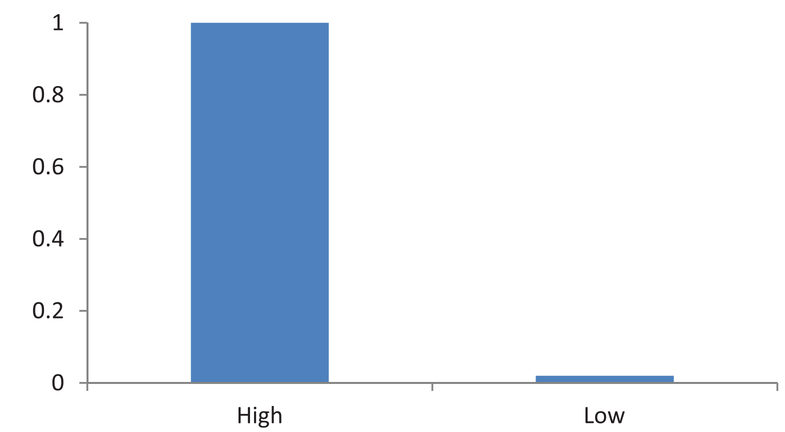


Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Medium	0.5

Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: Advance signage for cyclists to choose an alternate route as well as pre-event information to the Regional cycling clubs.

Pedestrian/Bicycle Safety

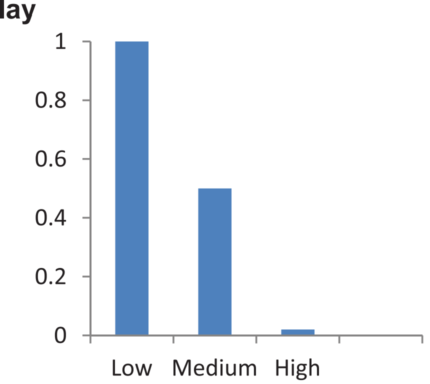


Description: This sub-factor measures if an alternative provides greater lateral space to increase pedestrian and bicycle safety. Those alternatives providing the largest span are preferred (high potential) and those alternatives matching the existing span are not preferred (i.e. low potential).

Alternatives	High/Low	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	0
Alternative A5e Conventional Rehab/Existing Span	Low	0
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Low	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	1
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Low	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Low	0
Alternative C6l Rapid Replacement/Full Closure/Longer Span	High	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	High	1
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	High	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	High	1

Mitigation: None.

Transit Operations Delay



Description: This sub-factor measures the delay during construction that will affect transit operations. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. The duration of the temporary signals will be 6 weeks.

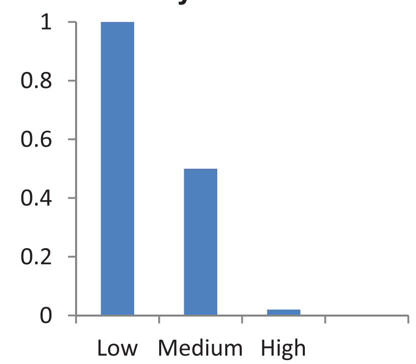
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure transit will be directed to Raymond/Rochester/Carling, for a maximum out-of-way travel of 0.9 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Medium	0.5

Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: Advance information to OC Transpo and temporary relocation of bus stops if required.

General Traffic Municipal Street Delay

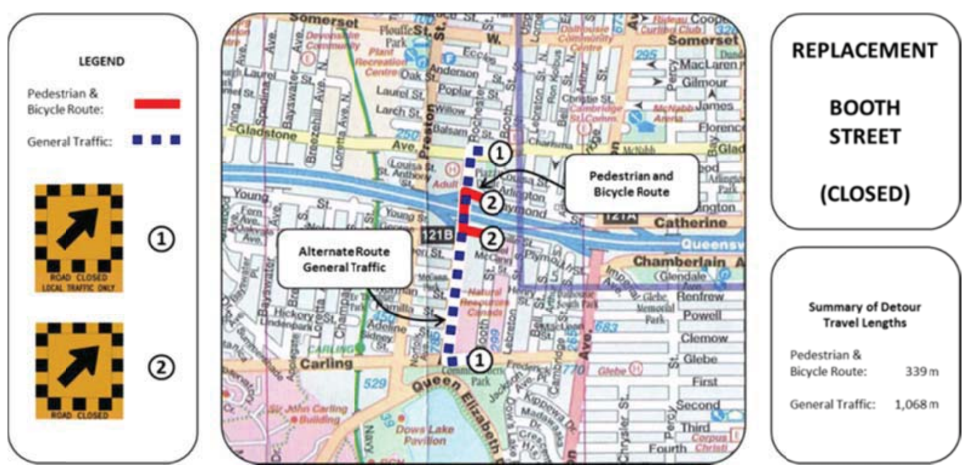


Description: This sub-factor measures the delay during construction that will affect general traffic operations. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. The duration of the temporary signals will be 6 weeks.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure vehicles will be directed to Rochester Street, for a maximum out-of-way travel of 1.1 km. This sub-factor measures a one-way trip only.



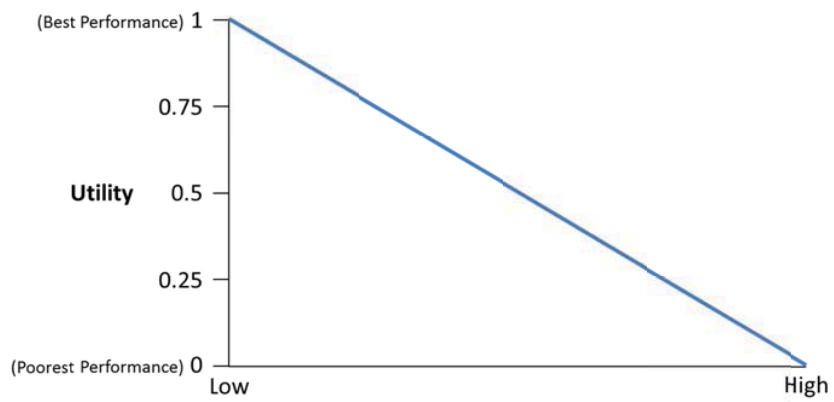
Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5

Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: The use of advisory signage and potential use of variable message signage can be used to advise drivers before reaching the construction site.

Factor Group: Social and Cultural Environment

Impact to Emergency Response

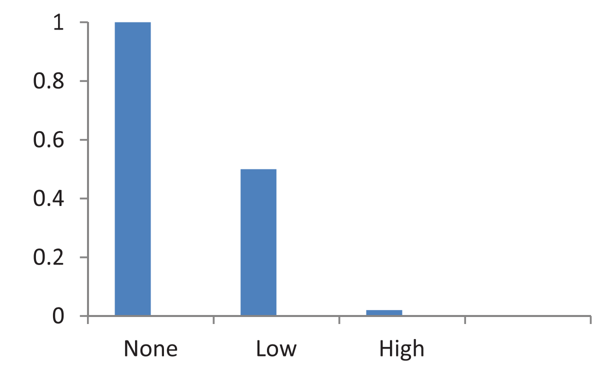


Description: This sub-factor measures the duration of Queensway closure that will affect emergency response service (police, ambulance and fire). Alternatives that reduce the length of time that there are lane closures on the Queensway are preferred.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	0.9
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.5
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0.0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0.0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	0	2	2	1.0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	20	12	32	0.9
Alternative C6l Rapid Replacement/Full Closure/Longer Span	0	2	2	1.0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	20	12	32	0.9
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	0	2	2	1.0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	20	12	32	0.9

Mitigation: Advanced warning of lane closures or detour routes.

Potentially Contaminated Property



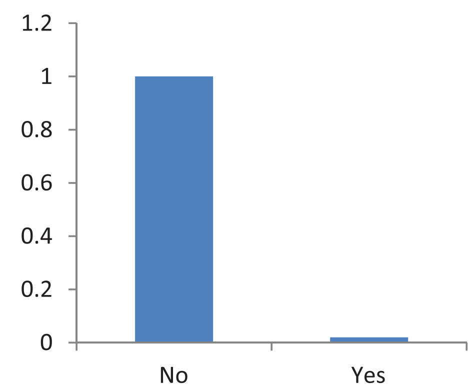
Description: This sub-factor measures whether there is potential to encounter potentially contaminated property during the construction of an alternative. Alternatives that minimize excavation are preferred. RBR staging sites have high potential (i.e. large footprint of excavation) to impact potentially contaminated property. Any alternative excavating in place has low potential to impact potentially contaminated property. The rehabilitation options have no potential to impact potentially contaminated property due to the small footprint of works.

Alternatives	No/Low/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Low	0.5
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Low	0.5
Alternative C6e Rapid Replacement/Full Closure/Existing Span	High	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	High	0
Alternative C6l Rapid Replacement/Full Closure/Longer Span	High	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	High	0
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	High	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	High	0

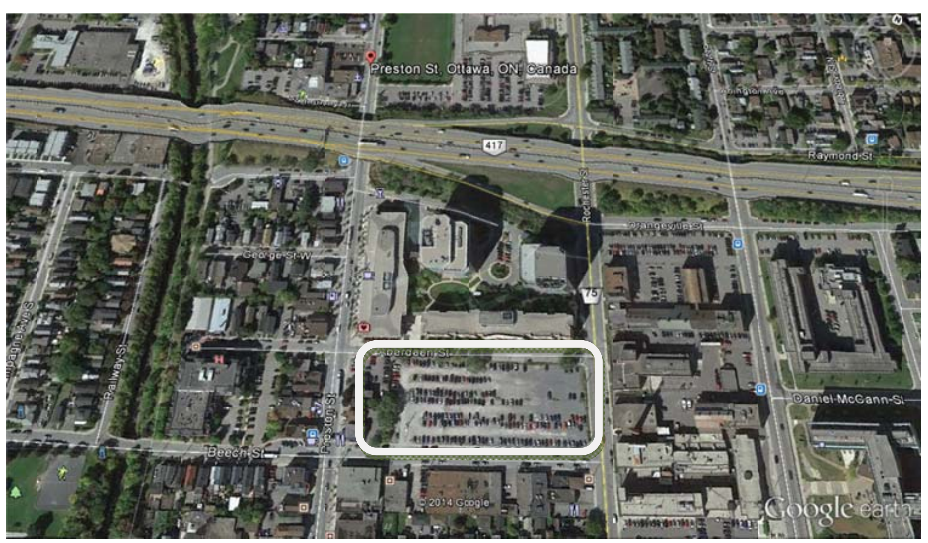
Mitigation: Avoidance.

Factor Group: Land Use and Property

Temporary Property Impacts



Description: This sub-factor measures whether property (i.e. parking lot at Beech/Rochester/Aberdeen) is required for temporary use as a bridge staging area (PR-03), as per the RBR Structure Staging Sites memo.



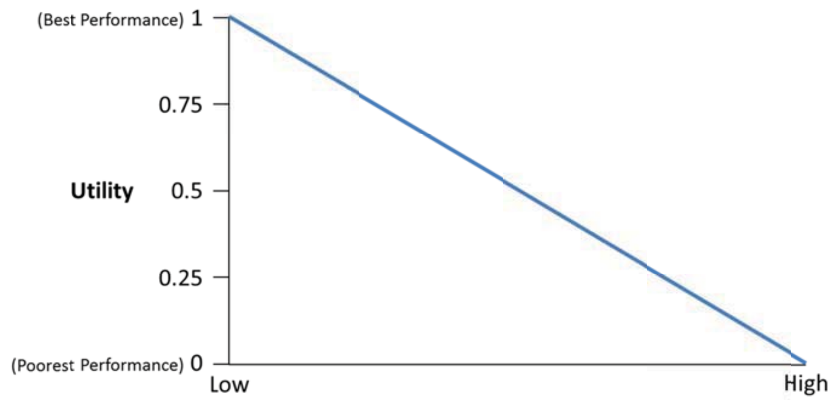
Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	No	1
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	No	1
Alternative C6e	Yes	0

Rapid Replacement/Full Closure/Existing Span		
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Yes	0
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Yes	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Yes	0
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Yes	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Yes	0

Mitigation: N/A

Factor Group: Cost

Capital Cost

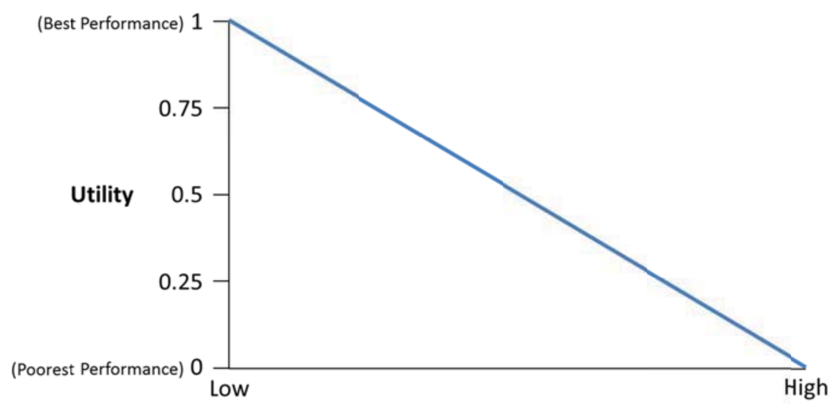


Description: This sub-factor measures the difference in initial capital cost of the alternative (bridge, traffic staging, staging area, and property costs). Those alternatives with the lowest capital cost are preferred. These costs do not include Engineering Costs.

Alternatives	$M		Utility Score
Alternative A2e Rapid Rehab/Existing Span	Structure 0.94 Staging 0.6 Property 0	1.54	1
Alternative A5e Conventional Rehab/Existing Span	Structure 0.94 Staging 1.25 Property 0	2.19	0.9
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Structure 2.61 Staging 1.2 Property 0	3.81	0.6
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Structure 3.24 Staging 1.2 Property 0	4.44	0.5
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Structure 4.68 Staging 0.60 Property 0.20	5.48	0.3
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Structure 4.68 Staging 0.60 Property 0.20	5.48	0.3
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Structure 6.41 Staging 0.60 Property 0.20	7.21	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Structure 6.41 Staging 0.60 Property 0.20	7.21	0
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Structure 5.90 Staging 0.60 Property 0.20	6.70	0.1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Structure 5.90 Staging 0.60 Property 0.20	6.70	0.1

Mitigation: N/A

Future Life Cycle Cost



Description: This sub-factor measures the difference in future life cycle costs (maintenance, operating costs and long term replacement and rehabilitation in the 40 year planning horizon). Those alternatives with the lowest long term life cycle cost are preferred. A 5% discount rate was used.

Alternatives	$M	Utility Score
Alternative A2e Rapid Rehab/Existing Span	3.60	1
Alternative A5e Conventional Rehab/Existing Span	4.25	0.9
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	4.40	0.8
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	5.11	0.7
Alternative C6e Rapid Replacement/Full Closure/Existing Span	6.13	0.5
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	6.68	0.4
Alternative C6l Rapid Replacement/Full Closure/Longer Span	8.07	0.1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	8.62	0
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	7.5	0.2
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	8.05	0.1

Mitigation: N/A

VERSION: November 11, 2014

APPENDIX E

SUB-FACTOR UTILITY FUNCTION DEFINITIONS AND MEASUREMENTS FOR SHORT LISTED EVALUATION CRITERIA

BOOTH STREET WESTBOUND BRIDGE

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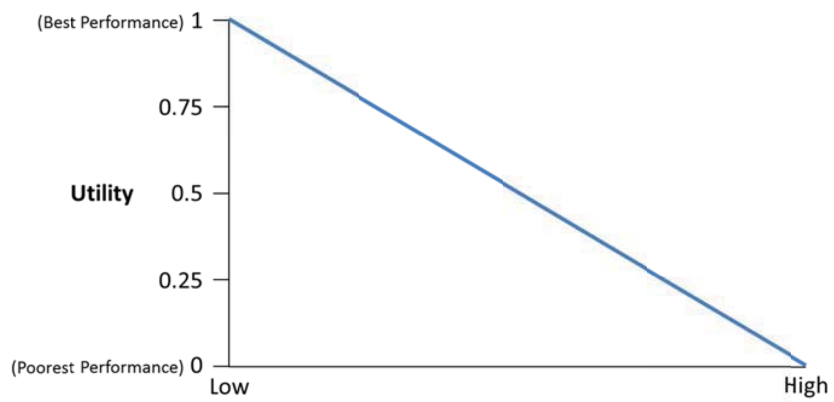
Factor Group: Transportation

Maximum Peak Queue Length on Queensway



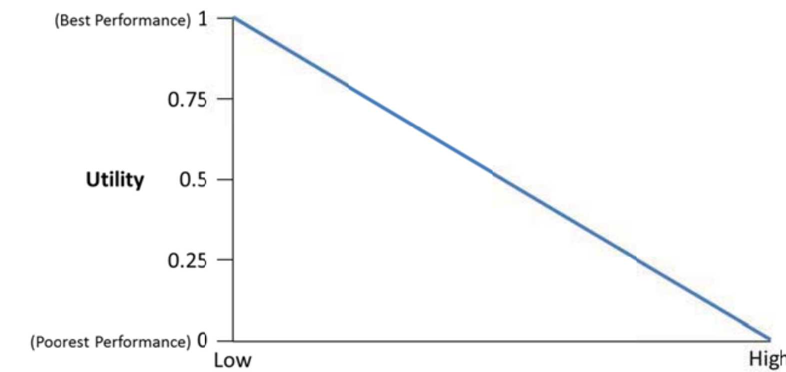
Description: This sub-factor measures the forecast queue length effect in the peak hour including measures to divert trips and induce transportation demand management during construction. The sub-factor measures the queue duration (days) and the forecast queue length (after the use of mitigation). This sub-factor is indicative of highway performance and safety, and is related to: effects on ramp operations, rear end collisions influenced by stop and go traffic, poor weaving conditions and traffic congestion.

(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	km days (peak hour)	Utility Score
Alternative A2e Rapid Rehab/Existing Span	41	0.98
Alternative A5e Conventional Rehab/Existing Span	780	0.59
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	1920	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	1920	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	2	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	240	0.9
Alternative C6l Rapid Replacement/Full Closure/Longer Span	2	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	240	0.9
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	2	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	240	0.9

Mitigation: The use of advance advertising and advising drivers of the scheduled lane closures through PVMS placement in advance of construction will be measures that will reduce demand by: changing the time of travel of commuters, use of transit as an alternate mode of travel or by inducing diversion to the municipal road system as an alternate route.

Delays

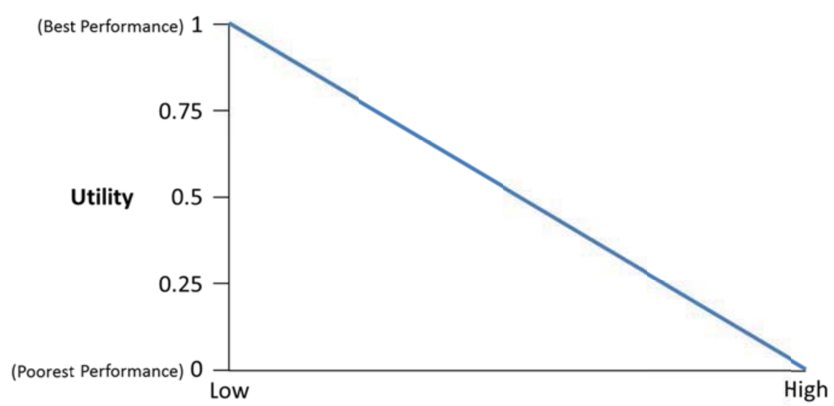


Description: This sub-factor measures the total lane closure peak period delay to drivers on the Queensway during the construction period. It includes the total peak period delay forecast for the duration of construction of the alternative. The delay sub-factor, although measuring vehicles on the Queensway, is also indicative of the delays for drivers diverted from the Queensway and operating on the municipal road system.
(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	Veh h	Utility Score
Alternative A2e Rapid Rehab/Existing Span	16,520	1
Alternative A5e Conventional Rehab/Existing Span	1,537,200	0.6
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	3,782,800	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	3,782,800	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	520	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	472,600	0.9
Alternative C6l Rapid Replacement/Full Closure/Longer Span	520	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	472,600	0.9
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	520	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	472,600	0.9

Mitigation: N/A

Ramp Closures

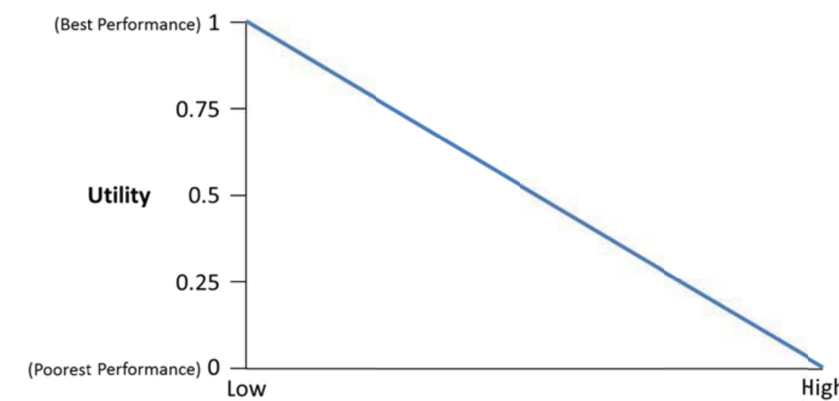


Description: This sub-factor measures the impact to community access by quantifying the volume of peak hour ramp trips that will be removed from entering or exiting from the Queensway. The sub-factor measures the peak hour ramp volume for each stage of the highway staging plan for the duration of the closure.

Alternatives	Veh (peak hour)	Utility Score
Alternative A2e Rapid Rehab/Existing Span	21,620	0.81
Alternative A5e Conventional Rehab/Existing Span	90,808	0.03
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	93,044	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	93,044	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	5,216	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	32,680	0.69
Alternative C6l Rapid Replacement/Full Closure/Longer Span	5,216	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	32,680	0.69
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	5,216	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	32,680	0.69

Mitigation: Ramps may be closed by time of day to allow access in non-peak hours.

Highway Safety - Collision Potential

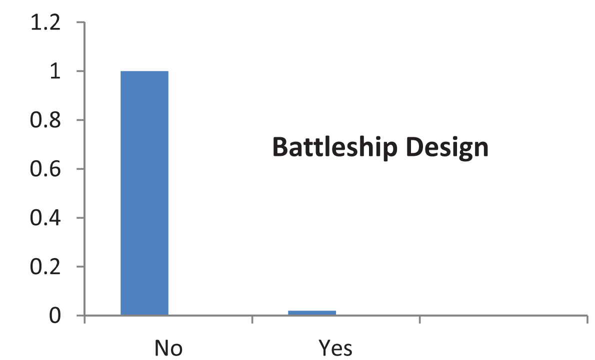


Description: This sub-factor measures the collision potential of the alternative by measuring the time duration that drivers will be required to transition through the construction zone.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	0.9
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.5
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	0	2	2	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	20	12	32	0.9
Alternative C6l Rapid Replacement/Full Closure/Longer Span	0	2	2	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	20	12	32	0.9
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	0	2	2	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	20	12	32	0.9

Mitigation: N/A

Highway Safety – Design Consistency of Traffic Staging Design

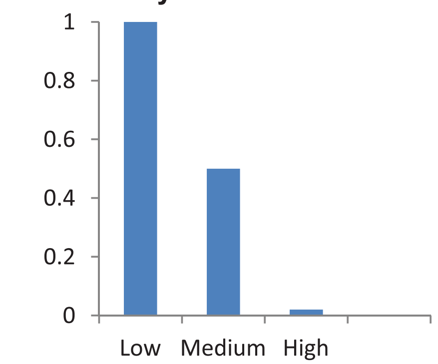


Description: This sub-factor measures the collision potential of the highway staging design. Those alternatives including a non-conventional battleship design (i.e. yes) are least preferred.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Yes	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Yes	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	No	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	No	1
Alternative C6l Rapid Replacement/Full Closure/Longer Span	No	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	No	1
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	No	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	No	1

Mitigation: Tow truck plan/incident plan.

Pedestrian – Delay and Out-of-way Travel

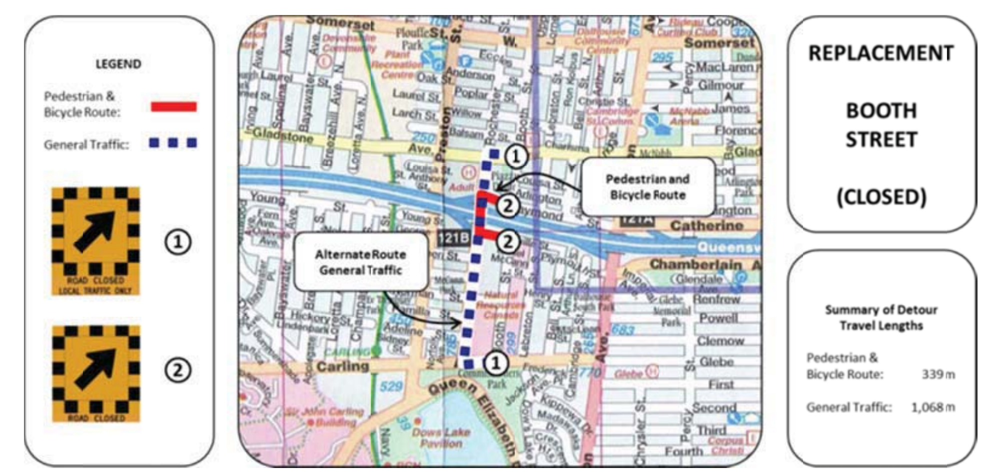


Description: This sub-factor measures the length and duration of pedestrian out-of-way travel on the side streets while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily sidewalk closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period. Pedestrians will be signed to use the opposite sidewalk from the adjacent signalized intersections.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. Pedestrians will use a single sidewalk and cross the street at the temporary signals. The duration of the temporary signals will be 6 weeks.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure pedestrians will be directed to Rochester Street, for a maximum out-of-way travel of 0.3 km. This sub-factor measures a one-way trip only.

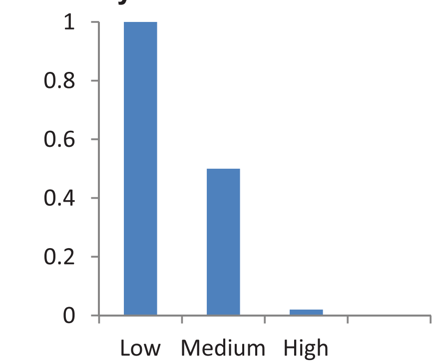


Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0

Alternative C6e Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: Advance signage for pedestrians to travel to the alternate sidewalk route as well as pre-event information to the property owners.

Bicycle – Delay and Out-of-Way Travel

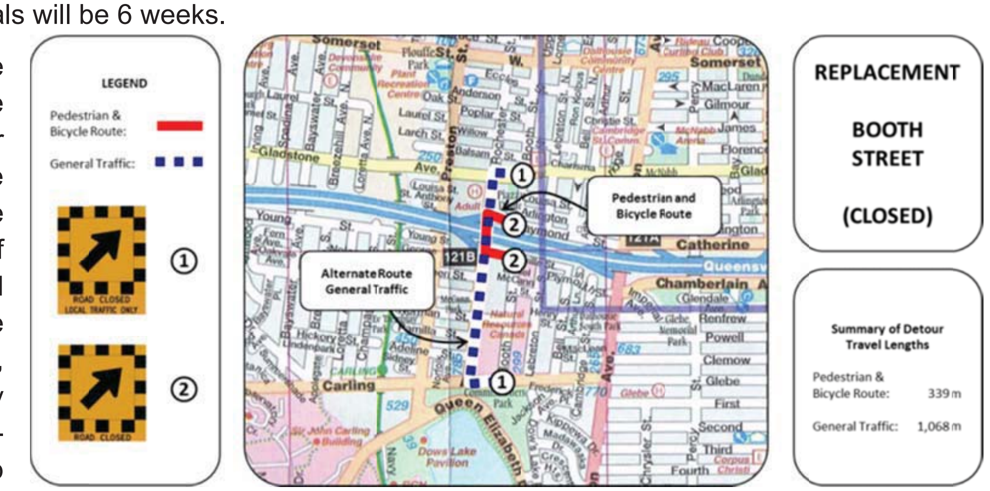


Description: This sub-factor measures the length and duration of bicycle delay and out-of-way travel on the side street while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily lane and bike lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. Bicyclists will use the single lane detour through the temporary signals. The duration of the temporary signals will be 6 weeks.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure, bicyclists will be directed to Rochester Street, for a maximum out-of-way travel of 0.3 km. This sub-factor measures a one-way trip only.

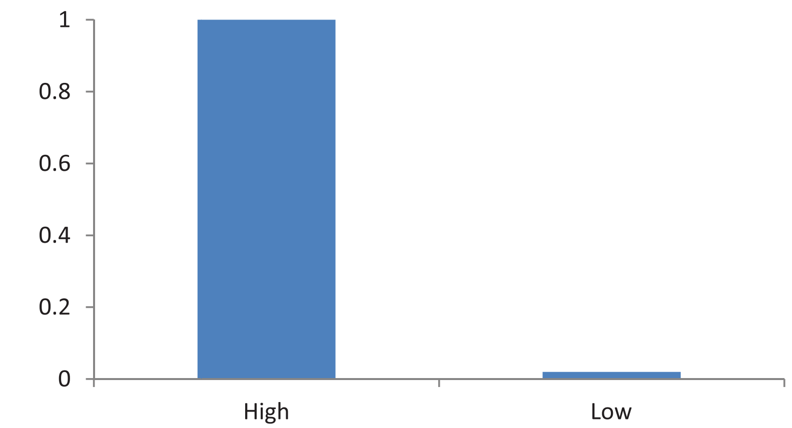


Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Medium	0.5

Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: Advance signage for cyclists to choose an alternate route as well as pre-event information to the Regional cycling clubs.

Pedestrian/Bicycle Safety

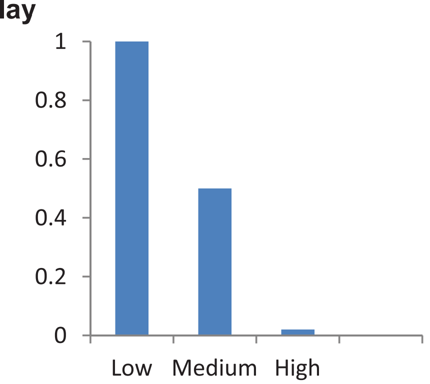


Description: This sub-factor measures if an alternative provides greater lateral space to increase pedestrian and bicycle safety. Those alternatives providing the largest span are preferred (high potential) and those alternatives matching the existing span are not preferred (i.e. low potential).

Alternatives	High/Low	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	0
Alternative A5e Conventional Rehab/Existing Span	Low	0
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Low	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	1
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Low	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Low	0
Alternative C6l Rapid Replacement/Full Closure/Longer Span	High	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	High	1
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	High	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	High	1

Mitigation: None.

Transit Operations Delay



Description: This sub-factor measures the delay during construction that will affect transit operations. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. The duration of the temporary signals will be 6 weeks.

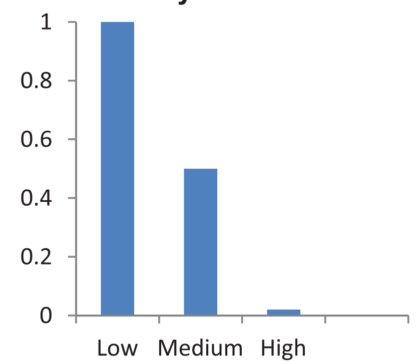
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure transit will be redirected to Raymond/Rochester/Carling, for a maximum out-of-way travel of 0.9 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5

Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: Advance information to OC Transpo and temporary relocation of bus stops if required.

General Traffic Municipal Street Delay

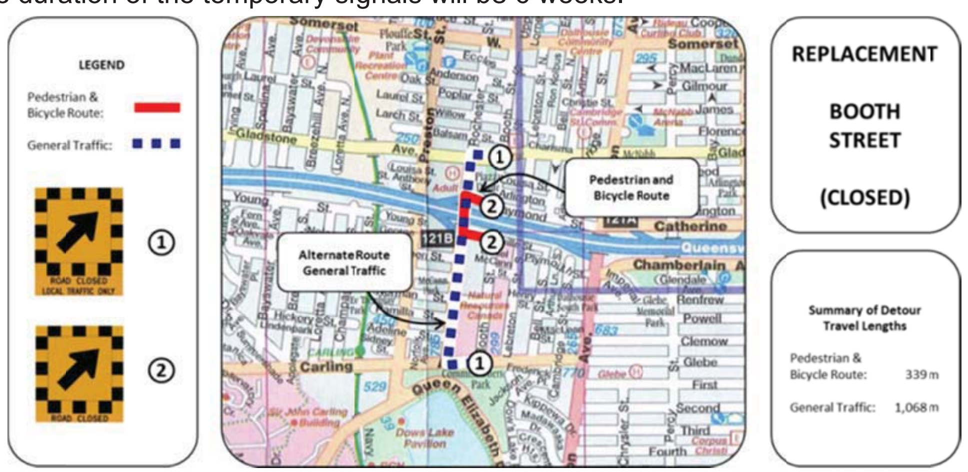


Description: This sub-factor measures the delay during construction that will affect general traffic operations. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. The duration of the temporary signals will be 6 weeks.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure vehicles will be directed to Rochester Street, for a maximum out-of-way travel of 1.1 km. This sub-factor measures a one-way trip only.



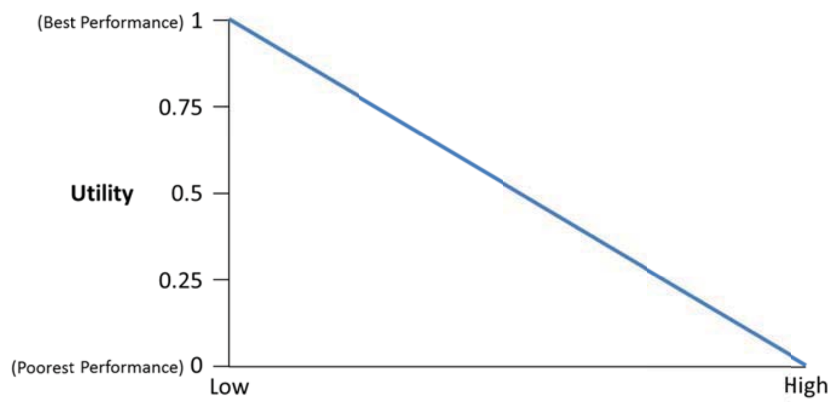
Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0.5

Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: The use of advisory signage and potential use of variable message signage can be used to advise drivers before reaching the construction site.

Factor Group: Social and Cultural Environment

Impact to Emergency Response

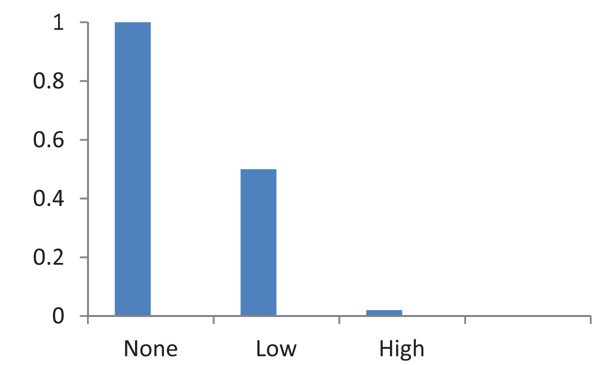


Description: This sub-factor measures the duration of Queensway closure that will affect emergency response service (police, ambulance and fire). Alternatives that reduce the length of time that there are lane closures on the Queensway are preferred.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	0.9
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0.0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0.0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	0	2	2	1.0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	20	12	32	0.9
Alternative C6l Rapid Replacement/Full Closure/Longer Span	0	2	2	1.0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	20	12	32	0.9
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	0	2	2	1.0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	20	12	32	0.9

Mitigation: Advanced warning of lane closures or detour routes.

Potentially Contaminated Property



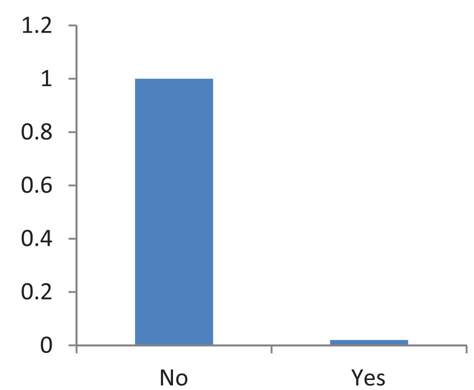
Description: This sub-factor measures whether there is potential to encounter potentially contaminated property during the construction of an alternative. Alternatives that minimize excavation are preferred. RBR staging sites have high potential (i.e. large footprint of excavation) to impact potentially contaminated property. Any alternative excavating in place has low potential to impact potentially contaminated property. The rehabilitation options have no potential to impact potentially contaminated property due to the small footprint of works.

Alternatives	No/Low/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Low	0.5
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Low	0.5
Alternative C6e Rapid Replacement/Full Closure/Existing Span	High	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	High	0
Alternative C6l Rapid Replacement/Full Closure/Longer Span	High	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	High	0
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	High	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	High	0

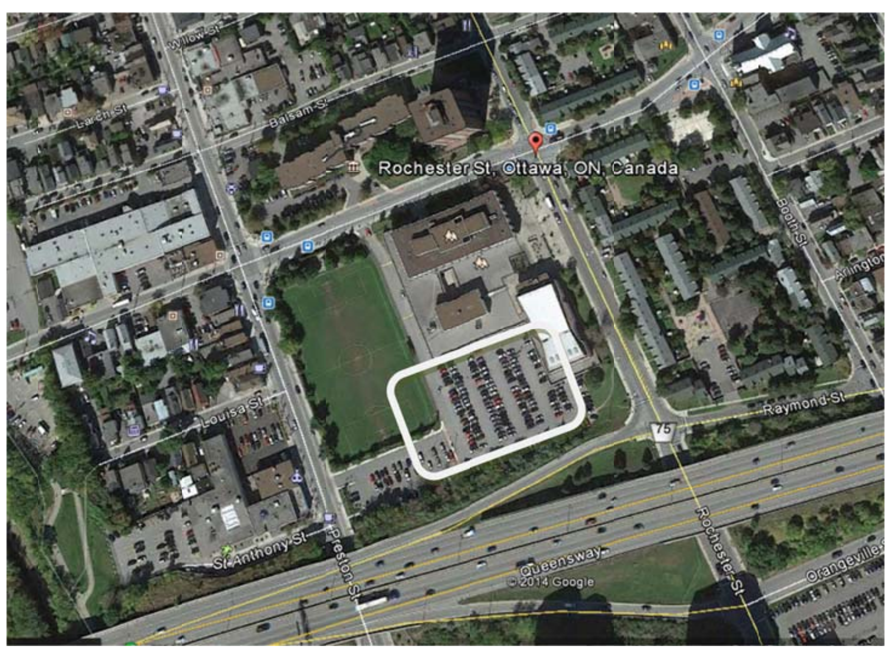
Mitigation: Avoidance.

Factor Group: Land Use and Property

Temporary Property Impacts



Description: This sub-factor measures whether property (i.e. parking lot at Raymond/Rochester) is required for temporary use as a bridge staging area (RO-01), as per the RBR Structure Staging Sites memo.



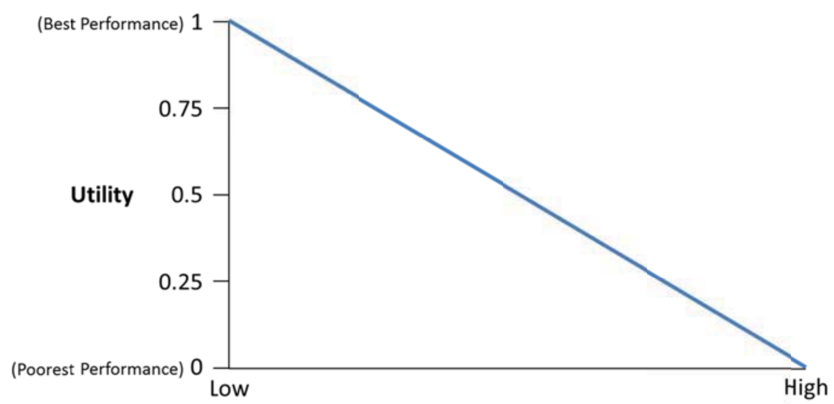
Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	No	1
Alternative B9l	No	1

Conventional Replacement/Three Stage Detour/Longer Span		
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Yes	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Yes	0
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Yes	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Yes	0
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Yes	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Yes	0

Mitigation: N/A

Factor Group: Cost

Capital Cost



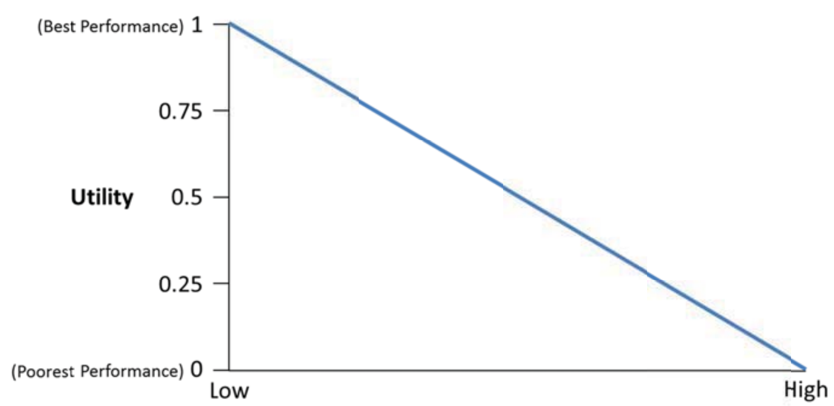
Description: This sub-factor measures the difference in initial capital cost of the alternative (bridge, traffic staging, staging area, and property costs). Those alternatives with the lowest capital cost are preferred. These costs do not include Engineering Costs.

Alternatives	$M		Utility Score
Alternative A2e Rapid Rehab/Existing Span	Structure 0.97 Staging 0.6 Property 0	1.57	1
Alternative A5e Conventional Rehab/Existing Span	Structure 0.97 Staging 1.25 Property 0	2.22	0.9
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Structure 2.61 Staging 1.2 Property 0	3.81	0.6
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Structure 3.24 Staging 1.2 Property 0	4.44	0.5
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Structure 4.68 Staging 0.60 Property 0.20	5.48	0.3
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Structure 4.68 Staging 0.60 Property 0.20	5.48	0.3
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Structure 6.41 Staging 0.60 Property 0.20	7.01	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Structure 6.41 Staging 0.60 Property 0.20	7.01	0
Alternative D6l Rapid Replacement Semi-integral/Full	Structure 5.90 Staging 0.60	6.70	0.1

Closure/Longer Span	Property 0.20		
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Structure 5.90 Staging 0.60 Property 0.20	6.70	0.1

Mitigation: N/A

Future Life Cycle Cost



Description: This sub-factor measures the difference in future life cycle costs (maintenance, operating costs and long term replacement and rehabilitation in the 40 year planning horizon). Those alternatives with the lowest long term life cycle cost are preferred. A 5% discount rate was used.

Alternatives	$M	Utility Score
Alternative A2e Rapid Rehab/Existing Span	3.63	1
Alternative A5e Conventional Rehab/Existing Span	4.28	0.9
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	4.40	0.8
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	5.11	0.7
Alternative C6e Rapid Replacement/Full Closure/Existing Span	6.13	0.5
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	6.68	0.4
Alternative C6l Rapid Replacement/Full Closure/Longer Span	8.07	0.1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	8.62	0
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	7.50	0.2
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	8.05	0.1

Mitigation: N/A

VERSION: November 11, 2014

APPENDIX E

SUB-FACTOR UTILITY FUNCTION DEFINITIONS AND MEASUREMENTS FOR SHORT LISTED EVALUATION CRITERIA

BRONSON AVENUE EASTBOUND BRIDGE

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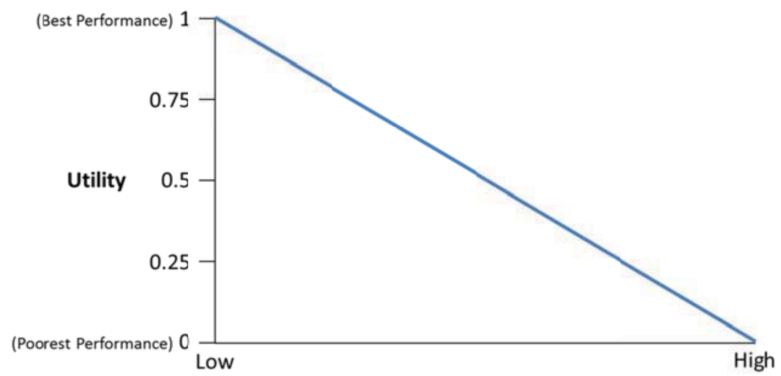
Factor Group: Transportation

Maximum Peak Queue Length on Queensway



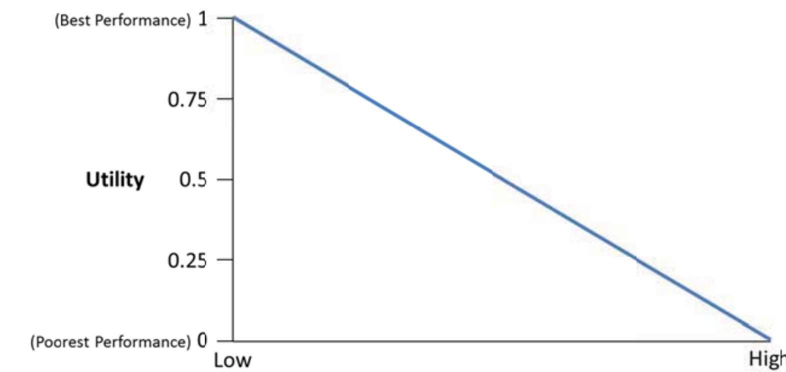
Description: This sub-factor measures the forecast queue length effect in the peak hour including measures to divert trips and induce transportation demand management during construction. The sub-factor measures the queue duration (days) and the forecast queue length (after the use of mitigation). This sub-factor is indicative of highway performance and safety, and is related to: effects on ramp operations, rear end collisions influenced by stop and go traffic, poor weaving conditions and traffic congestion.

(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	**km days (peak hour)**	**Utility Score**
Alternative A2e Rapid Rehab/Existing Span	41	0.98
Alternative A5e Conventional Rehab/Existing Span	780	0.59
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	1920	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	1920	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	3	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	240	0.89
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	3	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	240	0.89
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	3	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	240	0.89

Mitigation: The use of advance advertising and advising drivers of the scheduled lane closures through PVMS placement in advance of construction will be measures that will reduce demand by: changing the time of travel of commuters, use of transit as an alternate mode of travel, or by inducing diversion to the municipal road system as an alternate route.

Delays

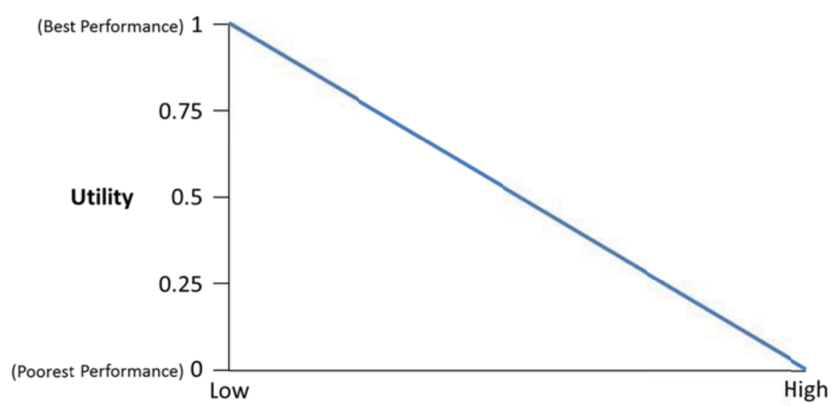


Description: This sub-factor measures the total lane closure peak period delay to drivers on the Queensway during the construction period. It includes the total peak period delay forecast for the duration of construction of the alternative. The delay sub-factor, although measuring vehicles on the Queensway, is also indicative of the delays for drivers diverted from the Queensway and operating on the municipal road system.
(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	**Veh h**	**Utility Score**
Alternative A2e Rapid Rehab/Existing Span	16,520	1
Alternative A5e Conventional Rehab/Existing Span	1,537,200	0.60
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	3,782,800	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	3,782,800	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	780	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	472,600	0.88
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	780	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	472,600	0.88
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	780	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	472,600	0.88

Mitigation: N/A

Ramp Closures

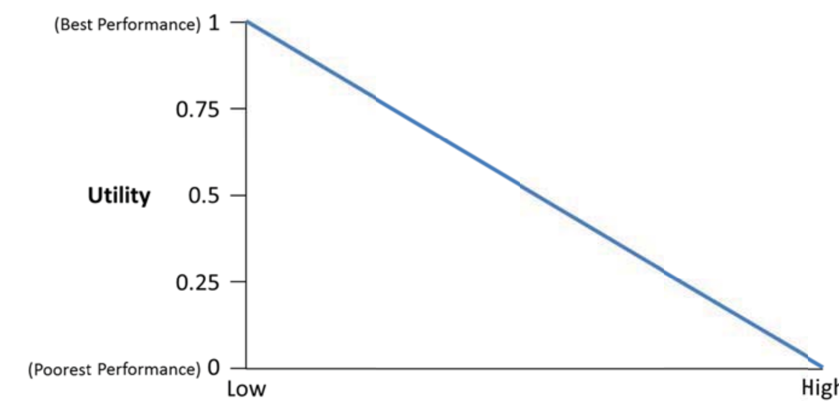


Description: This sub-factor measures the impact to community access by quantifying the volume of peak hour ramp trips that will be removed from entering or exiting from the Queensway. The sub-factor measures the peak hour ramp volume for each stage of the highway staging plan for the duration of the closure.

Alternatives	Veh (peak hour)	Utility Score
Alternative A2e Rapid Rehab/Existing Span	0	1
Alternative A5e Conventional Rehab/Existing Span	0	1
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	0	1
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	0	1
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	8,067	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	0	1
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	8,067	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	0	1
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	8,067	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	0	1

Mitigation: Ramps may be closed by time of day to allow access in non-peak hours.

Highway Safety - Collision Potential

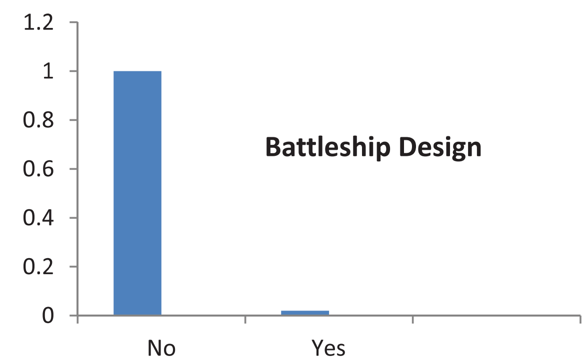


Description: This sub-factor measures the collision potential of the alternative by measuring the time duration that drivers will be required to transition through the construction zone.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	0.9
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	0	3	3	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	20	12	32	0.9
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	0	3	3	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	20	12	32	0.9
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	0	3	3	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	20	12	32	0.9

Mitigation: N/A

Highway Safety – Design Consistency of Traffic Staging Design

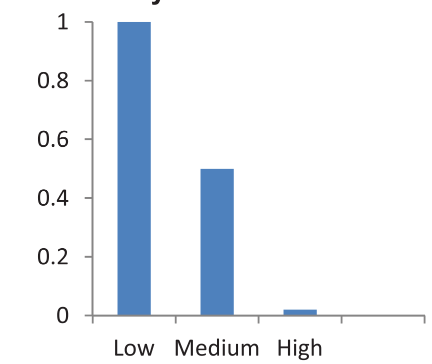


Description: This sub-factor measures the collision potential of the highway staging design. Those alternatives including a non-conventional battleship design (i.e. yes) are least preferred.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Yes	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Yes	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	No	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	No	1
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	No	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	No	1
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	No	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	No	1

Mitigation: Tow truck plan/incident plan.

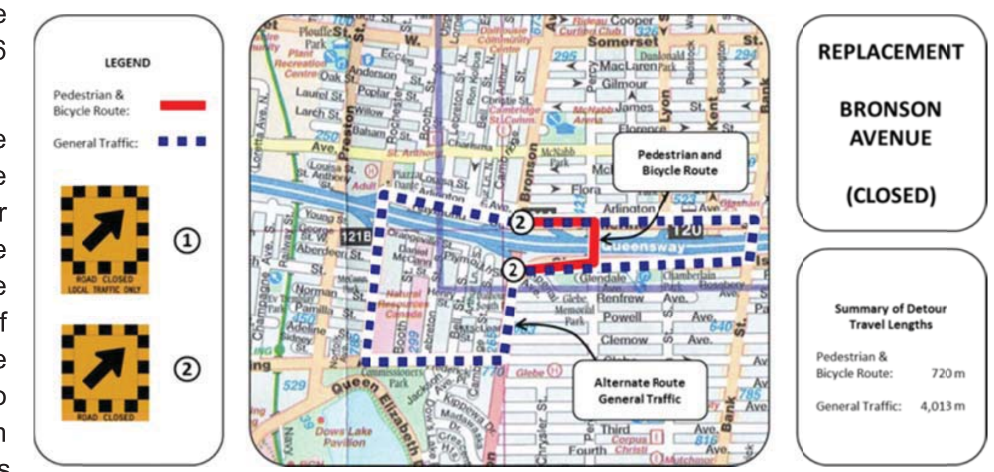
Pedestrian – Delay and Out-of-way Travel



Description: This sub-factor measures the length and duration of pedestrian out-of-way travel on the side streets while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily sidewalk closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period. Pedestrians will be signed to use the opposite sidewalk from the adjacent signalized intersections.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. Pedestrians will use a single sidewalk and cross the street at the temporary signals. The duration of the temporary signals will be 6 weeks.



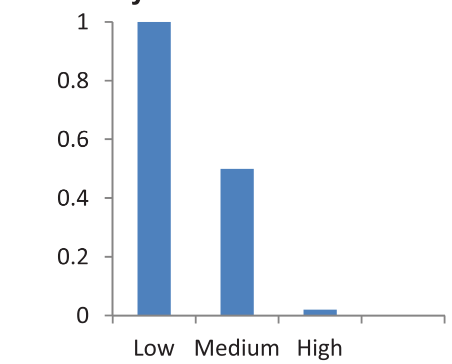
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure pedestrians will be directed to Percy Street, for a maximum out-of-way travel of 0.7 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0

Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: Advance signage for pedestrians to travel to the alternate sidewalk route as well as pre-event information to the property owners.

Bicycle – Delay and Out-of-Way Travel

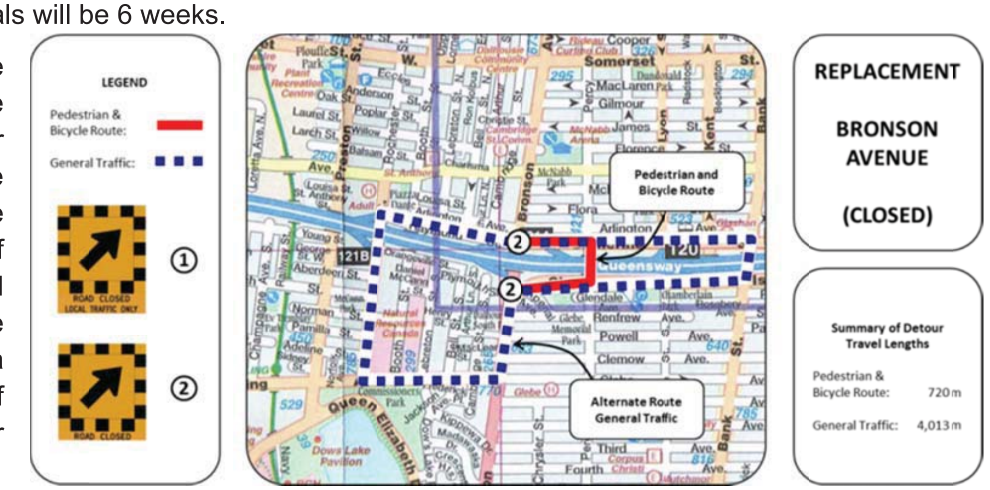


Description: This sub-factor measures the length and duration of bicycle delay and out-of-way travel on the side street while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily lane and bike lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. Bicyclists will use the single lane detour through the temporary signals. The duration of the temporary signals will be 6 weeks.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure, bicyclists will be directed to Percy Street, for a maximum out-of-way travel of 0.7 km. This sub-factor measures a one-way trip only.

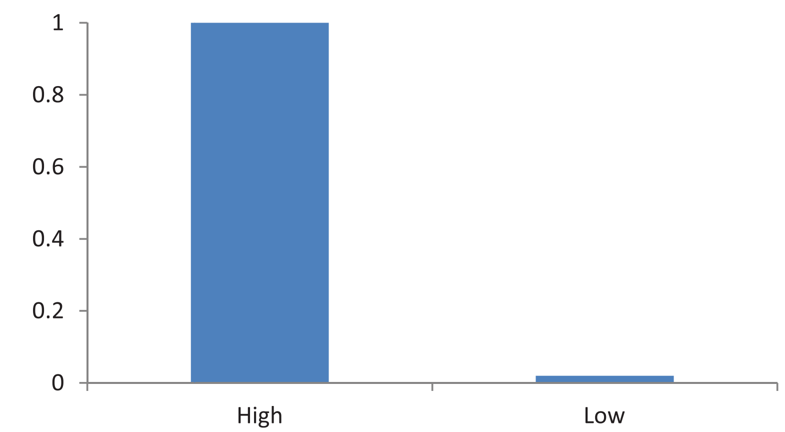


Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e ***TWIN*** REPLACEMENT	Medium	0.5

Rapid Replacement/Full Closure/Existing Span		
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: Advance signage for cyclists to choose an alternate route as well as pre-event information to the Regional cycling clubs.

Pedestrian/Bicycle Safety

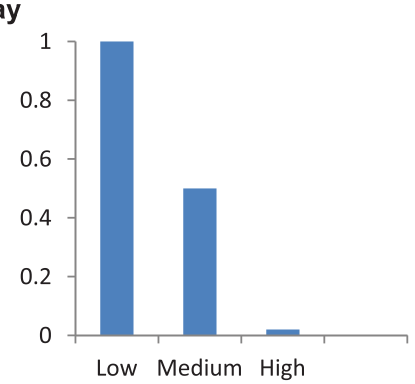


Description: This sub-factor measures if an alternative provides greater lateral space to increase pedestrian and bicycle safety. Those alternatives providing the largest span are preferred (high potential) and those alternatives matching the existing span are not preferred (i.e. low potential).

Alternatives	High/Low	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	0
Alternative A5e Conventional Rehab/Existing Span	Low	0
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Low	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	1
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Low	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Low	0
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	High	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	High	1
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	High	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	High	1

Mitigation: None.

Transit Operations Delay



Description: This sub-factor measures the delay during construction that will affect transit operations. Bus route affected: No. 4. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6 week period.

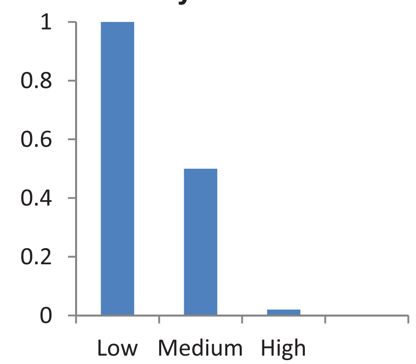
Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. The duration of the temporary signals will be 6 weeks.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure transit will be redirected to adjacent streets, for a maximum out-of-way travel of 2.7 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: Advance information to OC Transpo and temporary relocation of bus stops if required.

General Traffic Municipal Street Delay

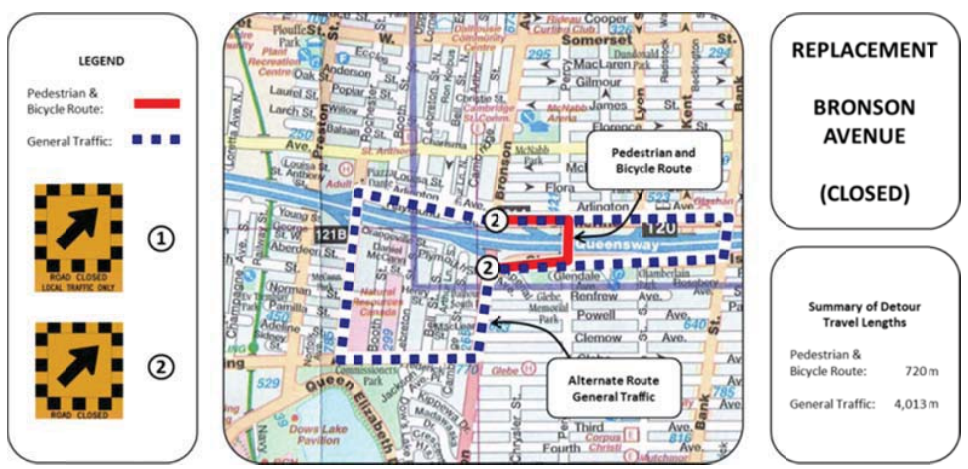


Description: This sub-factor measures the delay during construction that will affect general traffic operations. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. The duration of the temporary signals will be 6 weeks.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure vehicles will be redirected to adjacent streets, for a maximum out-of-way travel of 4.0 km. This sub-factor measures a one-way trip only.

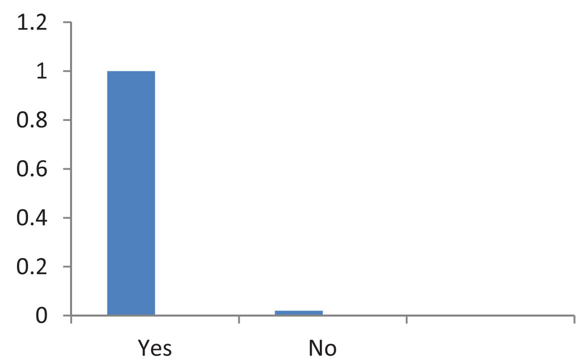


Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5

Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: The use of advisory signage and potential use of variable message signage can be used to advise drivers before reaching the construction site.

Provision of Ramp Terminal LT



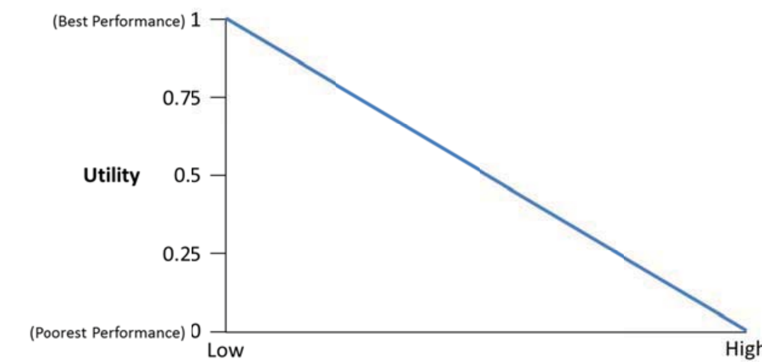
Description: This sub-factor measures whether the alternative allows for potential southbound left turn lane movements to Chamberlain Street.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	No	1
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Yes	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	No	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	No	1
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Yes	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Yes	0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Yes	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Yes	0

Mitigation: N/A

Factor Group: Social and Cultural Environment

Impact to Emergency Response

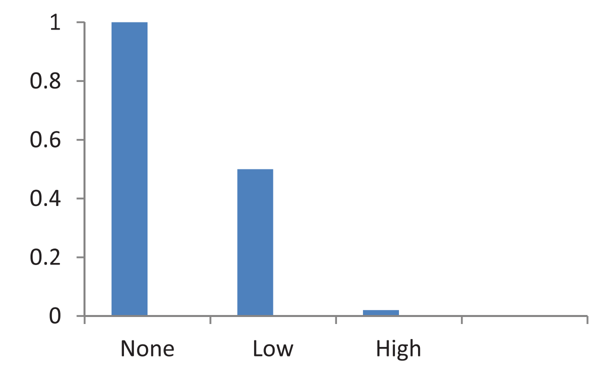


Description: This sub-factor measures the duration of Queensway closure that will affect emergency response service (police, ambulance and fire). Alternatives that reduce the length of time that there are lane closures on the Queensway are preferred.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	0.9
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0.0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0.0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	0	3	3	1.0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	20	12	32	0.9
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	0	3	3	1.0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	20	12	32	0.9
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	0	3	3	1.0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	20	12	32	0.9

Mitigation: Advanced warning of lane closures or detour routes.

Potentially Contaminated Property



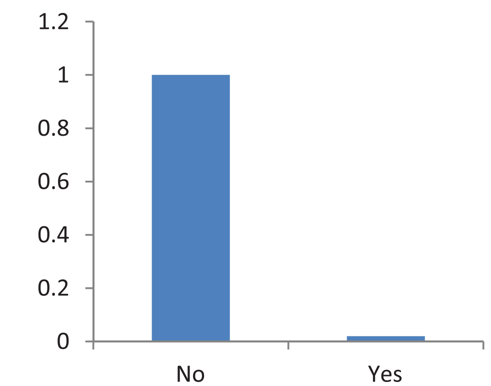
Description: This sub-factor measures whether there is potential to encounter potentially contaminated property during the construction of an alternative. Alternatives that minimize excavation are preferred. RBR staging sites have high potential (i.e. large footprint of excavation) to impact potentially contaminated property. Any alternative excavating in place has low potential to impact potentially contaminated property. The rehabilitation options have no potential to impact potentially contaminated property due to the small footprint of works.

Alternatives	No/Low/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Low	0.5
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Low	0.5
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	High	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	High	0
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	High	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	High	0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	High	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	High	0

Mitigation: Avoidance.

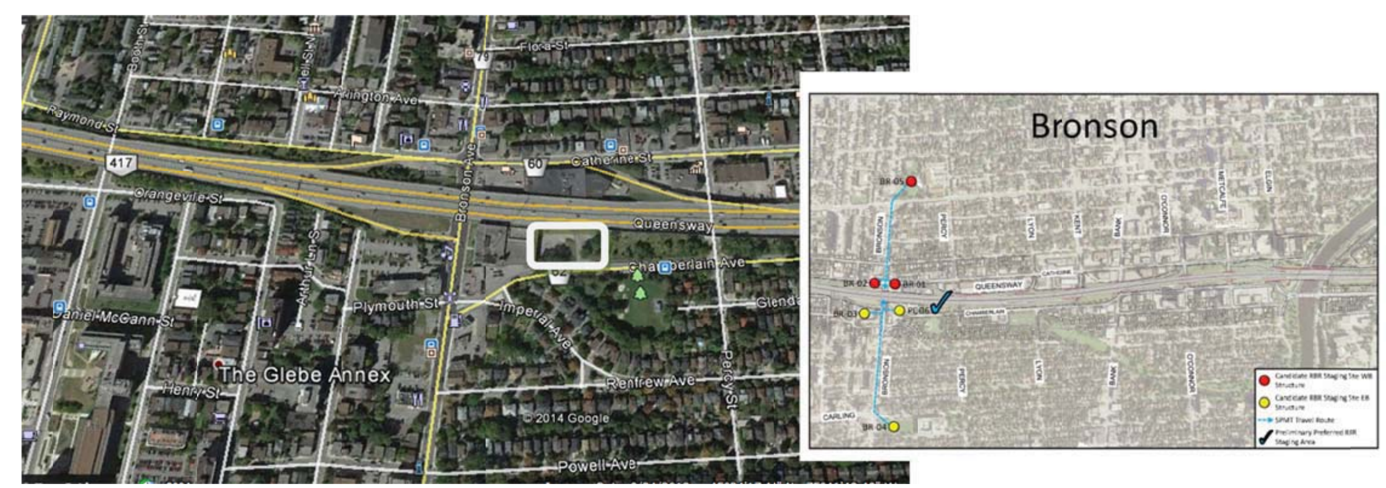
Factor Group: Land Use and Property

Temporary Property Impacts



Description:

This sub-factor measures whether property (i.e. parking lot at Bronson/Chamberlain/Queensway) is required for temporary use as a bridge staging area (PE-06), as per the RBR Structure Staging Sites memo.



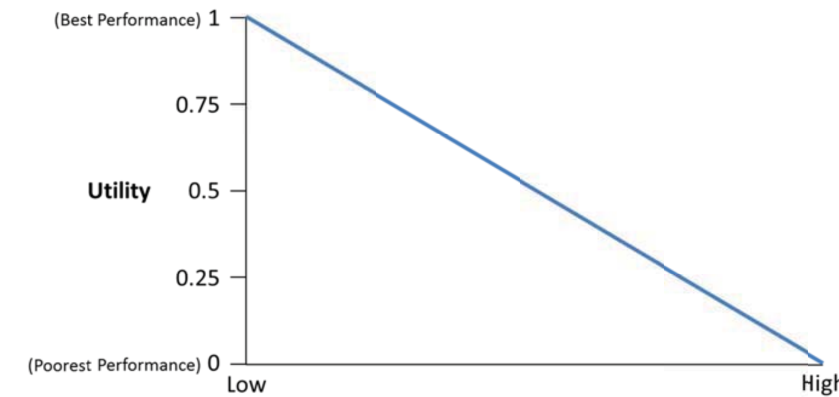
Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	No	1
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	No	1
Alternative C6e ***TWIN*** REPLACEMENT	Yes	0

Rapid Replacement/Full Closure/Existing Span		
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Yes	0
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Yes	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Yes	0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Yes	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Yes	0

Mitigation: N/A

Factor Group: Cost

Capital Cost



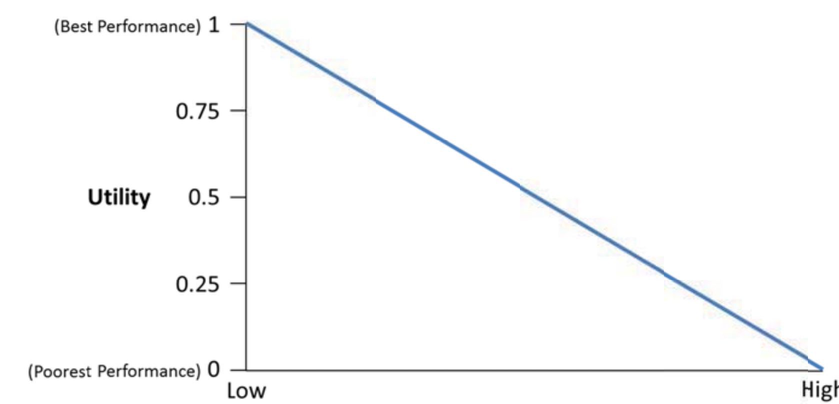
Description: This sub-factor measures the difference in initial capital cost of the alternative (bridge, traffic staging, staging area, and property costs). Those alternatives with the lowest capital cost are preferred. These costs do not include Engineering Costs.

Alternatives	$M		Utility Score
Alternative A2e Rapid Rehab/Existing Span	Structure 0.76 Staging 0.6 Property 0	1.36	1
Alternative A5e Conventional Rehab/Existing Span	Structure 0.76 Staging 1.25 Property 0	2.01	0.9
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Structure 3.16 Staging 1.2 Property 0	4.36	0.5
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Structure 3.85 Staging 1.2 Property 0	5.05	0.4
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Structure 5.48 Staging 0.60 Property 0.20	6.28	0.2
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Structure 5.48 Staging 0.60 Property 0.20	6.28	0.2
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Structure 6.86 Staging 0.60 Property 0.20	7.66	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Structure 6.86 Staging 0.60 Property 0.20	7.66	0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full	Structure 6.01 Staging 0.60	6.81	0.1

Closure/Longer Span	Property 0.20		
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Structure 6.01 Staging 0.60 Property 0.20	6.81	0.1

Mitigation: N/A

Future Life Cycle Cost



Description: This sub-factor measures the difference in future life cycle costs (maintenance, operating costs and long term replacement and rehabilitation in the 40 year planning horizon). Those alternatives with the lowest long term life cycle cost are preferred. A 5% discount rate was used.

Alternatives	$M	Utility Score
Alternative A2e Rapid Rehab/Existing Span	3.67	1
Alternative A5e Conventional Rehab/Existing Span	4.32	0.9
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	5.03	0.8
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	5.81	0.6
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	7.04	0.4
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	7.59	0.3
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	8.59	0.1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	9.14	0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	7.63	0.3
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	8.18	0.2

Mitigation: N/A

VERSION: November 11, 2014

APPENDIX E

SUB-FACTOR UTILITY FUNCTION DEFINITIONS AND MEASUREMENTS FOR SHORT LISTED EVALUATION CRITERIA

BRONSON AVENUE WESTBOUND BRIDGE

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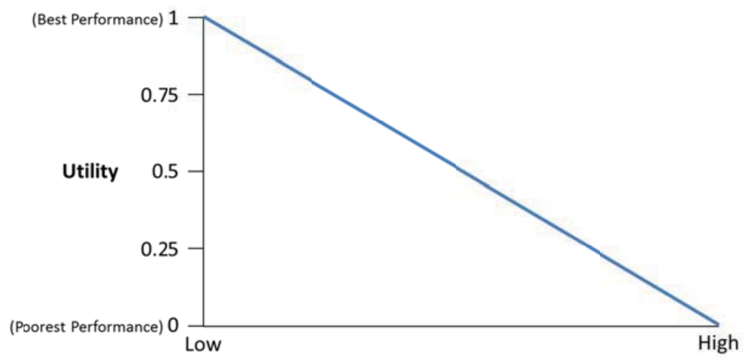
Factor Group: Transportation

Maximum Peak Queue Length on Queensway



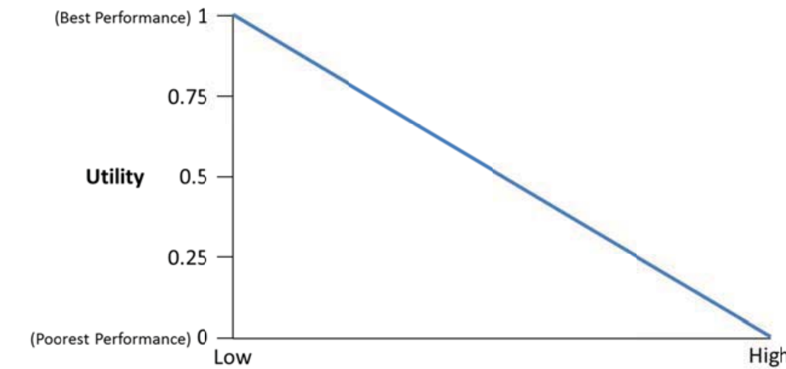
Description: This sub-factor measures the forecast queue length effect in the peak hour including measures to divert trips and induce transportation demand management during construction. The sub-factor measures the queue duration (days) and the forecast queue length (after the use of mitigation). This sub-factor is indicative of highway performance and safety, and is related to: effects on ramp operations, rear end collisions influenced by stop and go traffic, poor weaving conditions and traffic congestion.

(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	**km days (peak hour)**	**Utility Score**
Alternative A2e Rapid Rehab/Existing Span	41	0.98
Alternative A5e Conventional Rehab/Existing Span	780	0.59
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	1920	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	1920	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	3	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	240	0.89
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	3	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	240	0.89
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	3	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	240	0.89

Mitigation: The use of advance advertising and advising drivers of the scheduled lane closures through PVMS placement in advance of construction will be measures that will reduce demand by: changing the time of travel of commuters, use of transit as an alternate mode of travel, or by inducing diversion to the municipal road system as an alternate route.

Delays

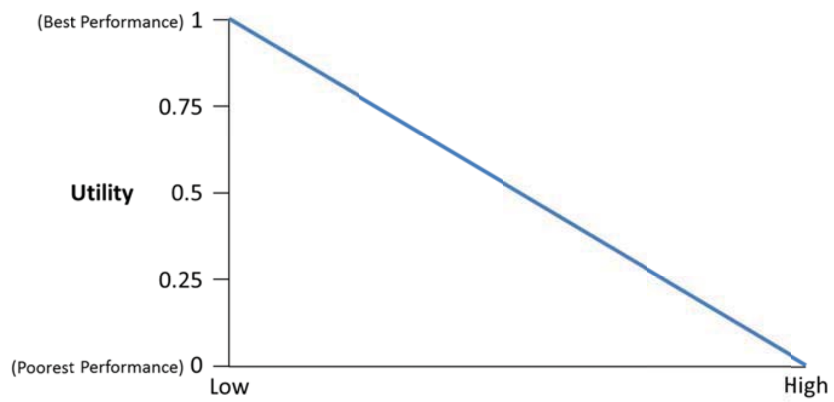


Description: This sub-factor measures the total lane closure peak period delay to drivers on the Queensway during the construction period. It includes the total peak period delay forecast for the duration of construction of the alternative. The delay sub-factor, although measuring vehicles on the Queensway, is also indicative of the delays for drivers diverted from the Queensway and operating on the municipal road system.
(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	**Veh h**	**Utility Score**
Alternative A2e Rapid Rehab/Existing Span	16,520	1
Alternative A5e Conventional Rehab/Existing Span	1,537,200	0.60
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	3,782,800	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	3,782,800	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	780	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	472,600	0.88
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	780	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	472,600	0.88
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	780	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	472,600	0.88

Mitigation: N/A

Ramp Closures

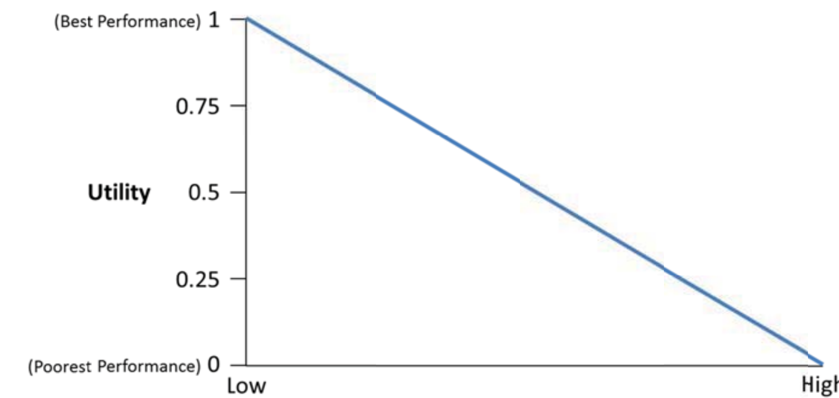


Description: This sub-factor measures the impact to community access by quantifying the volume of peak hour ramp trips that will be removed from entering or exiting from the Queensway. The sub-factor measures the peak hour ramp volume for each stage of the highway staging plan for the duration of the closure.

Alternatives	Veh (peak hour)	Utility Score
Alternative A2e Rapid Rehab/Existing Span	0	1
Alternative A5e Conventional Rehab/Existing Span	0	1
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	0	1
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	0	1
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	8,067	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	0	1
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	8,067	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	0	1
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	8,067	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	0	1

Mitigation: Ramps may be closed by time of day to allow access in non-peak hours.

Highway Safety - Collision Potential

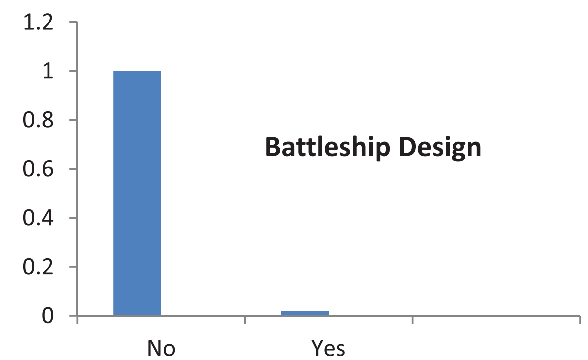


Description: This sub-factor measures the collision potential of the alternative by measuring the time duration that drivers will be required to transition through the construction zone.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	0.9
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	0	3	3	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	20	12	32	0.9
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	0	3	3	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	20	12	32	0.9
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	0	3	3	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	20	12	32	0.9

Mitigation: N/A

Highway Safety – Design Consistency of Traffic Staging Design

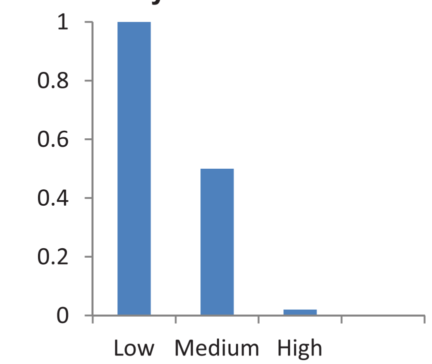


Description: This sub-factor measures the collision potential of the highway staging design. Those alternatives including a non-conventional battleship design (i.e. yes) are least preferred.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Yes	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Yes	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	No	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	No	1
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	No	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	No	1
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	No	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	No	1

Mitigation: Tow truck plan/incident plan.

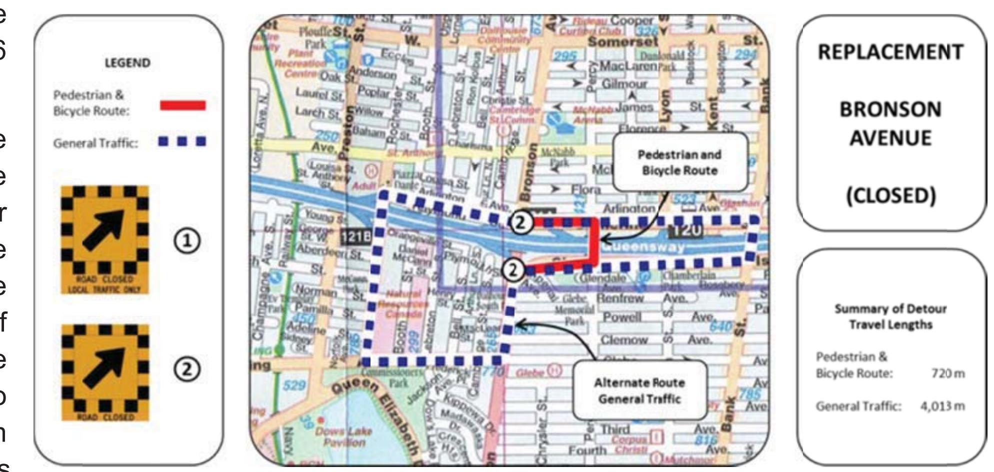
Pedestrian – Delay and Out-of-way Travel



Description: This sub-factor measures the length and duration of pedestrian out-of-way travel on the side streets while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily sidewalk closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period. Pedestrians will be signed to use the opposite sidewalk from the adjacent signalized intersections.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. Pedestrians will use a single sidewalk and cross the street at the temporary signals. The duration of the temporary signals will be 6 weeks.



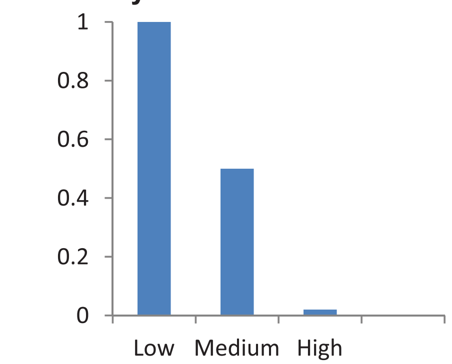
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure pedestrians will be directed to Percy Street, for a maximum out-of-way travel of 0.7 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0

Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: Advance signage for pedestrians to travel to the alternate sidewalk route as well as pre-event information to the property owners.

Bicycle – Delay and Out-of-Way Travel

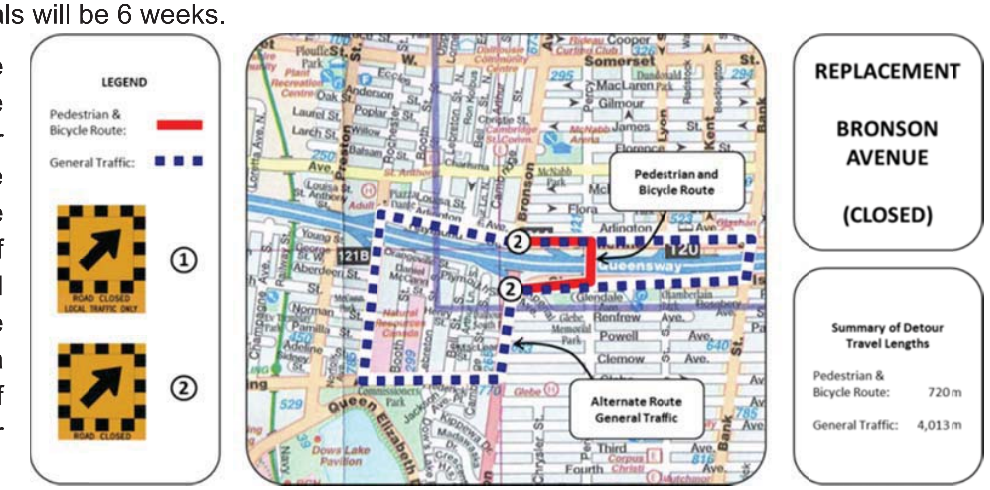


Description: This sub-factor measures the length and duration of bicycle delay and out-of-way travel on the side street while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily lane and bike lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. Bicyclists will use the single lane detour through the temporary signals. The duration of the temporary signals will be 6 weeks.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure, bicyclists will be directed to Percy Street, for a maximum out-of-way travel of 0.7 km. This sub-factor measures a one-way trip only.

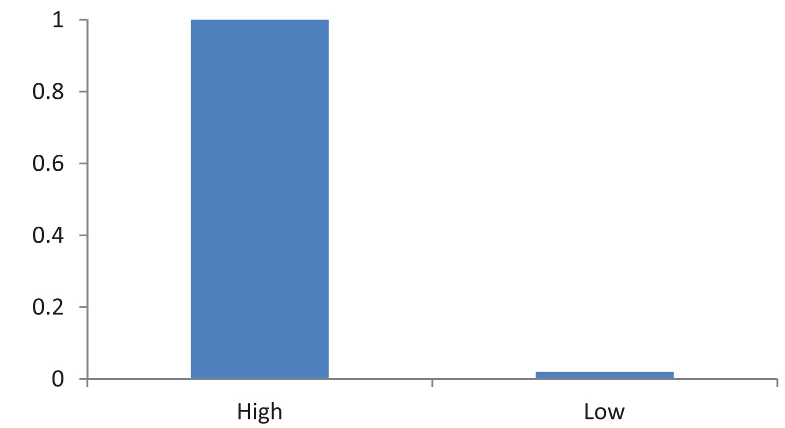


Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e ***TWIN*** REPLACEMENT	Medium	0.5

Rapid Replacement/Full Closure/Existing Span		
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: Advance signage for cyclists to choose an alternate route as well as pre-event information to the Regional cycling clubs.

Pedestrian/Bicycle Safety

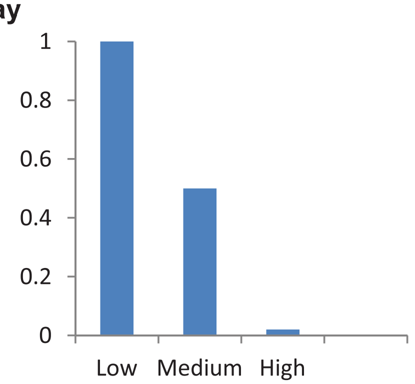


Description: This sub-factor measures if an alternative provides greater lateral space to increase pedestrian and bicycle safety. Those alternatives providing the largest span are preferred (high potential) and those alternatives matching the existing span are not preferred (i.e. low potential).

Alternatives	High/Low	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	0
Alternative A5e Conventional Rehab/Existing Span	Low	0
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Low	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	1
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Low	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Low	0
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	High	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	High	1
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	High	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	High	1

Mitigation: None.

Transit Operations Delay



Description: This sub-factor measures the delay during construction that will affect transit operations. Bus route affected: No. 4. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6 week period.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. The duration of the temporary signals will be 6 weeks.

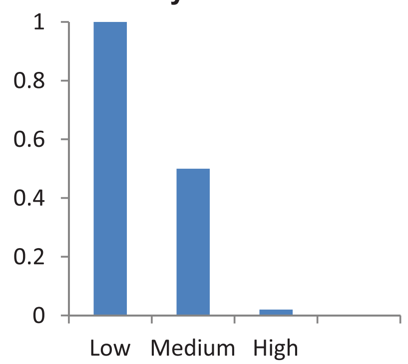
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure transit will be redirected to adjacent streets, for a maximum out-of-way travel of 2.7 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Medium	0.5

Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: Advance information to OC Transpo and temporary relocation of bus stops if required.

General Traffic Municipal Street Delay

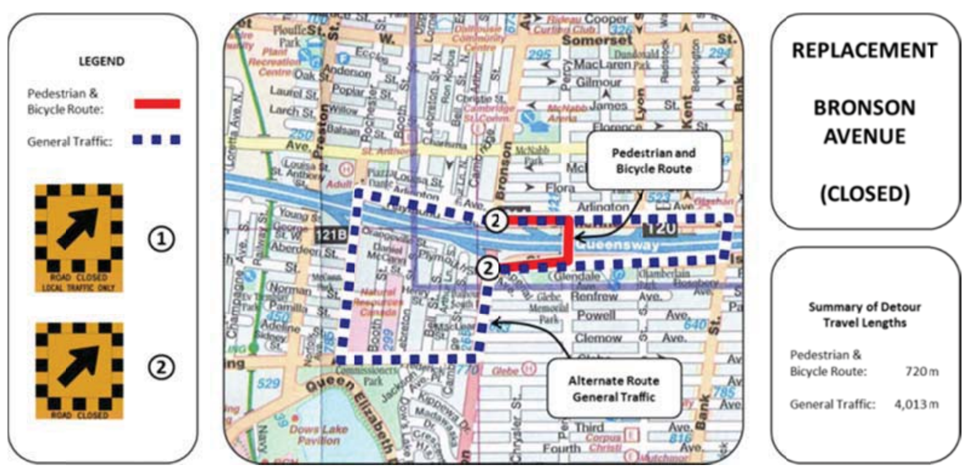


Description: This sub-factor measures the delay during construction that will affect general traffic operations. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. The duration of the temporary signals will be 6 weeks.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure vehicles will be redirected to adjacent streets, for a maximum out-of-way travel of 4.0 km. This sub-factor measures a one-way trip only.

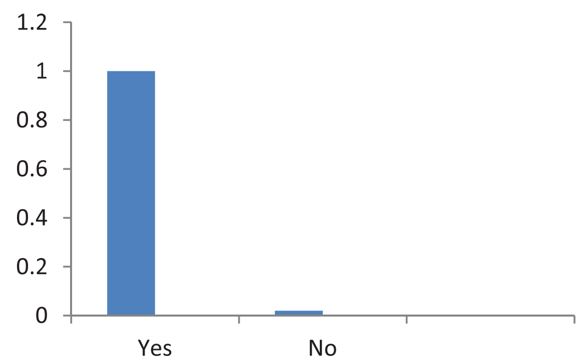


Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5

Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: The use of advisory signage and potential use of variable message signage can be used to advise drivers before reaching the construction site.

Provision of Ramp Terminal LT



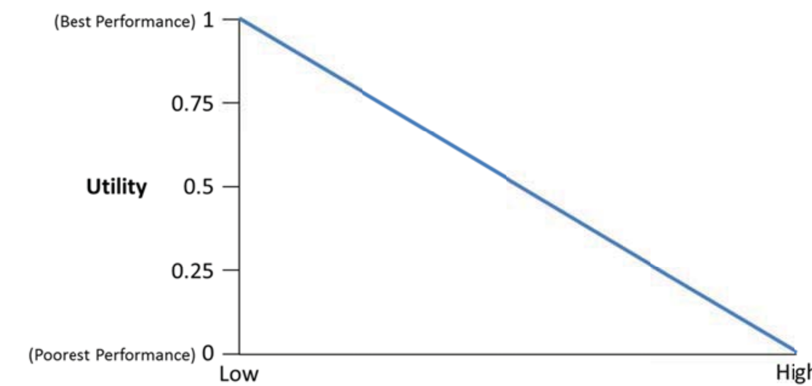
Description: This sub-factor measures whether the alternative allows for potential southbound left turn lane movements to Chamberlain Street.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	No	1
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Yes	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	No	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	No	1
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Yes	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Yes	0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Yes	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Yes	0

Mitigation: N/A

Factor Group: Social and Cultural Environment

Impact to Emergency Response

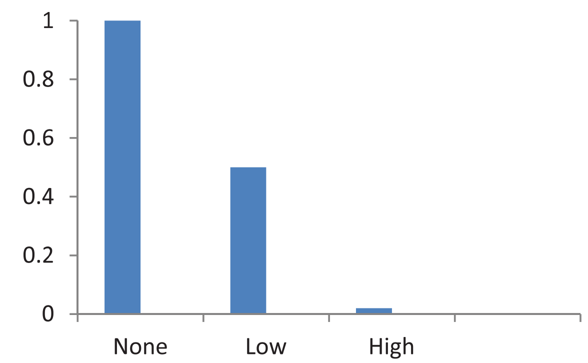


Description: This sub-factor measures the duration of Queensway closure that will affect emergency response service (police, ambulance and fire). Alternatives that reduce the length of time that there are lane closures on the Queensway are preferred.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	0.9
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0.0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0.0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	0	3	3	1.0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	20	12	32	0.9
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	0	3	3	1.0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	20	12	32	0.9
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	0	3	3	1.0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	20	12	32	0.9

Mitigation: Advanced warning of lane closures or detour routes.

Potentially Contaminated Property



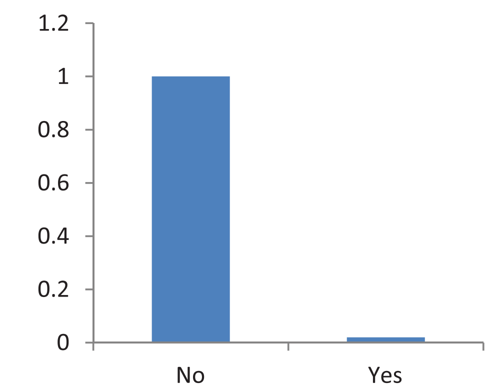
Description: This sub-factor measures whether there is potential to encounter potentially contaminated property during the construction of an alternative. Alternatives that minimize excavation are preferred. RBR staging sites have high potential (i.e. large footprint of excavation) to impact potentially contaminated property. Any alternative excavating in place has low potential to impact potentially contaminated property. The rehabilitation options have no potential to impact potentially contaminated property due to the small footprint of works.

Alternatives	No/Low/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Low	0.5
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Low	0.5
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	High	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	High	0
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	High	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	High	0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	High	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	High	0

Mitigation: Avoidance.

Factor Group: Land Use and Property

Temporary Property Impacts



Description:

This sub-factor measures whether property (i.e. parking lot at Bronson/Chamberlain/Queensway) is required for temporary use as a bridge staging area (PE-06), as per the RBR Structure Staging Sites memo.

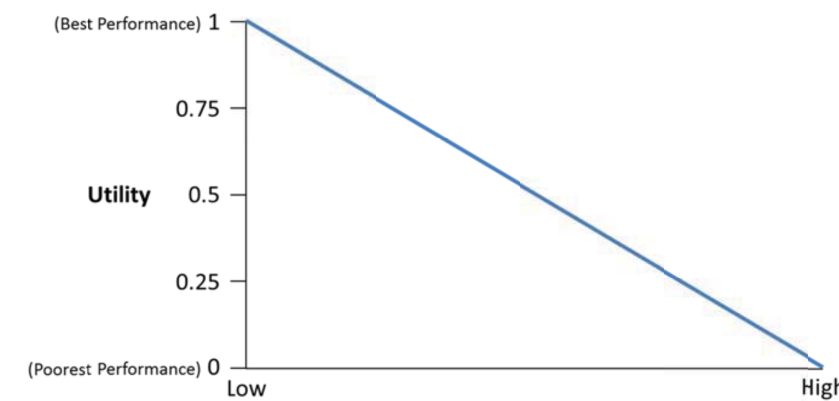
Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	No	1
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	No	1
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Yes	0

Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Yes	0
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Yes	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Yes	0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Yes	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Yes	0

Mitigation: N/A

Factor Group: Cost

Capital Cost



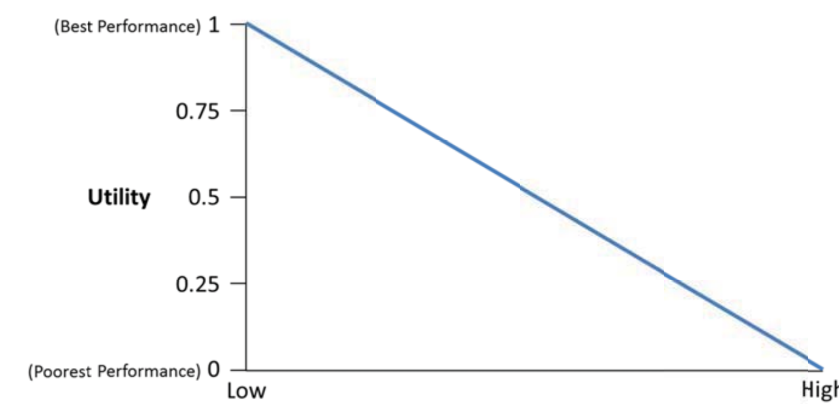
Description: This sub-factor measures the difference in initial capital cost of the alternative (bridge, traffic staging, staging area, and property costs). Those alternatives with the lowest capital cost are preferred. These costs do not include Engineering Costs.

Alternatives	$M		Utility Score
Alternative A2e Rapid Rehab/Existing Span	Structure 0.76 Staging 0.6 Property 0	1.52	1
Alternative A5e Conventional Rehab/Existing Span	Structure 0.76 Staging 1.25 Property 0	2.17	0.9
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Structure 3.16 Staging 1.2 Property 0	4.36	0.5
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Structure 3.85 Staging 1.2 Property 0	5.05	0.4
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Structure 5.48 Staging 0.60 Property 0.20	6.28	0.2
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Structure 5.48 Staging 0.60 Property 0.20	6.28	0.2
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Structure 6.86 Staging 0.60 Property 0.20	7.66	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Structure 6.86 Staging 0.60 Property 0.20	7.66	0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full	Structure 6.01 Staging 0.60	6.81	0.1

Closure/Longer Span	Property 0.20		
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Structure 6.01 Staging 0.60 Property 0.20	6.81	0.1

Mitigation: N/A

Future Life Cycle Cost



Description: This sub-factor measures the difference in future life cycle costs (maintenance, operating costs and long term replacement and rehabilitation in the 40 year planning horizon). Those alternatives with the lowest long term life cycle cost are preferred. A 5% discount rate was used.

Alternatives	$M	Utility Score
Alternative A2e Rapid Rehab/Existing Span	3.85	1
Alternative A5e Conventional Rehab/Existing Span	4.50	0.9
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	5.03	0.8
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	5.81	0.6
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	7.04	0.4
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	7.59	0.3
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	8.59	0.1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	9.14	0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	7.63	0.3
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	8.18	0.2

Mitigation: N/A

VERSION: November 11, 2014

APPENDIX E

SUB-FACTOR UTILITY FUNCTION DEFINITIONS AND MEASUREMENTS FOR SHORT LISTED EVALUATION CRITERIA

PERCY STREET EASTBOUND BRIDGE

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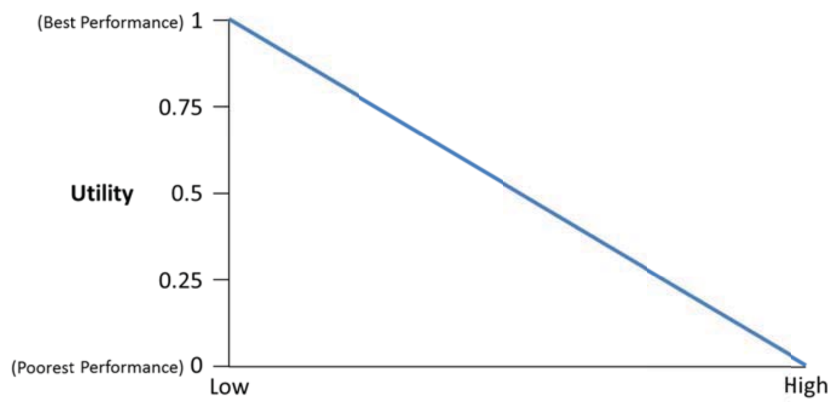
Factor Group: Transportation

Maximum Peak Queue Length on Queensway



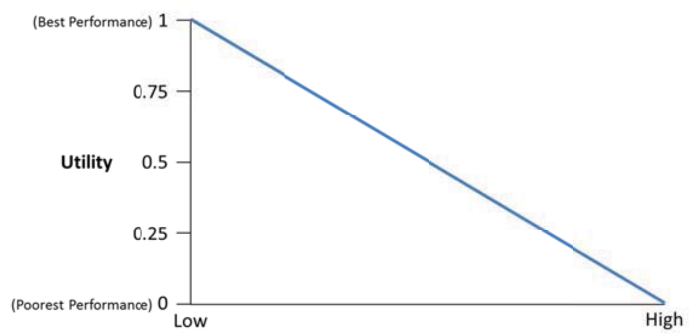
Description: This sub-factor measures the forecast queue length effect in the peak hour including measures to divert trips and induce transportation demand management during construction. The sub-factor measures the queue duration (days) and the forecast queue length (after the use of mitigation). This sub-factor is indicative of highway performance and safety, and is related to: effects on ramp operations, rear end collisions influenced by stop and go traffic, poor weaving conditions and traffic congestion.

(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	km days (peak hour)	Utility Score
Alternative A2e Rapid Rehab/Existing Span	41	0.98
Alternative A5e Conventional Rehab/Existing Span	780	0.59
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	1920	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	1920	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	3	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	240	0.89
Alternative C6s ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Shorter Span	3	1
Alternative C7s Rapid Replacement/Two Lane Detour/Shorter Span	240	0.89
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	3	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	240	0.89
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	3	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	240	0.89

Mitigation: The use of advance advertising and advising drivers of the scheduled lane closures through PVMS placement in advance of construction will be measures that will reduce demand by: changing the time of travel of commuters, use of transit as an alternate mode of travel or by inducing diversion to the municipal road system as an alternate route.

Delays

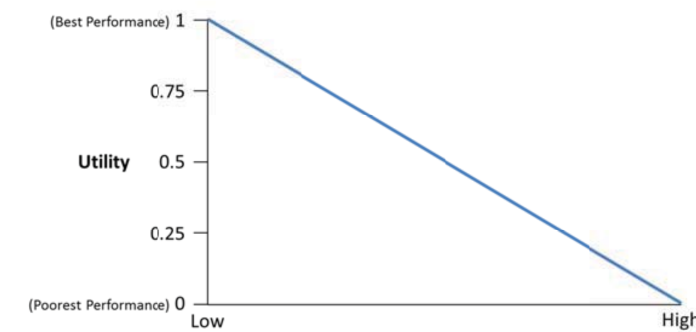


Description: This sub-factor measures the total lane closure peak period delay to drivers on the Queensway during the construction period. It includes the total peak period delay forecast for the duration of construction of the alternative. The delay sub-factor, although measuring vehicles on the Queensway, is also indicative of the delays for drivers diverted from the Queensway and operating on the municipal road system.
(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	**Veh h**	**Utility Score**
Alternative A2e Rapid Rehab/Existing Span	16,520	1
Alternative A5e Conventional Rehab/Existing Span	1,537,200	0.60
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	3,782,800	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	3,782,800	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	780	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	472,600	0.88
Alternative C6s ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Shorter Span	780	1
Alternative C7s Rapid Replacement/Two Lane Detour/Shorter Span	472,600	0.88
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	780	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	472,600	0.88
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	780	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	472,600	0.88

Mitigation: N/A

Ramp Closures

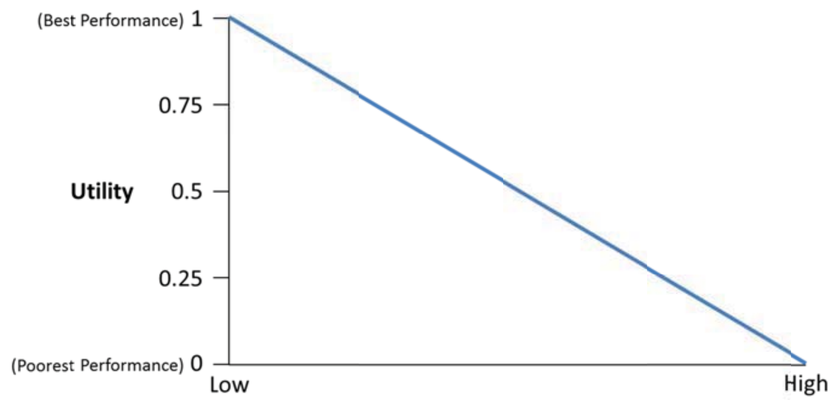


Description: This sub-factor measures the impact to community access by quantifying the volume of peak hour ramp trips that will be removed from entering or exiting from the Queensway. The sub-factor measures the peak hour ramp volume for each stage of the highway staging plan for the duration of the closure.

Alternatives	**Veh (peak hour)**	**Utility Score**
Alternative A2e Rapid Rehab/Existing Span	0	1
Alternative A5e Conventional Rehab/Existing Span	26,775	0
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	N/A	1
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	N/A	1
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	8,067	0.70
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	N/A	1
Alternative C6s ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Shorter Span	8,067	0.70
Alternative C7s Rapid Replacement/Two Lane Detour/Shorter Span	N/A	1
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	8,067	0.7
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	N/A	1
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	8,067	0.70
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	N/A	1

Mitigation: Ramps may be closed by time of day to allow access in non-peak hours.

Highway Safety - Collision Potential

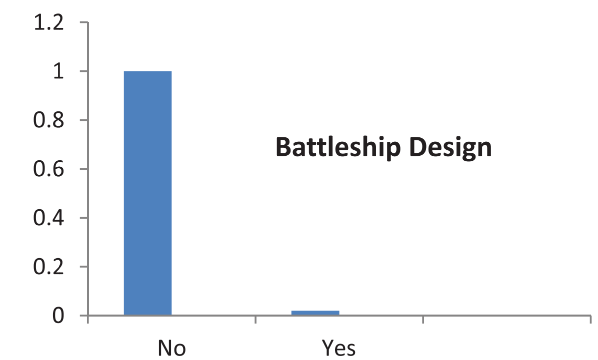


Description: This sub-factor measures the collision potential of the alternative by measuring the time duration that drivers will be required to transition through the construction zone.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	0.9
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	0	3	3	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	20	12	32	0.9
Alternative C6s ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Shorter Span	0	3	3	1
Alternative C7s Rapid Replacement/Two Lane Detour/Shorter Span	20	12	32	0.9
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	0	3	3	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	20	12	32	0.9
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	0	3	3	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	20	12	32	0.9

Mitigation: N/A

Highway Safety – Design Consistency of Traffic Staging Design

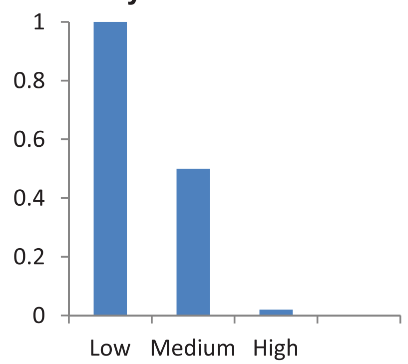


Description: This sub-factor measures the collision potential of the highway staging design. Those alternatives including a non-conventional battleship design (i.e. yes) are least preferred.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Yes	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Yes	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	No	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	No	1
Alternative C6s ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Shorter Span	No	1
Alternative C7s Rapid Replacement/Two Lane Detour/Shorter Span	No	1
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	No	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	No	1
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	No	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	No	1

Mitigation: Tow truck plan/incident plan.

Pedestrian – Delay and Out-of-way Travel



Description: This sub-factor measures the length and duration of pedestrian out-of-way travel on the side streets while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily sidewalk closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period. Pedestrians will be signed to use the opposite sidewalk from the adjacent signalized intersections.

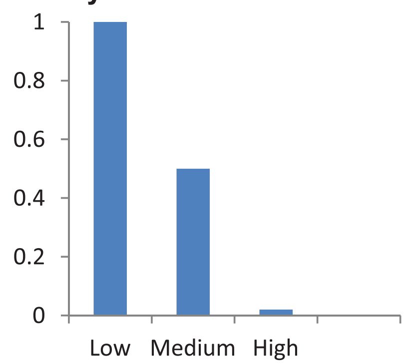
Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. Pedestrians will use a single sidewalk and cross the street at the temporary signals. The duration of the temporary signals will be 6 weeks.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure pedestrians will be directed to Bronson Avenue, for a maximum out-of-way travel of 0.8 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5
Alternative C6s ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Shorter Span	Medium	0.5
Alternative C7s Rapid Replacement/Two Lane Detour/Shorter Span	Medium	0.5
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: Advance signage for pedestrians to travel to the alternate sidewalk route as well as pre-event information to the property owners.

Bicycle – Delay and Out-of-Way Travel



Description: This sub-factor measures the length and duration of bicycle delay and out-of-way travel on the side street while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily lane and bike lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. Bicyclists will use the single lane detour through the temporary signals. The duration of the temporary signals will be 6 weeks.

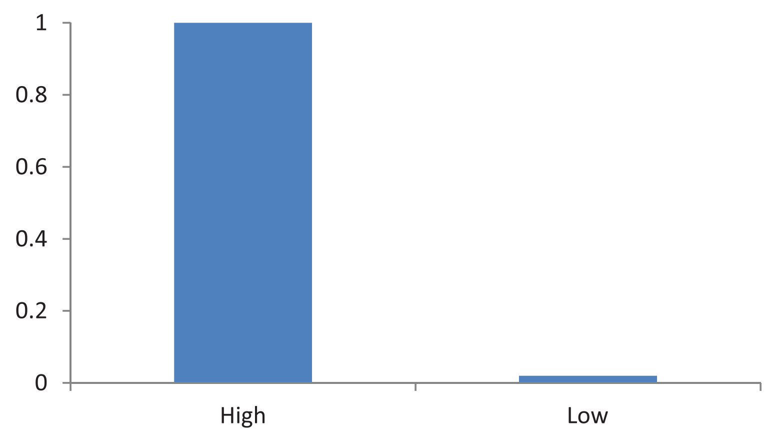
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure, bicyclists will be directed to Bronson Avenue, for a maximum out-of-way travel of 0.8 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Medium	0.5

Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5
Alternative C6s ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Shorter Span	Medium	0.5
Alternative C7s Rapid Replacement/Two Lane Detour/Shorter Span	Medium	0.5
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: Advance signage for cyclists to choose an alternate route as well as pre-event information to the Regional cycling clubs.

Pedestrian/Bicycle Safety

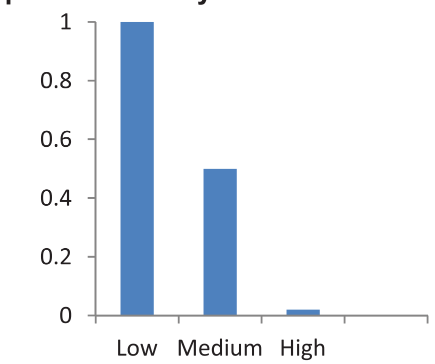


Description: This sub-factor measures if an alternative provides greater lateral space to increase pedestrian and bicycle safety. Those alternatives providing the largest span are preferred (high potential) and those alternatives matching the existing span are not preferred (i.e. low potential).

Alternatives	High/Low	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	0
Alternative A5e Conventional Rehab/Existing Span	Low	0
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Low	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	1
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Low	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Low	0
Alternative C6s ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Shorter Span	Low	0
Alternative C7s Rapid Replacement/Two Lane Detour/Shorter Span	Low	0
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	High	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	High	1
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	High	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	High	1

Mitigation: None.

General Traffic Municipal Street Delay

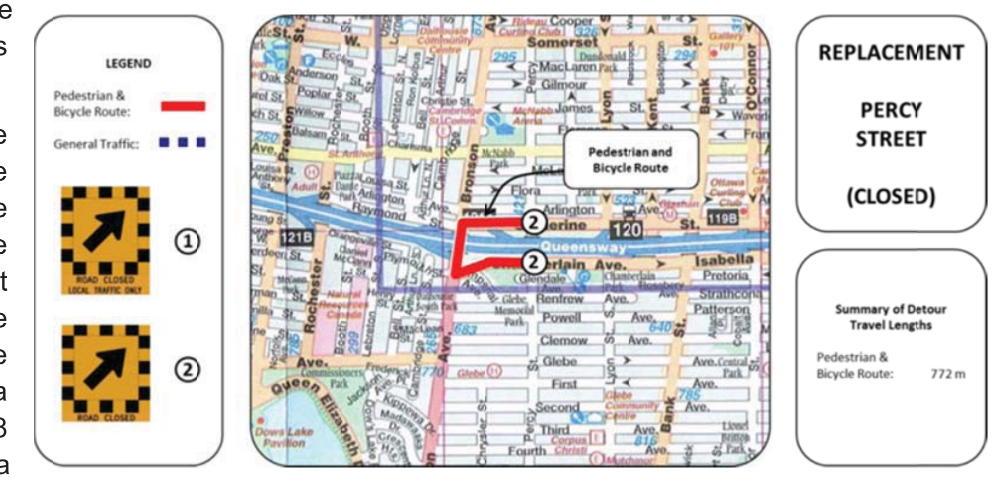


Description: This sub-factor measures the delay during construction that will affect general traffic operations. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. The duration of the temporary signals will be 6 weeks.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure vehicles will be directed to Bronson Avenue, for a maximum out-of-way travel of 0.8 km. This sub-factor measures a one-way trip only.



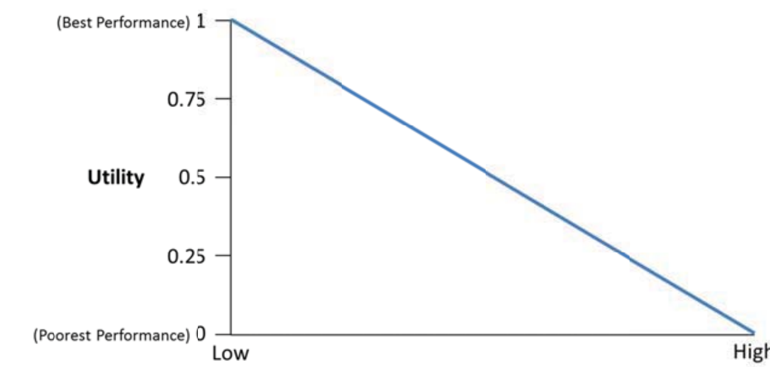
Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5

Alternative C6s ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Shorter Span	Medium	0.5
Alternative C7s Rapid Replacement/Two Lane Detour/Shorter Span	Medium	0.5
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: The use of advisory signage and potential use of variable message signage can be used to advise drivers before reaching the construction site.

Factor Group: Social and Cultural Environment

Impact to Emergency Response

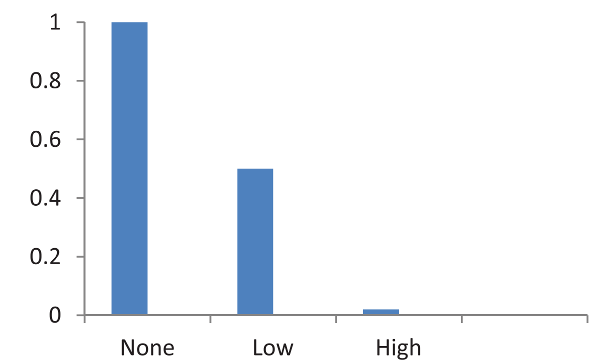


Description: This sub-factor measures the duration of Queensway closure that will affect emergency response service (police, ambulance and fire). Alternatives that reduce the length of time that there are lane closures on the Queensway are preferred.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	0.9
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0.0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0.0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	0	3	3	1.0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	20	12	32	0.9
Alternative C6s ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Shorter Span	0	3	3	1.0
Alternative C7s Rapid Replacement/Two Lane Detour/Shorter Span	20	12	32	0.9
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	0	3	3	1.0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	20	12	32	0.9
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	0	3	3	1.0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	20	12	32	0.9

Mitigation: Advanced warning of lane closures or detour routes.

Potentially Contaminated Property



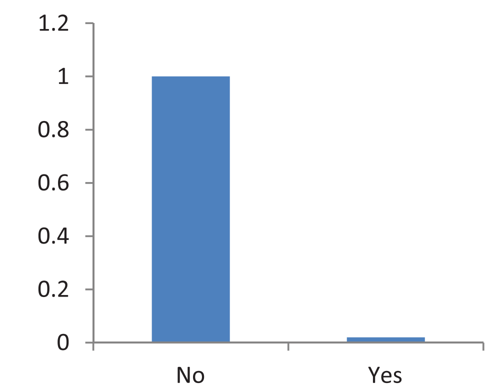
Description: This sub-factor measures whether there is potential to encounter potentially contaminated property during the construction of an alternative. Alternatives that minimize excavation are preferred. RBR staging sites have high potential (i.e. large footprint of excavation) to impact potentially contaminated property. Any alternative excavating in place has low potential to impact potentially contaminated property. The rehabilitation options have no potential to impact potentially contaminated property due to the small footprint of works.

Alternatives	No/Low/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Low	0.5
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Low	0.5
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	High	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	High	0
Alternative C6s ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Shorter Span	High	0
Alternative C7s Rapid Replacement/Two Lane Detour/Shorter Span	High	0
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	High	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	High	0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	High	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	High	0

Mitigation: Avoidance.

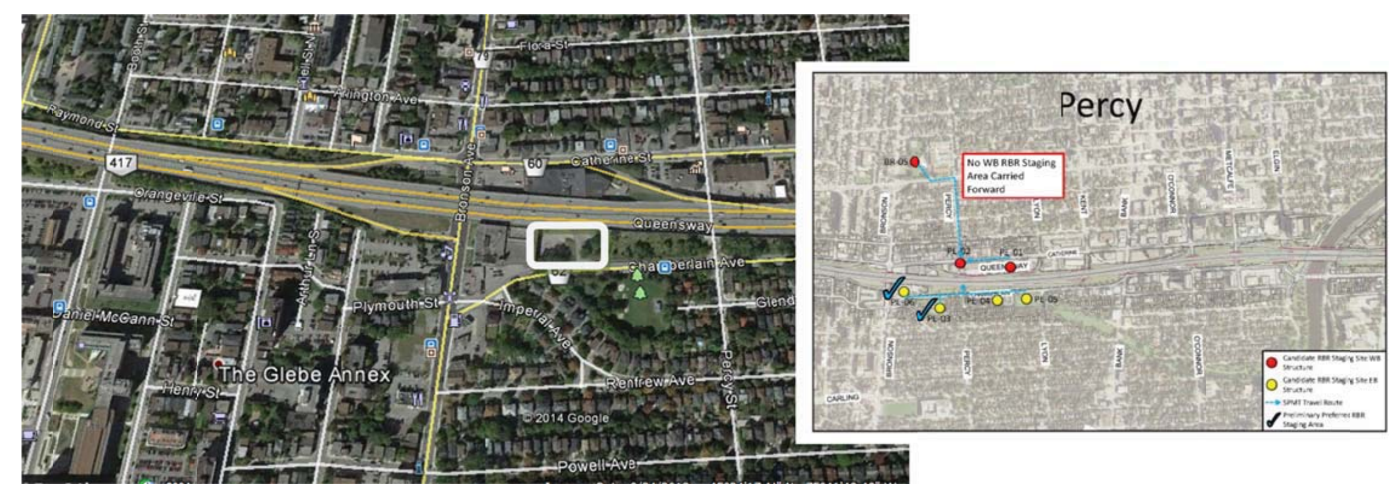
Factor Group: Land Use and Property

Temporary Property Impacts



Description:

This sub-factor measures whether property (i.e. parking lot at Bronson/Chamberlain/Queensway) is required for temporary use as a bridge staging area (PE-06), as per the RBR Structure Staging Sites memo.

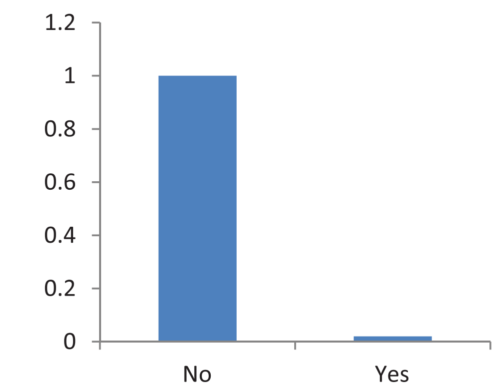


Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	No	1
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	No	1
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Yes	0

Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Yes	0
Alternative C6s ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Shorter Span	Yes	0
Alternative C7s Rapid Replacement/Two Lane Detour/Shorter Span	Yes	0
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Yes	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Yes	0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Yes	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Yes	0

Mitigation: N/A

Permanent Property Impacts – Impact to Ontario Hydro Plant



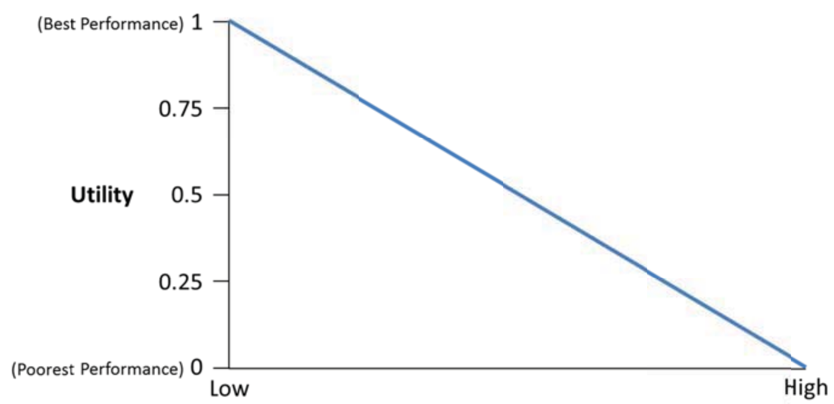
Description: This sub-factor measures the potential to impact buried high voltage transmission lines that are located 3 m from both the north and south abutments. Those alternatives that consider a shorter span have the potential to impact (i.e. relocate or require protection) these transmission lines.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	No	1
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	No	1
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	No	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	No	1
Alternative C6s ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Shorter Span	Yes	0
Alternative C7s Rapid Replacement/Two Lane Detour/Shorter Span	Yes	0
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	No	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	No	1
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	No	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	No	1

Mitigation: Relocation or protection.

Factor Group: Cost

Capital Cost

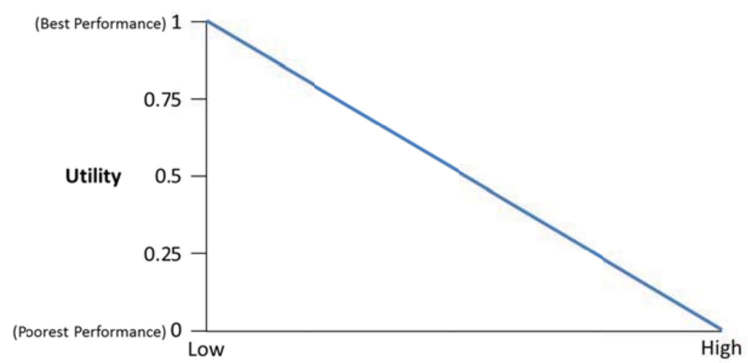


Description: This sub-factor measures the difference in initial capital cost of the alternative (bridge, traffic staging, staging area, and property costs). Those alternatives with the lowest capital cost are preferred. These costs do not include Engineering Costs.

Alternatives	$M		Utility Score
Alternative A2e Rapid Rehab/Existing Span	Structure 0.97 Staging 0.6 Property 0	1.57	1
Alternative A5e Conventional Rehab/Existing Span	Structure 0.97 Staging 1.25 Property 0	2.22	0.9
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Structure 3.00 Staging 1.2 Property 0	4.20	0.6
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Structure 3.70 Staging 1.2 Property 0	4.9	0.5
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Structure 5.04 Staging 0.60 Property 0.20	5.84	0.3
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Structure 5.04 Staging 0.60 Property 0.20	5.84	0.3
Alternative C6s ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Shorter Span	Structure 4.84 Staging 0.60 Property 0.20	5.64	0.3
Alternative C7s Rapid Replacement/Two Lane Detour/Shorter Span	Structure 4.84 Staging 0.60 Property 0.20	5.64	0.3
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Structure 6.91 Staging 0.60 Property 0.20	7.71	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Structure 6.91 Staging 0.60 Property 0.20	7.71	0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Structure 6.45 Staging 0.60 Property 0.20	7.25	0.1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Structure 6.45 Staging 0.60 Property 0.20	7.25	0.1

Mitigation: N/A

Future Life Cycle Cost



Description: This sub-factor measures the difference in future life cycle costs (maintenance, operating costs and long term replacement and rehabilitation in the 40 year planning horizon). Those alternatives with the lowest long term life cycle cost are preferred. A 5% discount rate was used.

Alternatives	$M	Utility Score
Alternative A2e Rapid Rehab/Existing Span	3.75	1
Alternative A5e Conventional Rehab/Existing Span	4.40	0.9
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	4.85	0.8
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	5.64	0.7
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	6.54	0.5
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	7.09	0.4
Alternative C6s ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Shorter Span	6.32	0.5
Alternative C7s Rapid Replacement/Two Lane Detour/Shorter Span	6.87	0.4
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	8.64	0.1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	9.20	0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	8.13	0.2
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	8.68	0.1

Mitigation: N/A

VERSION: November 11, 2014

APPENDIX E

SUB-FACTOR UTILITY FUNCTION DEFINITIONS AND MEASUREMENTS FOR SHORT LISTED EVALUATION CRITERIA

PERCY STREET WESTBOUND BRIDGE

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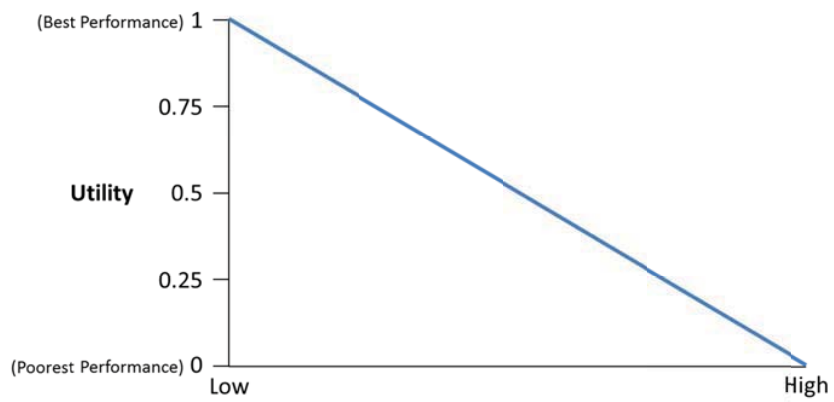
Factor Group: Transportation

Maximum Peak Queue Length on Queensway



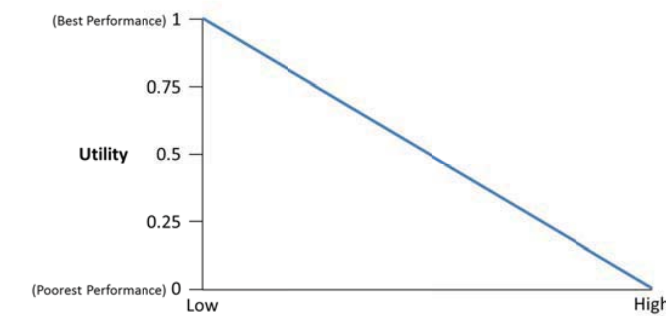
Description: This sub-factor measures the forecast queue length effect in the peak hour including measures to divert trips and induce transportation demand management during construction. The sub-factor measures the queue duration (days) and the forecast queue length (after the use of mitigation). This sub-factor is indicative of highway performance and safety, and is related to: effects on ramp operations, rear end collisions influenced by stop and go traffic, poor weaving conditions and traffic congestion.

(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	km days (peak hour)	Utility Score
Alternative A2e Rapid Rehab/Existing Span	41	0.98
Alternative A5e Conventional Rehab/Existing Span	780	0.59
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	1920	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	1920	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	3	1
Alternative C6s ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Shorter Span	3	1
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	3	1
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	3	1

Mitigation: The use of advance advertising and advising drivers of the scheduled lane closures through PVMS placement in advance of construction will be measures that will reduce demand by: changing the time of travel of commuters, use of transit as an alternate mode of travel or by inducing diversion to the municipal road system as an alternate route.

Delays

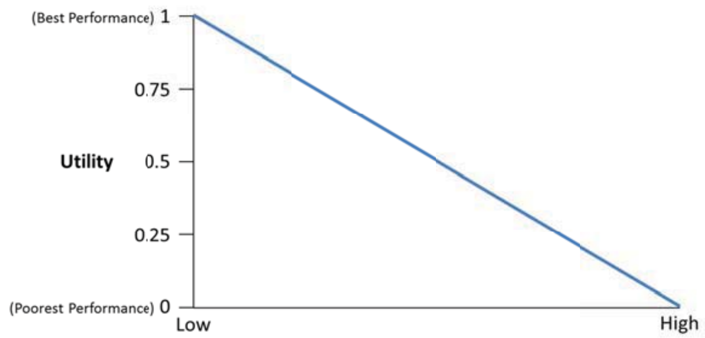


Description: This sub-factor measures the total lane closure peak period delay to drivers on the Queensway during the construction period. It includes the total peak period delay forecast for the duration of construction of the alternative. The delay sub-factor, although measuring vehicles on the Queensway, is also indicative of the delays for drivers diverted from the Queensway and operating on the municipal road system.
(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	Veh h	Utility Score
Alternative A2e Rapid Rehab/Existing Span	16,520	1
Alternative A5e Conventional Rehab/Existing Span	1,537,200	0.60
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	3,782,800	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	3,782,800	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	780	1
Alternative C6s ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Shorter Span	780	1
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	780	1
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	780	1

Mitigation: N/A

Ramp Closures

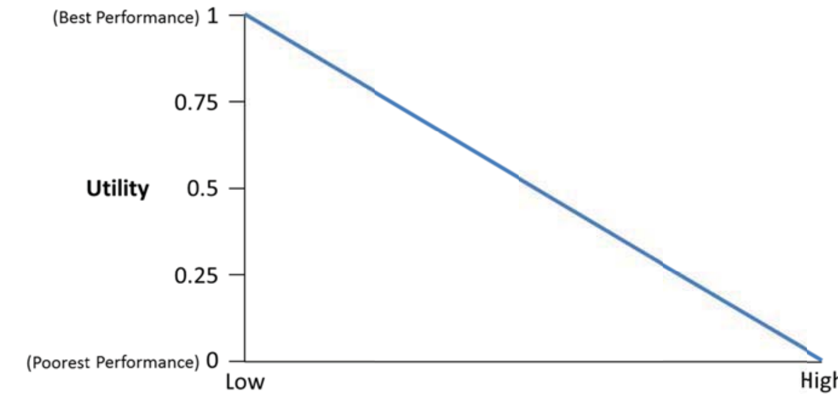


Description: This sub-factor measures the impact to community access by quantifying the volume of peak hour ramp trips that will be removed from entering or exiting from the Queensway. The sub-factor measures the peak hour ramp volume for each stage of the highway staging plan for the duration of the closure.

Alternatives	Veh (peak hour)	Utility Score
Alternative A2e Rapid Rehab/Existing Span	42,802	0.93
Alternative A5e Conventional Rehab/Existing Span	285,664	0.50
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	571,328	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	571,328	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	8,067	1
Alternative C6s ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Shorter Span	8,067	1
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	8,067	1
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	8,067	1

Mitigation: Ramps may be closed by time of day to allow access in non-peak hours.

Highway Safety - Collision Potential

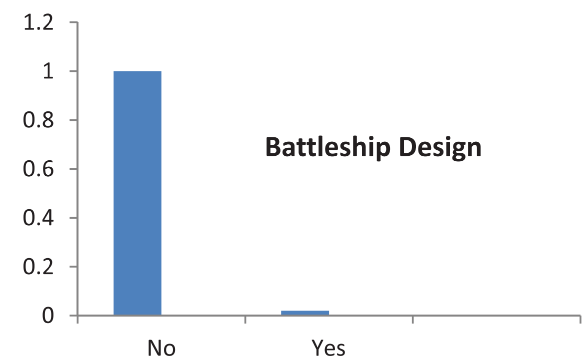


Description: This sub-factor measures the collision potential of the alternative by measuring the time duration that drivers will be required to transition through the construction zone.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	0.9
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	0	3	3	1
Alternative C6s ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Shorter Span	0	3	3	1
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	0	3	3	1
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	0	3	3	1

Mitigation: N/A

Highway Safety – Design Consistency of Traffic Staging Design



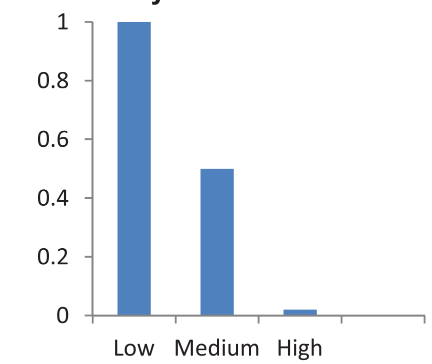
Description: This sub-factor measures the collision potential of the highway staging design. Those alternatives including a non-conventional battleship design (i.e. yes) are least preferred.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Yes	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Yes	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	No	1
Alternative C6s ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Shorter Span	No	1
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	No	1
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	No	1

Mitigation: Tow truck plan/incident plan.

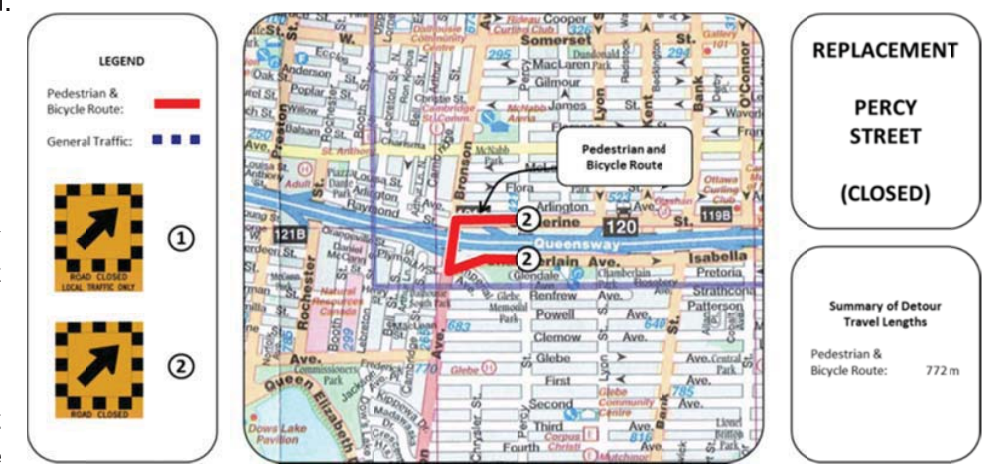
Preliminary Design and Environmental Assessment Study for the Rehabilitation/Replacement of Ottawa Queensway Mid-town Bridges from Holland Avenue to O'Connor Street
UTILITY FUNCTION DEFINITIONS AND MEASUREMENTS FOR SHORT LISTED EVALUATION CRITERIA
PERCY STREET WESTBOUND BRIDGE
GWP #4075-11-00

Pedestrian – Delay and Out-of-way Travel



Description: This sub-factor measures the length and duration of pedestrian out-of-way travel on the side streets while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily sidewalk closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period. Pedestrians will be signed to use the opposite sidewalk from the adjacent signalized intersections.



Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. Pedestrians will use a single sidewalk and cross the street at the temporary signals. The duration of the temporary signals will be 6 weeks.

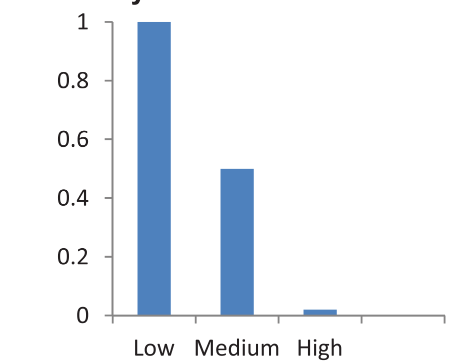
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure pedestrians will be directed to Bronson Avenue, for a maximum out-of-way travel of 0.8 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e ***TWIN*** REPLACEMENT	Medium	0.5

Rapid Replacement/Full Closure/Existing Span		
Alternative C6s ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Shorter Span	Medium	0.5
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5

Mitigation: Advance signage for pedestrians to travel to the alternate sidewalk route as well as pre-event information to the property owners.

Bicycle – Delay and Out-of-Way Travel



Description: This sub-factor measures the length and duration of bicycle delay and out-of-way travel on the side street while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily lane and bike lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. Bicyclists will use the single lane detour through the temporary signals. The duration of the temporary signals will be 6 weeks.

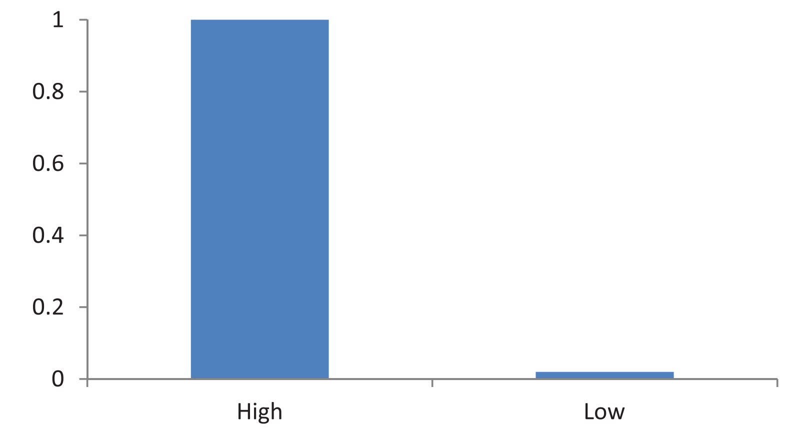
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure, bicyclists will be directed to Bronson Avenue, for a maximum out-of-way travel of 0.8 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Medium	0.5

Alternative C6s ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Shorter Span	Medium	0.5
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5

Mitigation: Advance signage for cyclists to choose an alternate route as well as pre-event information to the Regional cycling clubs.

Pedestrian/Bicycle Safety

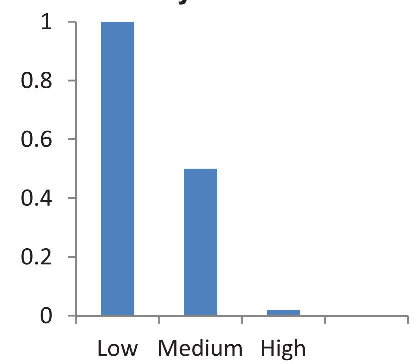


Description: This sub-factor measures if an alternative provides greater lateral space to increase pedestrian and bicycle safety. Those alternatives providing the largest span are preferred (high potential) and those alternatives matching the existing span are not preferred (i.e. low potential).

Alternatives	High/Low	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	0
Alternative A5e Conventional Rehab/Existing Span	Low	0
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Low	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	1
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Low	0
Alternative C6s ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Shorter Span	Low	0
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	High	1
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	High	1

Mitigation: None.

General Traffic Municipal Street Delay



Description: This sub-factor measures the delay during construction that will affect general traffic operations. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. The duration of the temporary signals will be 6 weeks.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure vehicles will be directed to Bronson Avenue, for a maximum out-of-way travel of 0.8 km. This sub-factor measures a one-way trip only.

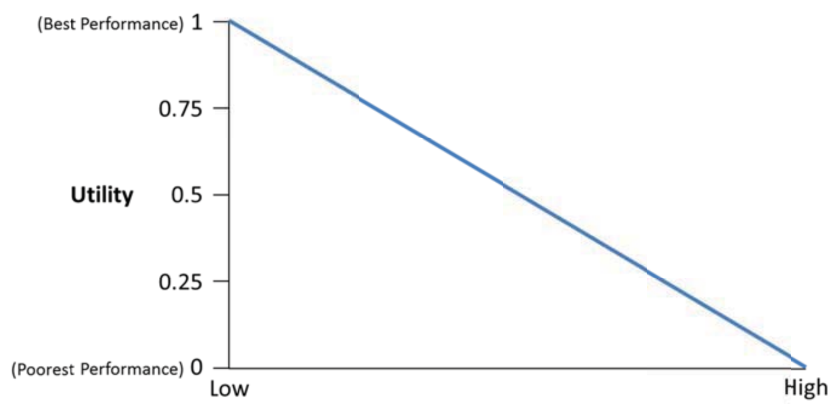
Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C6s ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Shorter Span	Medium	0.5

Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5

Mitigation: The use of advisory signage and potential use of variable message signage can be used to advise drivers before reaching the construction site.

Factor Group: Social and Cultural Environment

Impact to Emergency Response

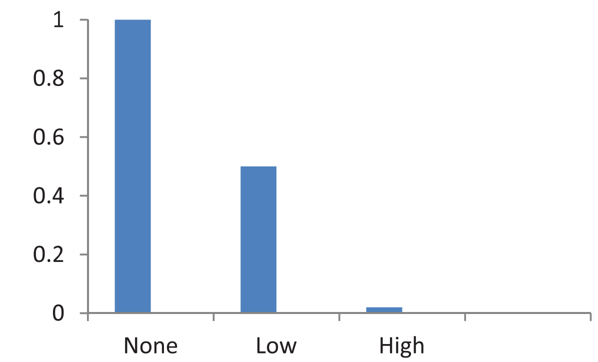


Description: This sub-factor measures the duration of Queensway closure that will affect emergency response service (police, ambulance and fire). Alternatives that reduce the length of time that there are lane closures on the Queensway are preferred.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	0.9
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0.0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0.0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	0	3	3	1.0
Alternative C6s ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Shorter Span	0	3	3	1.0
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	0	3	3	1.0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	0	3	3	1.0

Mitigation: Advanced warning of lane closures or detour routes.

Potentially Contaminated Property



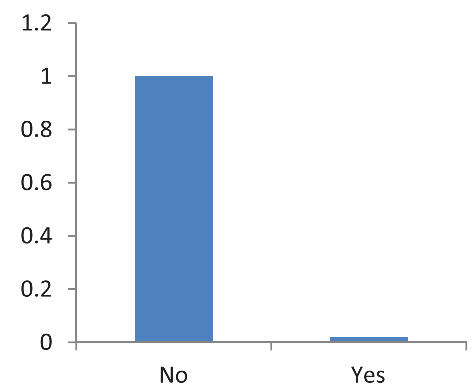
Description: This sub-factor measures whether there is potential to encounter potentially contaminated property during the construction of an alternative. Alternatives that minimize excavation are preferred. RBR staging sites have high potential (i.e. large footprint of excavation) to impact potentially contaminated property. Any alternative excavating in place has low potential to impact potentially contaminated property. The rehabilitation options have no potential to impact potentially contaminated property due to the small footprint of works.

Alternatives	No/Low/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Low	0.5
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Low	0.5
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	High	0
Alternative C6s ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Shorter Span	High	0
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	High	0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	High	0

Mitigation: Avoidance.

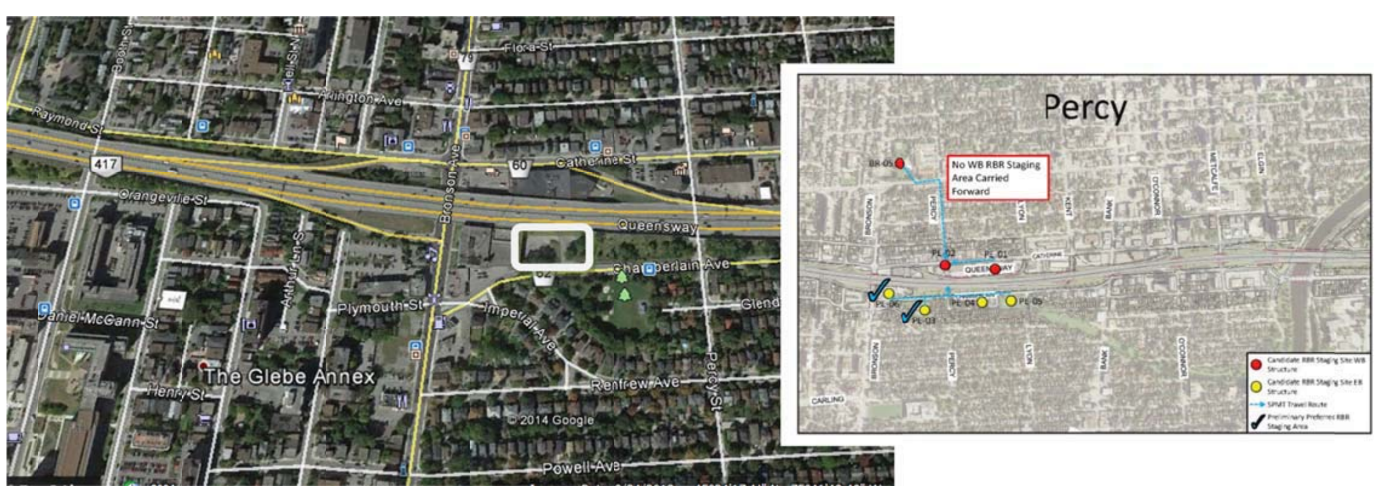
Factor Group: Land Use and Property

Temporary Property Impacts



Description:

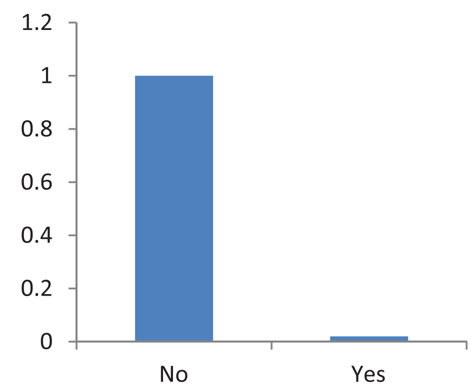
This sub-factor measures whether property (i.e. parking lot at Bronson/Chamberlain/Queensway) is required for temporary use as a bridge staging area (PE-06), as per the RBR Structure Staging Sites memo. Because there are no WB staging areas carried forward, the EB staging area is to be used to replace both the EB and WB (i.e. TWIN) bridges.



Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	No	1
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	No	1
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Yes	0
Alternative C6s ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Shorter Span	Yes	0
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Yes	0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Yes	0

Mitigation: N/A

Permanent Property Impacts – Impact to Ontario Hydro Plant



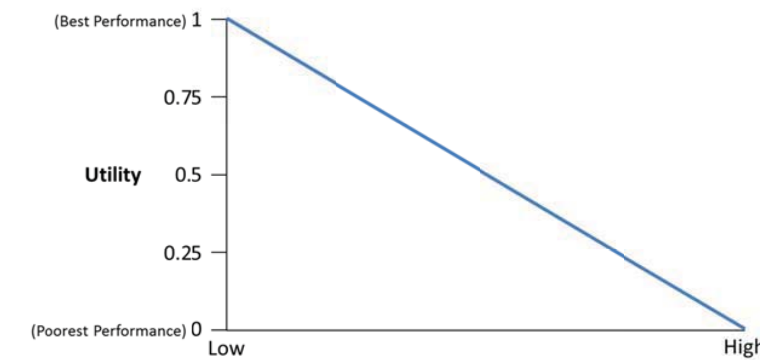
Description: This sub-factor measures the potential to impact buried high voltage transmission lines that are located 3 m from both the north and south abutments. Those alternatives that consider a shorter span have the potential to impact (i.e. relocate or require protection) these transmission lines.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	No	1
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	No	1
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	No	1
Alternative C6s ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Shorter Span	Yes	0
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	No	1
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	No	1

Mitigation: Relocation or protection.

Factor Group: Cost

Capital Cost

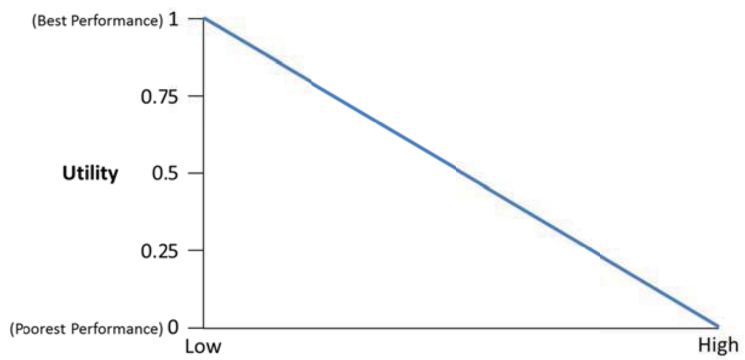


Description: This sub-factor measures the difference in initial capital cost of the alternative (bridge, traffic staging, staging area, and property costs). Those alternatives with the lowest capital cost are preferred. These costs do not include Engineering Costs.

Alternatives	$M		Utility Score
Alternative A2e Rapid Rehab/Existing Span	Structure 1.06 Staging 0.6 Property 0	1.66	1
Alternative A5e Conventional Rehab/Existing Span	Structure 1.06 Staging 1.25 Property 0	2.31	0.9
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Structure 3.00 Staging 1.2 Property 0	4.20	0.6
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Structure 3.70 Staging 1.2 Property 0	4.9	0.5
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Structure 5.04 Staging 0.60 Property 0.20	5.84	0.3
Alternative C6s ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Shorter Span	Structure 4.84 Staging 0.60 Property 0.20	5.64	0.3
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Structure 6.91 Staging 0.60 Property 0.20	7.71	0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Structure 6.45 Staging 0.60 Property 0.20	7.25	0.1

Mitigation: N/A

Future Life Cycle Cost



Description: This sub-factor measures the difference in future life cycle costs (maintenance, operating costs and long term replacement and rehabilitation in the 40 year planning horizon). Those alternatives with the lowest long term life cycle cost are preferred. A 5% discount rate was used.

Alternatives	$M	Utility Score
Alternative A2e Rapid Rehab/Existing Span	3.85	1
Alternative A5e Conventional Rehab/Existing Span	4.51	0.9
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	4.85	0.8
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	5.64	0.6
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	6.54	0.5
Alternative C6s **TWIN** REPLACEMENT Rapid Replacement/Full Closure/Shorter Span	6.32	0.4
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	8.64	0.1
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	8.13	0

Mitigation: N/A

VERSION: November 11, 2014

APPENDIX E

SUB-FACTOR UTILITY FUNCTION DEFINITIONS AND MEASUREMENTS FOR SHORT LISTED EVALUATION CRITERIA

BANK STREET EASTBOUND BRIDGE

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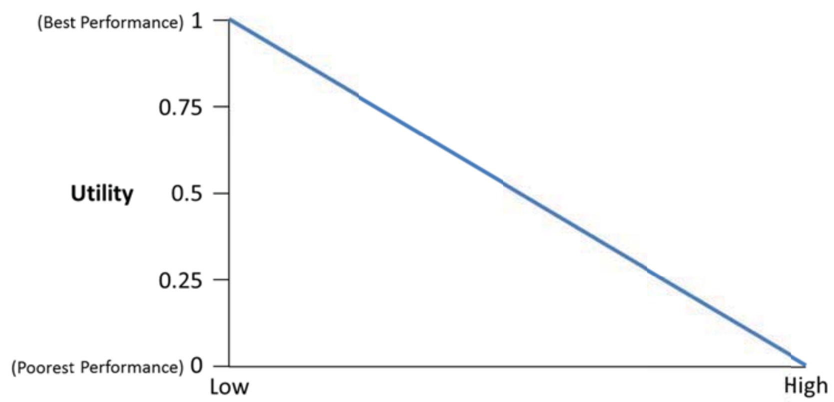
Factor Group: Transportation

Maximum Peak Queue Length on Queensway



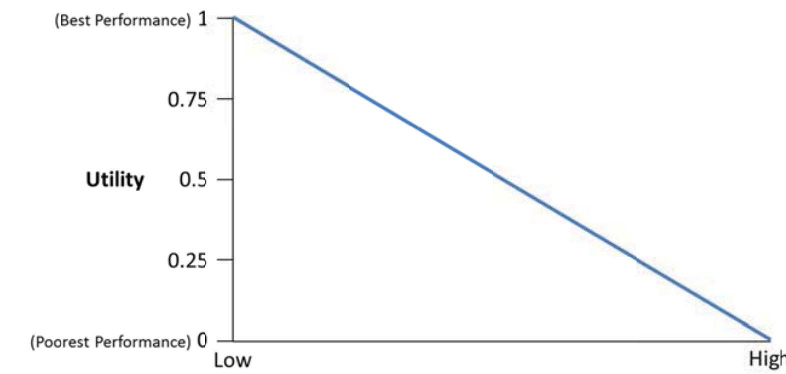
Description: This sub-factor measures the forecast queue length effect in the peak hour including measures to divert trips and induce transportation demand management during construction. The sub-factor measures the queue duration (days) and the forecast queue length (after the use of mitigation). This sub-factor is indicative of highway performance and safety, and is related to: effects on ramp operations, rear end collisions influenced by stop and go traffic, poor weaving conditions and traffic congestion.

(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	km days (peak hour)	Utility Score
Alternative A2e Rapid Rehab/Existing Span	41	0.98
Alternative A5e Conventional Rehab/Existing Span	780	0.59
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	1920	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	1920	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	2	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	240	0.9
Alternative C6l Rapid Replacement/Full Closure/Longer Span	2	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	240	0.9
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	2	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	240	0.9

Mitigation: The use of advance advertising and advising drivers of the scheduled lane closures through PVMS placement in advance of construction will be measures that will reduce demand by: changing the time of travel of commuters, use of transit as an alternate mode of travel or by inducing diversion to the municipal road system as an alternate route.

Delays

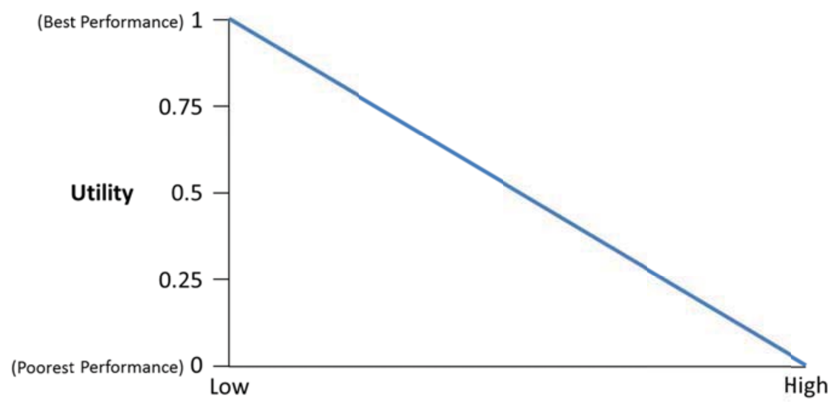


Description: This sub-factor measures the total lane closure peak period delay to drivers on the Queensway during the construction period. It includes the total peak period delay forecast for the duration of construction of the alternative. The delay sub-factor, although measuring vehicles on the Queensway, is also indicative of the delays for drivers diverted from the Queensway and operating on the municipal road system.
(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	Veh h	Utility Score
Alternative A2e Rapid Rehab/Existing Span	16,520	1
Alternative A5e Conventional Rehab/Existing Span	1,537,200	0.60
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	3,782,800	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	3,782,800	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	520	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	472,600	0.9
Alternative C6l Rapid Replacement/Full Closure/Longer Span	520	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	472,600	0.9
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	520	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	472,600	0.9

Mitigation: N/A

Ramp Closures

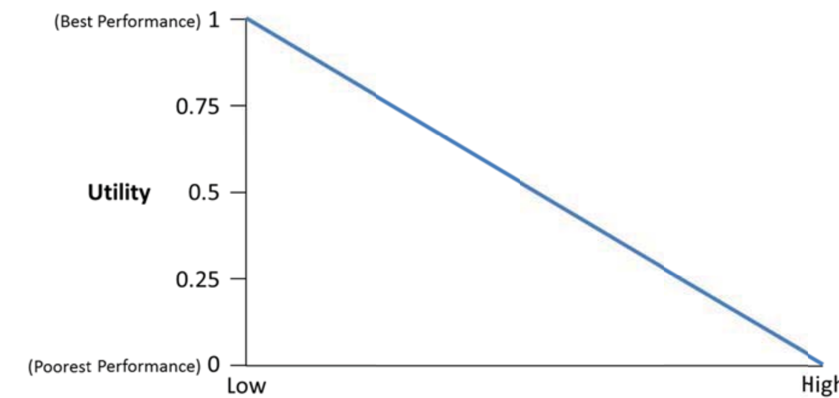


Description: This sub-factor measures the impact to community access by quantifying the volume of peak hour ramp trips that will be removed from entering or exiting from the Queensway. The sub-factor measures the peak hour ramp volume for each stage of the highway staging plan for the duration of the closure.

Alternatives	Veh (peak hour)	Utility Score
Alternative A2e Rapid Rehab/Existing Span	16,930	0.83
Alternative A5e Conventional Rehab/Existing Span	23,395	0.76
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	91,650	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	91,650	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	1,988	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	52,128	0.44
Alternative C6l Rapid Replacement/Full Closure/Longer Span	1,988	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	52,128	0.44
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	1,988	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	52,128	0.44

Mitigation: Ramps may be closed by time of day to allow access in non-peak hours.

Highway Safety - Collision Potential

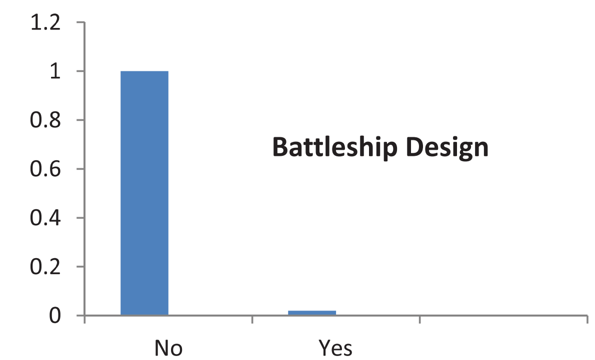


Description: This sub-factor measures the collision potential of the alternative by measuring the time duration that drivers will be required to transition through the construction zone.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	0.9
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	0	2	2	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	20	12	32	0.9
Alternative C6l Rapid Replacement/Full Closure/Longer Span	0	2	2	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	20	12	32	0.9
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	0	2	2	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	20	12	32	0.9

Mitigation: N/A

Highway Safety – Design Consistency of Traffic Staging Design

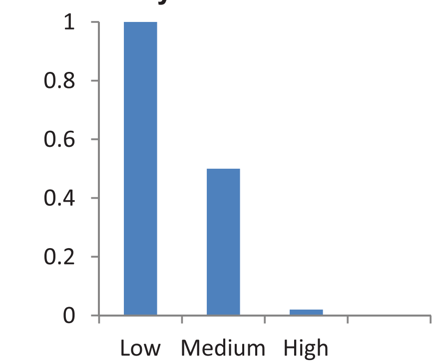


Description: This sub-factor measures the collision potential of the highway staging design. Those alternatives including a non-conventional battleship design (i.e. yes) are least preferred.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Yes	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Yes	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	No	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	No	1
Alternative C6l Rapid Replacement/Full Closure/Longer Span	No	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	No	1
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	No	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	No	1

Mitigation: Tow truck plan/incident plan.

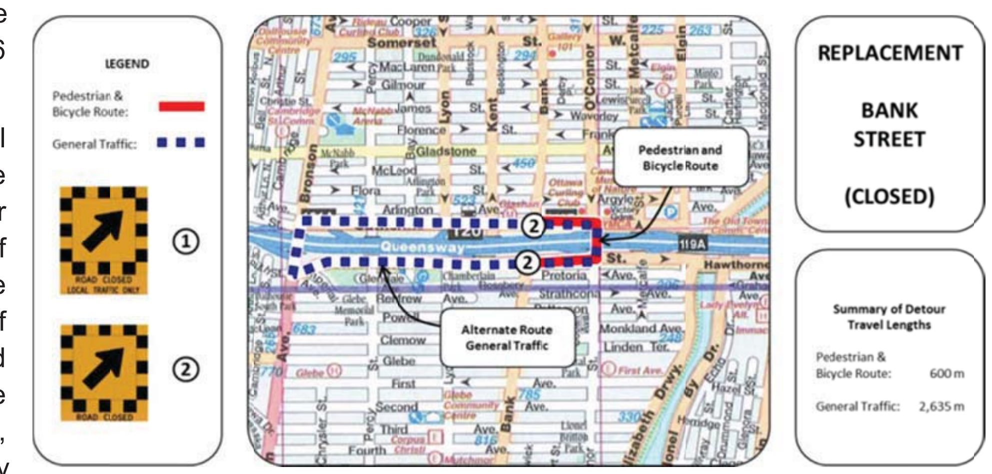
Pedestrian – Delay and Out-of-way Travel



Description: This sub-factor measures the length and duration of pedestrian out-of-way travel on the side streets while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily sidewalk closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period. Pedestrians will be signed to use the opposite sidewalk from the adjacent signalized intersections.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. Pedestrians will use a single sidewalk and cross the street at the temporary signals. The duration of the temporary signals will be 6 weeks.



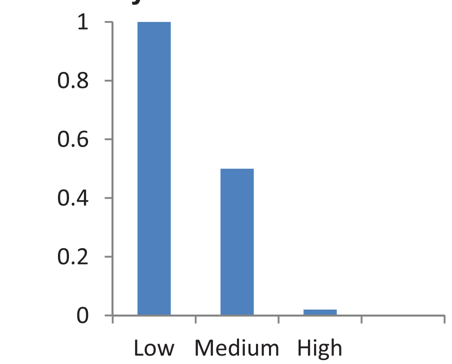
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure pedestrians will be directed to O'Connor Street, for a maximum out-of-way travel of 0.6 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0

Alternative C6e Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: Advance signage for pedestrians to travel to the alternate sidewalk route as well as pre-event information to the property owners.

Bicycle – Delay and Out-of-Way Travel



Description: This sub-factor measures the length and duration of bicycle delay and out-of-way travel on the side street while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily lane and bike lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6 week period.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. Bicyclists will use the single lane detour through the temporary signals. The duration of the temporary signals will be 6 weeks.

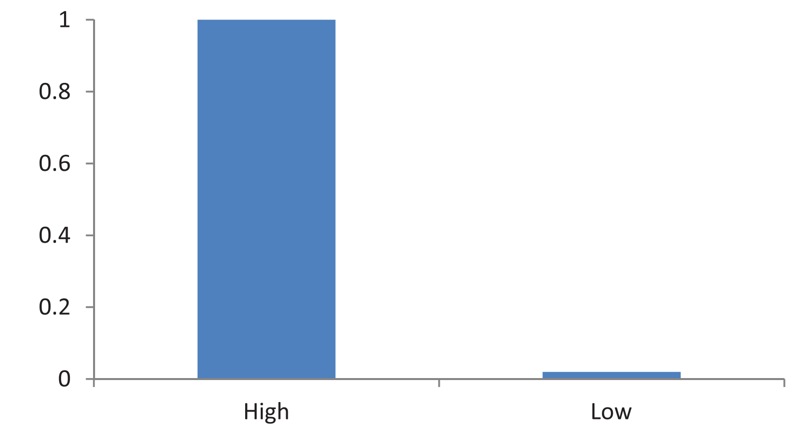
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure, bicyclists will be directed to O'Connor Street, for a maximum out-of-way travel of 0.6 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C7e	Medium	0.5

Rapid Replacement/Two Lane Detour/Existing Span		
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: Advance signage for cyclists to choose an alternate route as well as pre-event information to the Regional cycling clubs.

Pedestrian/Bicycle Safety

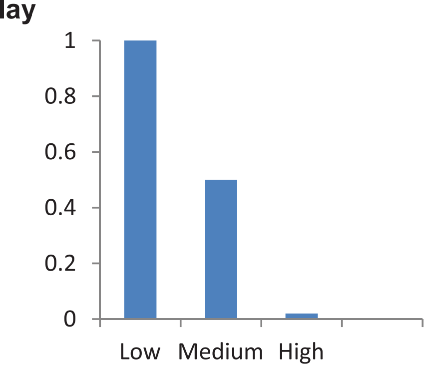


Description: This sub-factor measures if an alternative provides greater lateral space to increase pedestrian and bicycle safety. Those alternatives providing the largest span are preferred (high potential) and those alternatives matching the existing span are not preferred (i.e. low potential).

Alternatives	High/Low	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	0
Alternative A5e Conventional Rehab/Existing Span	Low	0
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Low	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	1
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Low	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Low	0
Alternative C6l Rapid Replacement/Full Closure/Longer Span	High	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	High	1
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	High	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	High	1

Mitigation: None.

Transit Operations Delay



Description: This sub-factor measures the delay during construction that will affect transit operations. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. The duration of the temporary signals will be 6 weeks.

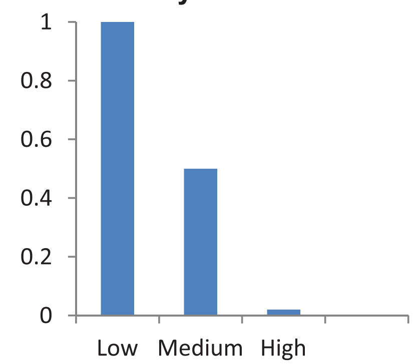
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure transit will be redirected to adjacent streets, for a maximum out-of-way travel of 2.1 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0.5

Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: Advance information to OC Transpo and temporary relocation of bus stops if required.

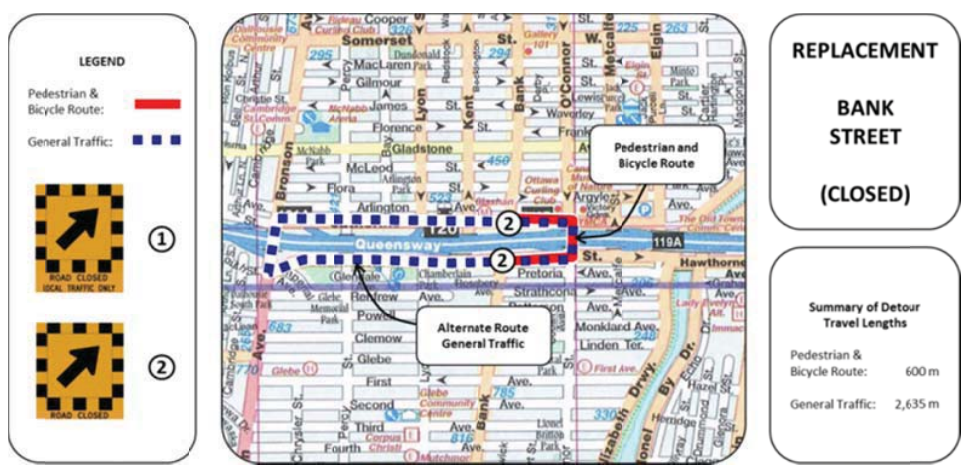
General Traffic Municipal Street Delay



Description: This sub-factor measures the delay during construction that will affect general traffic operations. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. The duration of the temporary signals will be 6 weeks.



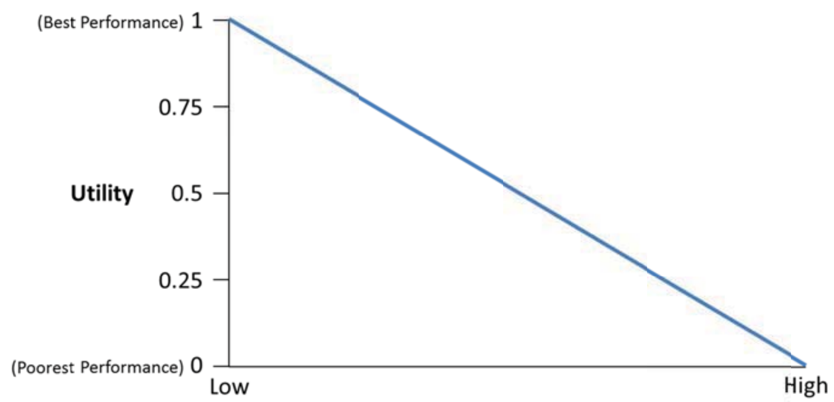
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure vehicles will be directed to O'Connor Street, for a maximum out-of-way travel of 2.6 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: The use of advisory signage and potential use of variable message signage can be used to advise drivers before reaching the construction site.

Factor Group: Social and Cultural Environment

Impact to Emergency Response

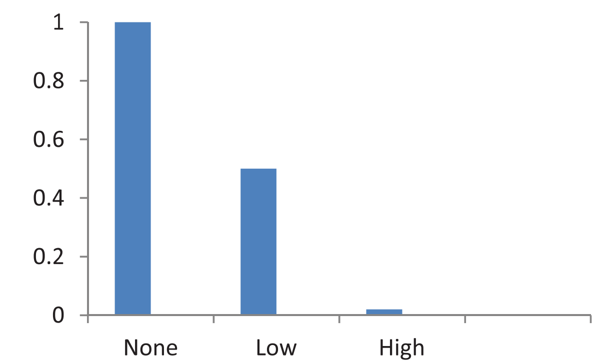


Description: This sub-factor measures the duration of Queensway closure that will affect emergency response service (police, ambulance and fire). Alternatives that reduce the length of time that there are lane closures on the Queensway are preferred.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	0.9
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0.0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0.0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	0	2	2	1.0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	20	12	32	0.9
Alternative C6l Rapid Replacement/Full Closure/Longer Span	0	2	2	1.0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	20	12	32	0.9
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	0	2	2	1.0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	20	12	32	0.9

Mitigation: Advanced warning of lane closures or detour routes.

Potentially Contaminated Property



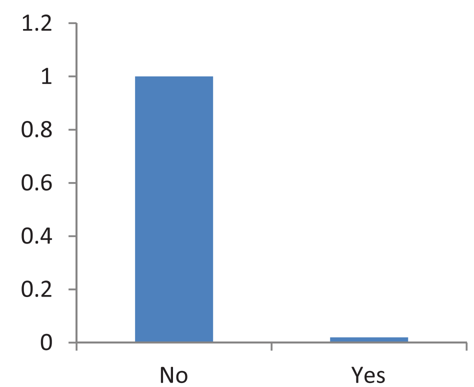
Description: This sub-factor measures whether there is potential to encounter potentially contaminated property during the construction of an alternative. Alternatives that minimize excavation are preferred. RBR staging sites have high potential (i.e. large footprint of excavation) to impact potentially contaminated property. Any alternative excavating in place has low potential to impact potentially contaminated property. The rehabilitation options have no potential to impact potentially contaminated property due to the small footprint of works.

Alternatives	No/Low/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Low	0.5
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Low	0.5
Alternative C6e Rapid Replacement/Full Closure/Existing Span	High	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	High	0
Alternative C6l Rapid Replacement/Full Closure/Longer Span	High	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	High	0
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	High	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	High	0

Mitigation: Avoidance.

Factor Group: Land Use and Property

Temporary Property Impacts



Description: This sub-factor measures whether property (i.e. parking lot at Beech/Rochester/Aberdeen) is required for temporary use as a bridge staging area (PE-06), as per the RBR Structure Staging Sites memo.

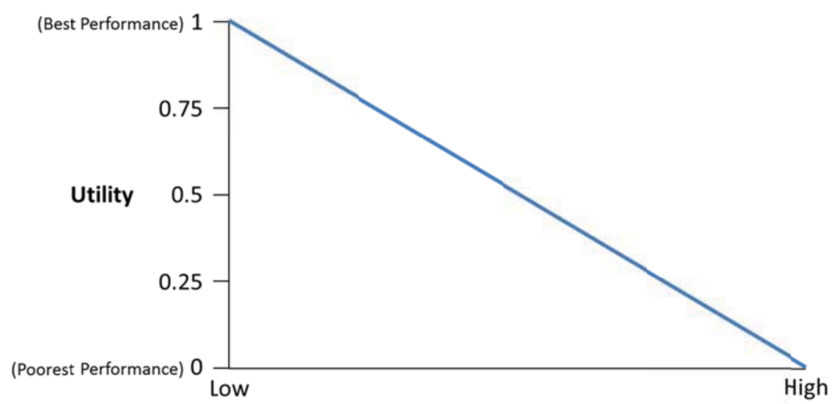
Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	No	1

Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	No	1
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Yes	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Yes	0
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Yes	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Yes	0
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Yes	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Yes	0

Mitigation: N/A

Factor Group: Cost

Capital Cost

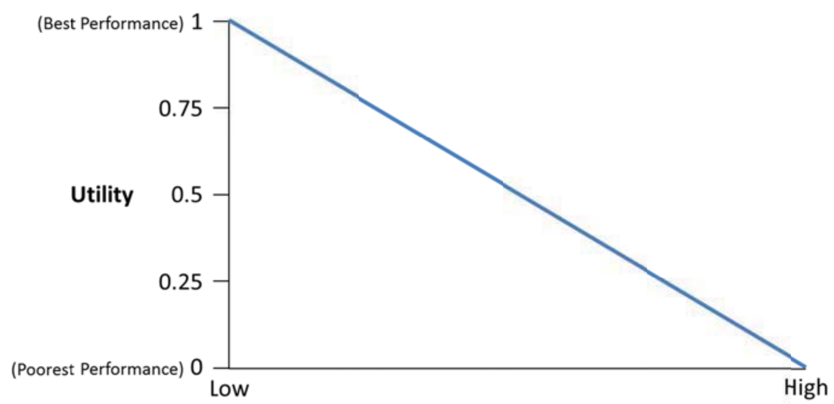


Description: This sub-factor measures the difference in initial capital cost of the alternative (bridge, traffic staging, staging area, and property costs). Those alternatives with the lowest capital cost are preferred. These costs do not include Engineering Costs.

Alternatives	$M		Utility Score
Alternative A2e Rapid Rehab/Existing Span	Structure 0.69 Staging 0.6 Property 0	1.29	1
Alternative A5e Conventional Rehab/Existing Span	Structure 0.69 Staging 1.25 Property 0	1.94	0.9
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Structure 2.80 Staging 1.2 Property 0	4	0.8
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Structure 3.50 Staging 1.2 Property 0	4.7	0.7
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Structure 5.01 Staging 0.60 Property 0.20	5.81	0.3
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Structure 5.01 Staging 0.60 Property 0.20	5.81	0.3
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Structure 7.39 Staging 0.60 Property 0.20	8.19	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Structure 7.39 Staging 0.60 Property 0.20	8.19	0
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Structure 6.77 Staging 0.60 Property 0.20	7.57	0.1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Structure 6.77 Staging 0.60 Property 0.20	7.57	0.1

Mitigation: N/A

Future Life Cycle Cost



Description: This sub-factor measures the difference in future life cycle costs (maintenance, operating costs and long term replacement and rehabilitation in the 40 year planning horizon). Those alternatives with the lowest long term life cycle cost are preferred. A 5% discount rate was used.

Alternatives	$M	Utility Score
Alternative A2e Rapid Rehab/Existing Span	3.43	1
Alternative A5e Conventional Rehab/Existing Span	4.08	0.9
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	4.63	0.8
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	5.42	0.7
Alternative C6e Rapid Replacement/Full Closure/Existing Span	6.51	0.5
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	7.06	0.4
Alternative C6l Rapid Replacement/Full Closure/Longer Span	9.18	0.1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	9.74	0
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	8.49	0.2
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	9.04	0.1

Mitigation: N/A

VERSION: November 11, 2014

APPENDIX E

SUB-FACTOR UTILITY FUNCTION DEFINITIONS AND MEASUREMENTS FOR SHORT LISTED EVALUATION CRITERIA

BANK STREET WESTBOUND BRIDGE

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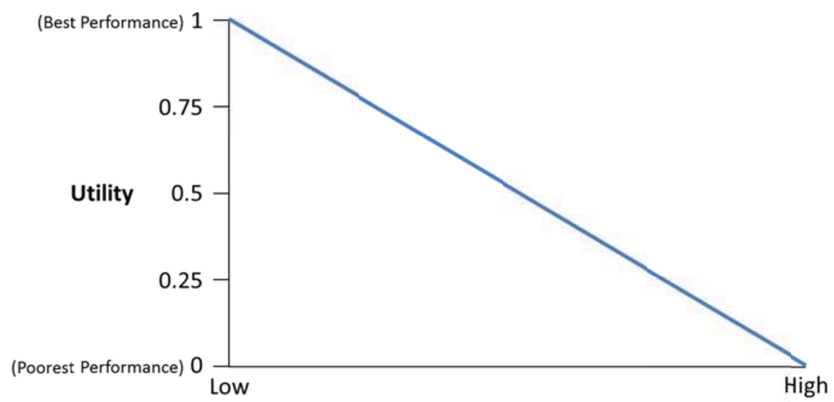
Factor Group: Transportation

Maximum Peak Queue Length on Queensway



Description: This sub-factor measures the forecast queue length effect in the peak hour including measures to divert trips and induce transportation demand management during construction. The sub-factor measures the queue duration (days) and the forecast queue length (after the use of mitigation). This sub-factor is indicative of highway performance and safety, and is related to: effects on ramp operations, rear end collisions influenced by stop and go traffic, poor weaving conditions and traffic congestion.

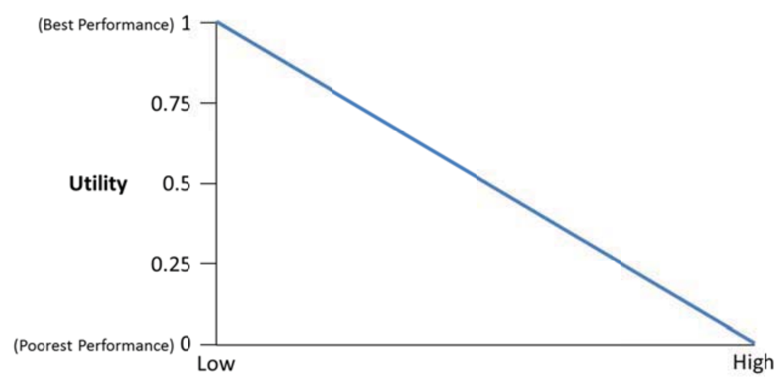
(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	km days (peak hour)	Utility Score
Alternative A2e Rapid Rehab/Existing Span	41	0.98
Alternative A5e Conventional Rehab/Existing Span	780	0.59
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	1920	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	1920	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	2	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	240	0.9
Alternative C6l Rapid Replacement/Full Closure/Longer Span	2	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	240	0.9
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	2	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	240	0.9

Mitigation: The use of advance advertising and advising drivers of the scheduled lane closures through PVMS placement in advance of construction will be measures that will reduce demand by: changing the time of

travel of commuters, use of transit as an alternate mode of travel, or by inducing diversion to the municipal road system as an alternate route.

Delays

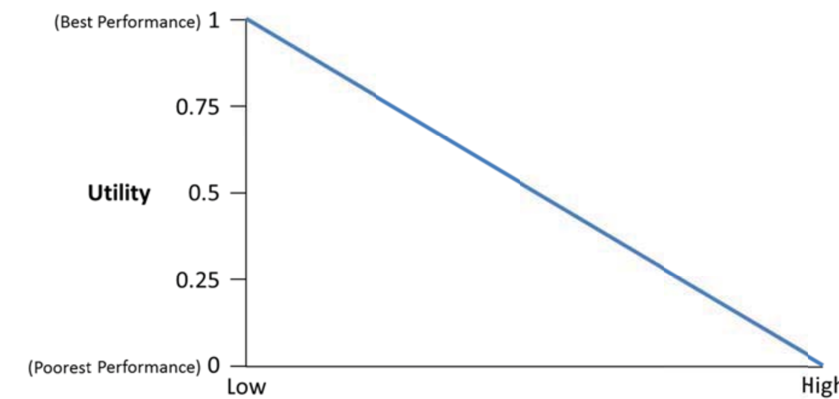


Description: This sub-factor measures the total lane closure peak period delay to drivers on the Queensway during the construction period. It includes the total peak period delay forecast for the duration of construction of the alternative. The delay sub-factor, although measuring vehicles on the Queensway, is also indicative of the delays for drivers diverted from the Queensway and operating on the municipal road system.
(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	Veh h	Utility Score
Alternative A2e Rapid Rehab/Existing Span	16,520	1
Alternative A5e Conventional Rehab/Existing Span	1,537,200	0.60
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	3,782,800	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	3,782,800	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	520	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	472,600	0.9
Alternative C6l Rapid Replacement/Full Closure/Longer Span	520	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	472,600	0.9
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	520	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	472,600	0.9

Mitigation: N/A

Ramp Closures

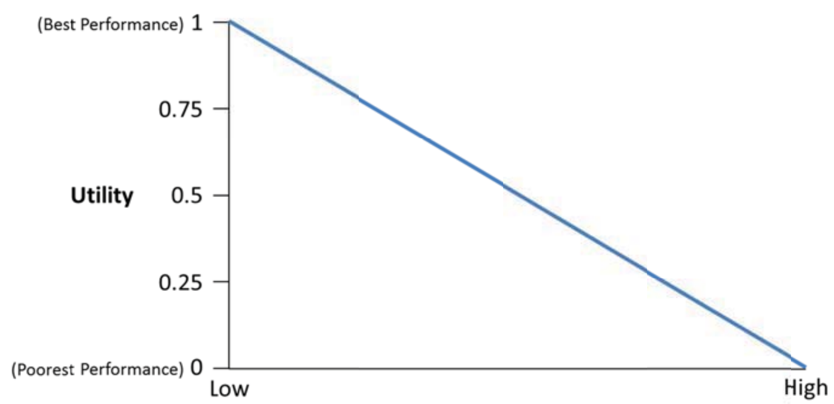


Description: This sub-factor measures the impact to community access by quantifying the volume of peak hour ramp trips that will be removed from entering or exiting from the Queensway. The sub-factor measures the peak hour ramp volume for each stage of the highway staging plan for the duration of the closure.

Alternatives	Veh (peak hour)	Utility Score
Alternative A2e Rapid Rehab/Existing Span	18,718	0.88
Alternative A5e Conventional Rehab/Existing Span	25,329	0.83
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	130,252	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	130,252	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	3,390	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	34,516	0.75
Alternative C6l Rapid Replacement/Full Closure/Longer Span	3,390	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	34,516	0.75
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	3,390	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	34,516	0.75

Mitigation: Ramps may be closed by time of day to allow access in non-peak hours.

Highway Safety - Collision Potential

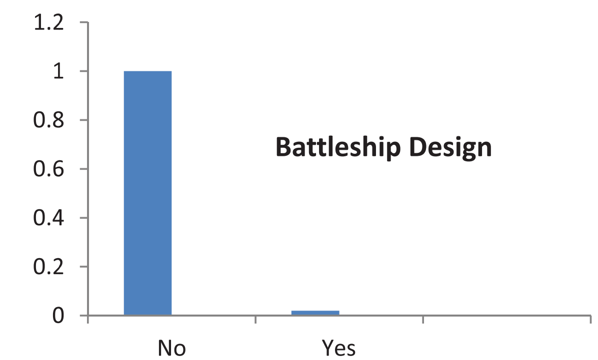


Description: This sub-factor measures the collision potential of the alternative by measuring the time duration that drivers will be required to transition through the construction zone.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	0.9
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	0	2	2	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	20	12	32	0.9
Alternative C6l Rapid Replacement/Full Closure/Longer Span	0	2	2	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	20	12	32	0.9
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	0	2	2	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	20	12	32	0.9

Mitigation: N/A

Highway Safety – Design Consistency of Traffic Staging Design

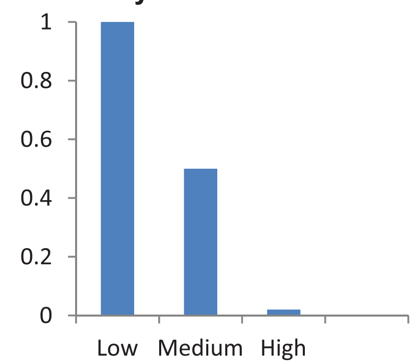


Description: This sub-factor measures the collision potential of the highway staging design. Those alternatives including a non-conventional battleship design (i.e. yes) are least preferred.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Yes	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Yes	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	No	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	No	1
Alternative C6l Rapid Replacement/Full Closure/Longer Span	No	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	No	1
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	No	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	No	1

Mitigation: Tow truck plan/incident plan.

Pedestrian – Delay and Out-of-way Travel



Description: This sub-factor measures the length and duration of pedestrian out-of-way travel on the side streets while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily sidewalk closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period. Pedestrians will be signed to use the opposite sidewalk from the adjacent signalized intersections.

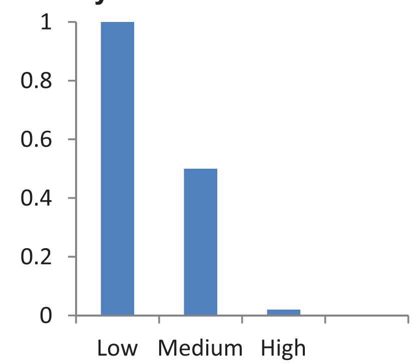
Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. Pedestrians will use a single sidewalk and cross the street at the temporary signals. The duration of the temporary signals will be 6 weeks.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure pedestrians will be directed to O'Connor Street, for a maximum out-of-way travel of 0.6 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: Advance signage for pedestrians to travel to the alternate sidewalk route as well as pre-event information to the property owners.

Bicycle – Delay and Out-of-Way Travel



Description: This sub-factor measures the length and duration of bicycle delay and out-of-way travel on the side street while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily lane and bike lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. Bicyclists will use the single lane detour through the temporary signals. The duration of the temporary signals will be 6 weeks.

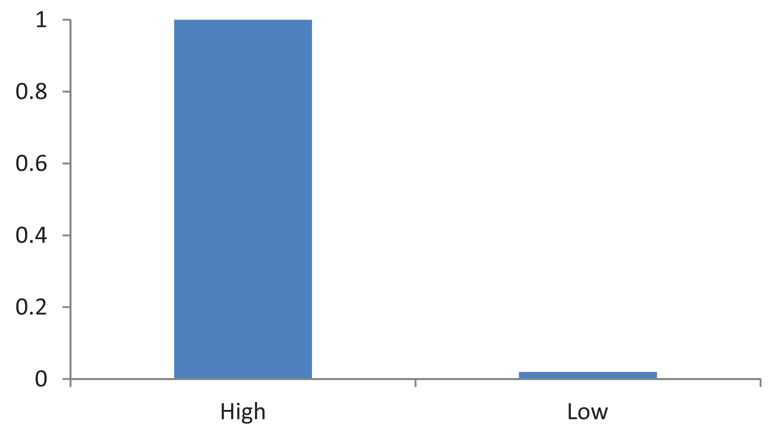
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure, bicyclists will be directed to O'Connor Street, for a maximum out-of-way travel of 0.6 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Medium	0.5

Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: Advance signage for cyclists to choose an alternate route as well as pre-event information to the Regional cycling clubs.

Pedestrian/Bicycle Safety

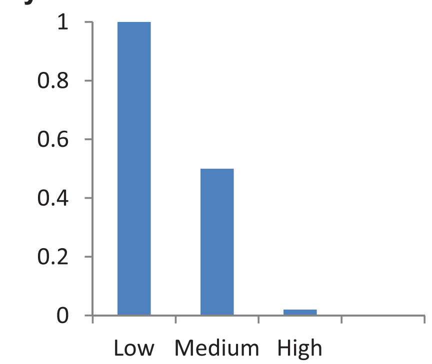


Description: This sub-factor measures if an alternative provides greater lateral space to increase pedestrian and bicycle safety. Those alternatives providing the largest span are preferred (high potential) and those alternatives matching the existing span are not preferred (i.e. low potential).

Alternatives	High/Low	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	0
Alternative A5e Conventional Rehab/Existing Span	Low	0
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Low	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	1
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Low	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Low	0
Alternative C6l Rapid Replacement/Full Closure/Longer Span	High	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	High	1
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	High	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	High	1

Mitigation: None.

Transit Operations Delay



Description: This sub-factor measures the delay during construction that will affect transit operations. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. The duration of the temporary signals will be 6 weeks.

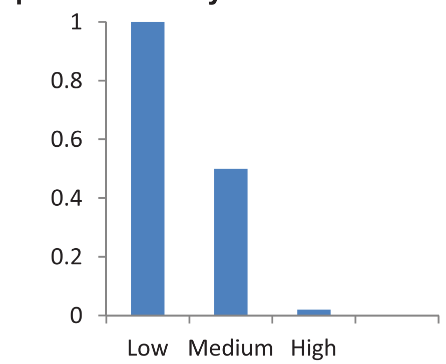
High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure transit will be redirected to adjacent streets for a maximum out-of-way travel of 2.1 km. This sub-factor measures a one-way trip only.

Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5

Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: Advance information to OC Transpo and temporary relocation of bus stops if required.

General Traffic Municipal Street Delay



Description: This sub-factor measures the delay during construction that will affect general traffic operations. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. The duration of the temporary signals will be 6 weeks.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure vehicles will be directed to Bronson Avenue, for a maximum out-of-way travel of 2.6 km. This sub-factor measures a one-way trip only.

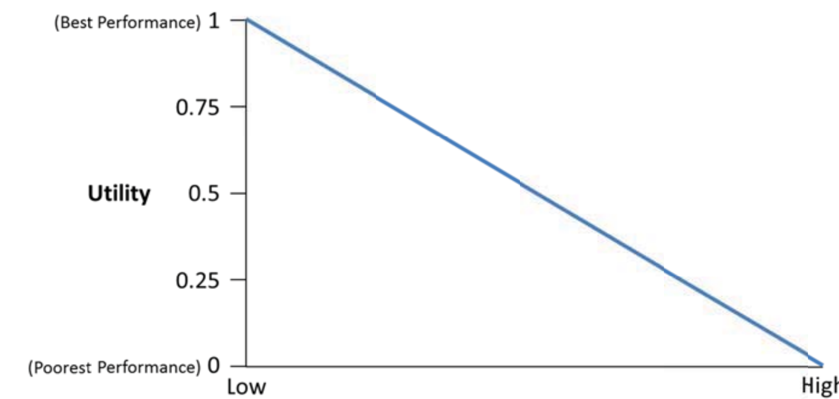
Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5

Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: The use of advisory signage and potential use of variable message signage can be used to advise drivers before reaching the construction site.

Factor Group: Social and Cultural Environment

Impact to Emergency Response

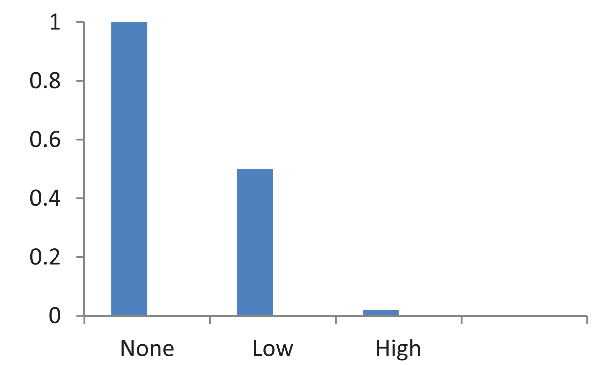


Description: This sub-factor measures the duration of Queensway closure that will affect emergency response service (police, ambulance and fire). Alternatives that reduce the length of time that there are lane closures on the Queensway are preferred.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	0.9
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0.0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0.0
Alternative C6e Rapid Replacement/Full Closure/Existing Span	0	2	2	1.0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	20	12	32	0.9
Alternative C6l Rapid Replacement/Full Closure/Longer Span	0	2	2	1.0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	20	12	32	0.9
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	0	2	2	1.0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	20	12	32	0.9

Mitigation: Advanced warning of lane closures or detour routes.

Potentially Contaminated Property



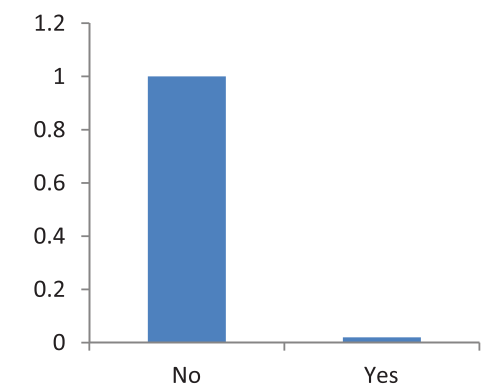
Description: This sub-factor measures whether there is potential to encounter potentially contaminated property during the construction of an alternative. Alternatives that minimize excavation are preferred. RBR staging sites have high potential (i.e. large footprint of excavation) to impact potentially contaminated property. Any alternative excavating in place has low potential to impact potentially contaminated property. The rehabilitation options have no potential to impact potentially contaminated property due to the small footprint of works.

Alternatives	No/Low/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Low	0.5
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Low	0.5
Alternative C6e Rapid Replacement/Full Closure/Existing Span	High	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	High	0
Alternative C6l Rapid Replacement/Full Closure/Longer Span	High	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	High	0
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	High	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	High	0

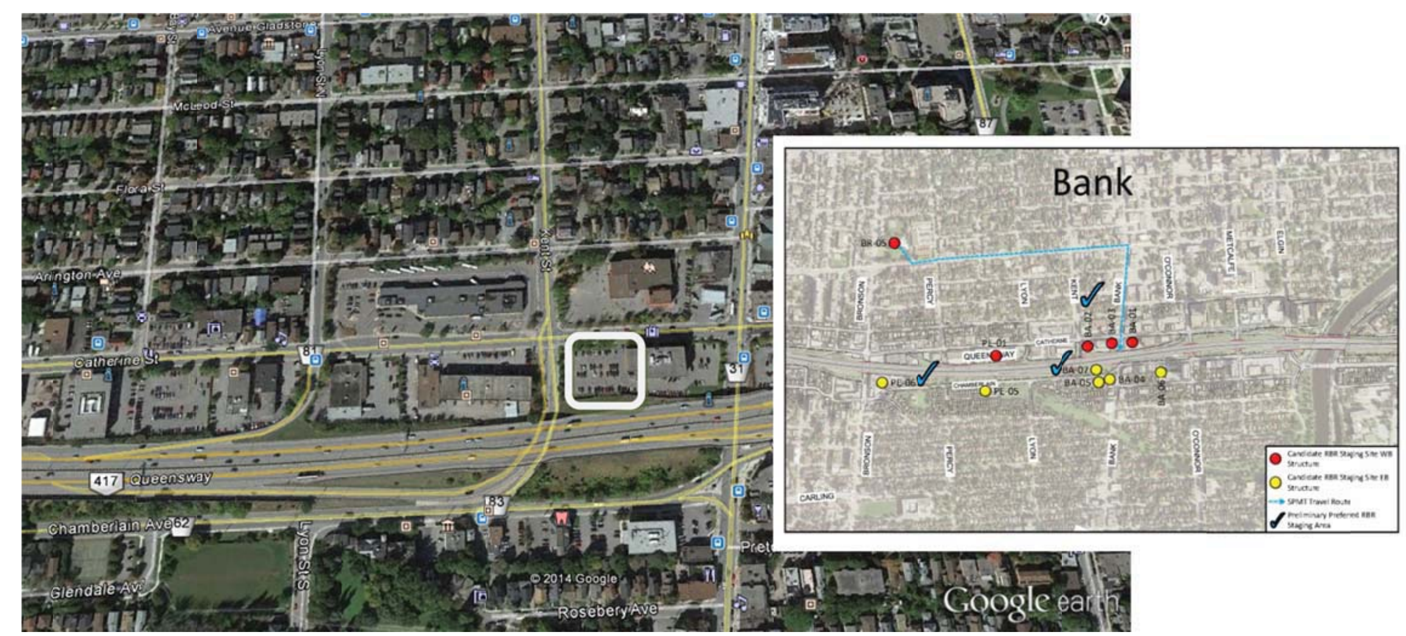
Mitigation: Avoidance.

Factor Group: Land Use and Property

Temporary Property Impacts



Description: This sub-factor measures whether property (i.e. parking lot at Kent/Queensway) is required for temporary use as a bridge staging area (BA-02), as per the RBR Structure Staging Sites memo.



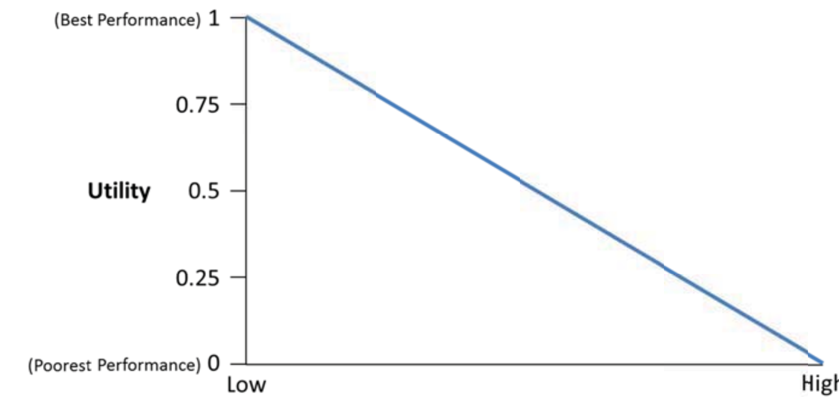
Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	No	1

Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	No	1
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Yes	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Yes	0
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Yes	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Yes	0
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Yes	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Yes	0

Mitigation: N/A

Factor Group: Cost

Capital Cost



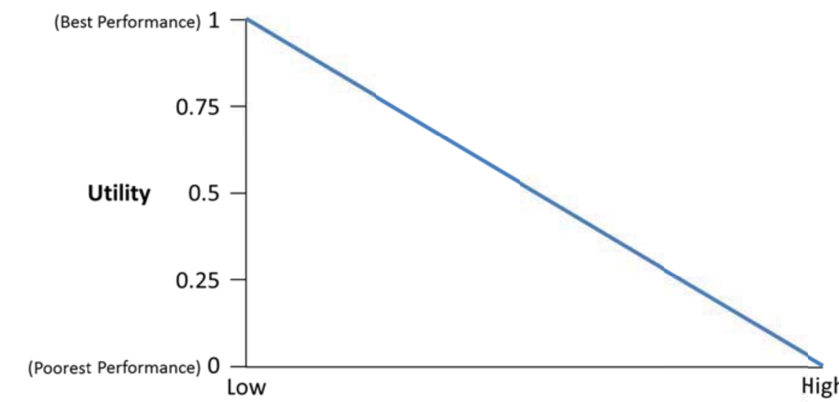
Description: This sub-factor measures the difference in initial capital cost of the alternative (bridge, traffic staging, staging area, and property costs). Those alternatives with the lowest capital cost are preferred. These costs do not include Engineering Costs.

Alternatives	$M		Utility Score
Alternative A2e Rapid Rehab/Existing Span	Structure 0.71 Staging 0.6 Property 0	1.31	1
Alternative A5e Conventional Rehab/Existing Span	Structure 0.71 Staging 1.25 Property 0	1.96	0.9
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Structure 2.80 Staging 1.2 Property 0	4	0.8
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Structure 3.50 Staging 1.2 Property 0	4.7	0.7
Alternative C6e Rapid Replacement/Full Closure/Existing Span	Structure 5.01 Staging 0.60 Property 0.20	5.81	0.3
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Structure 5.01 Staging 0.60 Property 0.20	5.81	0.3
Alternative C6l Rapid Replacement/Full Closure/Longer Span	Structure 7.39 Staging 0.60 Property 0.20	8.19	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Structure 7.39 Staging 0.60 Property 0.20	8.19	0
Alternative D6l Rapid Replacement Semi-integral/Full	Structure 6.77 Staging 0.60	7.57	0.1

Closure/Longer Span	Property 0.20		
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Structure 6.77 Staging 0.60 Property 0.20	7.57	0.1

Mitigation: N/A

Future Life Cycle Cost



Description: This sub-factor measures the difference in future life cycle costs (maintenance, operating costs and long term replacement and rehabilitation in the 40 year planning horizon). Those alternatives with the lowest long term life cycle cost are preferred. A 5% discount rate was used.

Alternatives	$M	Utility Score
Alternative A2e Rapid Rehab/Existing Span	3.45	1
Alternative A5e Conventional Rehab/Existing Span	4.10	0.9
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	4.63	0.8
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	5.42	0.7
Alternative C6e Rapid Replacement/Full Closure/Existing Span	6.51	0.6
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	7.06	0.4
Alternative C6l Rapid Replacement/Full Closure/Longer Span	9.18	0.1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	9.74	0
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	8.49	0.2
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	9.04	0.1

Mitigation: N/A

VERSION: November 11, 2014

APPENDIX E

SUB-FACTOR UTILITY FUNCTION DEFINITIONS AND MEASUREMENTS FOR SHORT LISTED EVALUATION CRITERIA

O'CONNOR STREET OVERPASS (EB and WB)

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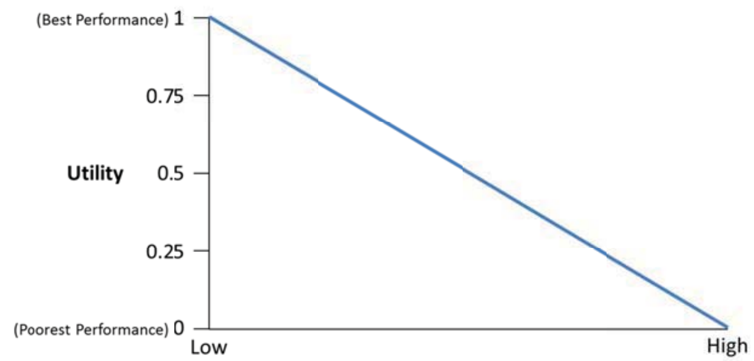
Factor Group: Transportation

Maximum Peak Queue Length on Queensway



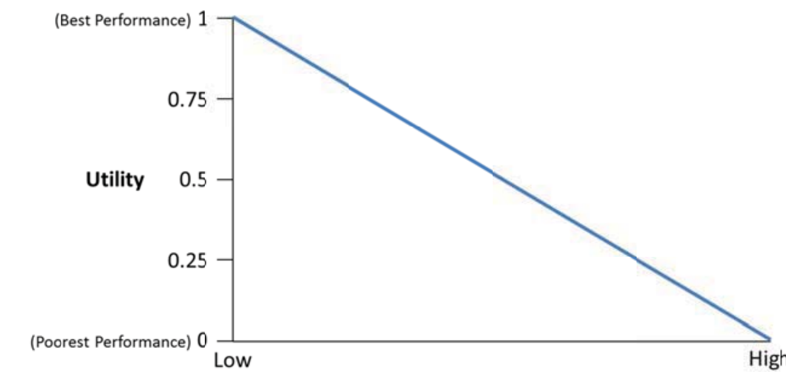
Description: This sub-factor measures the forecast queue length effect in the peak hour including measures to divert trips and induce transportation demand management during construction. The sub-factor measures the queue duration (days) and the forecast queue length (after the use of mitigation). This sub-factor is indicative of highway performance and safety, and is related to: effects on ramp operations, rear end collisions influenced by stop and go traffic, poor weaving conditions and traffic congestion.

(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	**km days (peak hour)**	**Utility Score**
Alternative A2e Rapid Rehab/Existing Span	144.2	0.93
Alternative A5e Conventional Rehab/Existing Span	1892	0
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	1600	0.15
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	1600	0.15
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	4	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	254.4	0.9
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	4	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	254.4	0.9
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	4	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	254.4	0.9

Mitigation: The use of advance advertising and advising drivers of the scheduled lane closures through PVMS placement in advance of construction will be measures that will reduce demand by: changing the time of travel of commuters, use of transit as an alternate mode of travel, or by inducing diversion to the municipal road system as an alternate route.

Delays

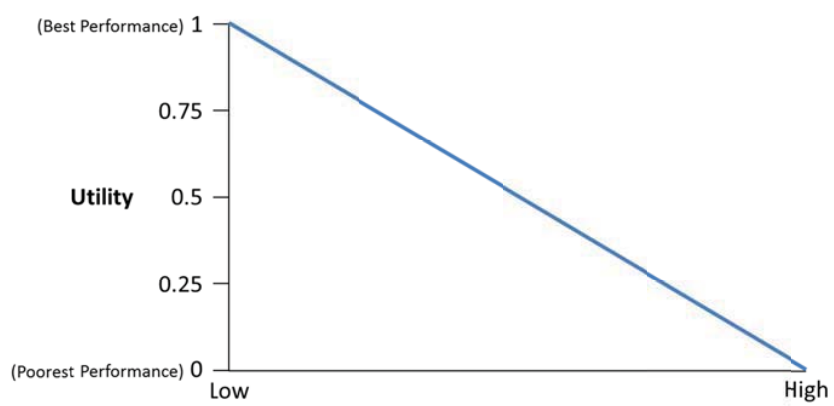


Description: This sub-factor measures the total lane closure peak period delay to drivers on the Queensway during the construction period. It includes the total peak period delay forecast for the duration of construction of the alternative. The delay sub-factor, although measuring vehicles on the Queensway, is also indicative of the delays for drivers diverted from the Queensway and operating on the municipal road system.
(Data from VISSIM Traffic Memo February 19, 2014 and Traffic Sub-factors Utility Functions Technical Memorandum August 5, 2014)

Alternatives	**Veh h**	**Utility Score**
Alternative A2e Rapid Rehab/Existing Span	748,920	0.59
Alternative A5e Conventional Rehab/Existing Span	456,000	0.75
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	1,824,000	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	1,824,000	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	1,040	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	480,200	0.74
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	1,040	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	480,200	0.74
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	1,040	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	480,200	0.74

Mitigation: N/A

Ramp Closures

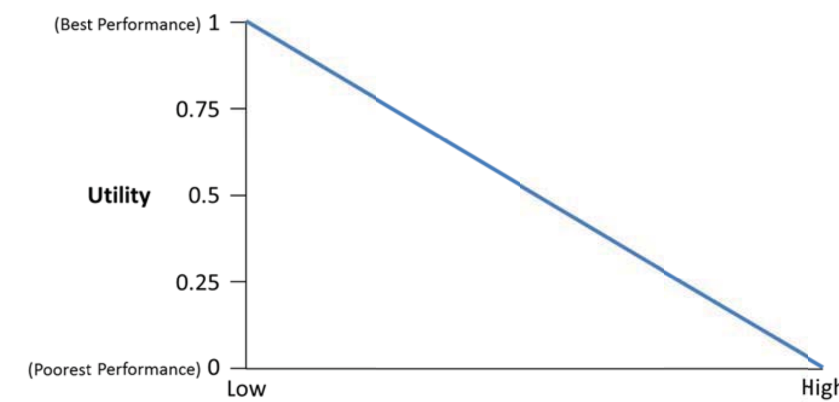


Description: This sub-factor measures the impact to community access by quantifying the volume of peak hour ramp trips that will be removed from entering or exiting from the Queensway. The sub-factor measures the peak hour ramp volume for each stage of the highway staging plan for the duration of the closure.

Alternatives	Veh (peak hour)	Utility Score
Alternative A2e Rapid Rehab/Existing Span	0	1
Alternative A5e Conventional Rehab/Existing Span	0	1
Alternative B9e Conventional Replacement/ Three Stage Detour/Existing Span	0	1
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	0	1
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	8,067	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	0	1
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	8,067	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	0	1
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	8,067	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	0	1

Mitigation: Ramps may be closed by time of day to allow access in non-peak hours.

Highway Safety - Collision Potential

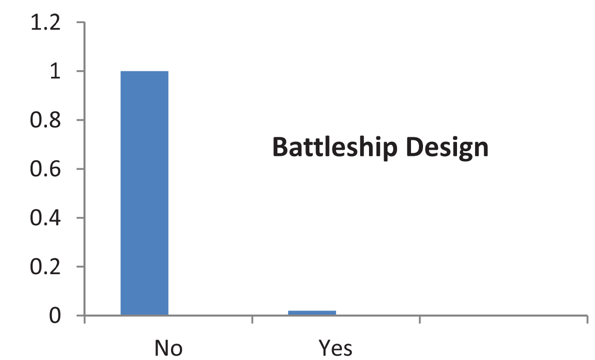


Description: This sub-factor measures the collision potential of the alternative by measuring the time duration that drivers will be required to transition through the construction zone.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	0.9
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	0	3	3	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	20	12	32	0.9
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	0	3	3	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	20	12	32	0.9
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	0	3	3	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	20	12	32	0.9

Mitigation: N/A

Highway Safety – Design Consistency of Traffic Staging Design

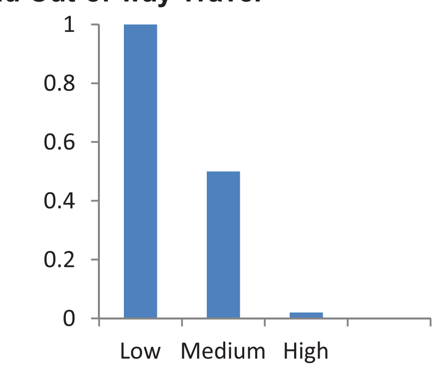


Description: This sub-factor measures the collision potential of the highway staging design. Those alternatives including a non-conventional battleship design (i.e. yes) are least preferred.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Yes	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Yes	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	No	1
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	No	1
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	No	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	No	1
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	No	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	No	1

Mitigation: Tow truck plan/incident plan.

Pedestrian – Delay and Out-of-way Travel

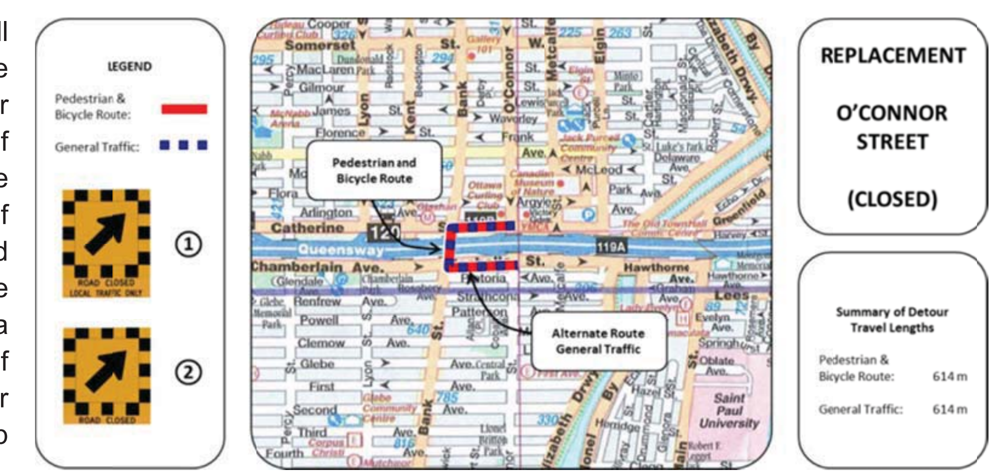


Description: This sub-factor measures the length and duration of pedestrian out-of-way travel on the side streets while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily sidewalk closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period. Pedestrians will be signed to use the opposite sidewalk from the adjacent signalized intersections.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. Pedestrians will use a single sidewalk and cross the street at the temporary signals. The duration of the temporary signals will be 6 weeks.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure pedestrians will be directed to Bank Street, for a maximum out-of-way travel of 0.6 km. This sub-factor measures a one-way trip only.

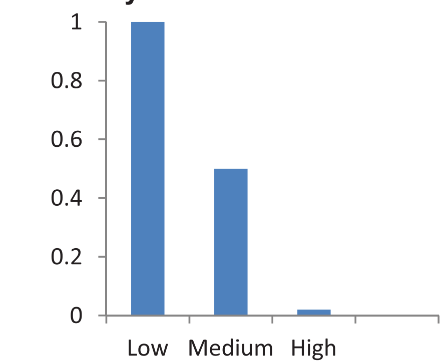


Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e ***TWIN*** REPLACEMENT	Medium	0.5

Rapid Replacement/Full Closure/Existing Span		
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: Advance signage for pedestrians to travel to the alternate sidewalk route as well as pre-event information to the property owners.

Bicycle – Delay and Out-of-Way Travel

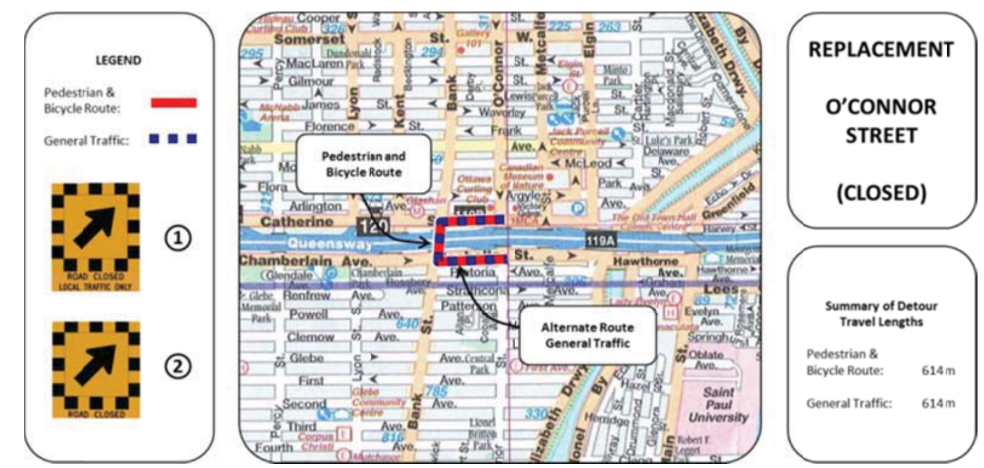


Description: This sub-factor measures the length and duration of bicycle delay and out-of-way travel on the side street while work is completed to rehabilitate or replace the structure. Categories of effects include:

Low impacts – daily lane and bike lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period.

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. Bicyclists will use the single lane detour through the temporary signals. The duration of the temporary signals will be 6 weeks.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure, bicyclists will be directed to Bank Street, for a maximum out-of-way travel of 0.6 km. This sub-factor measures a one-way trip only.

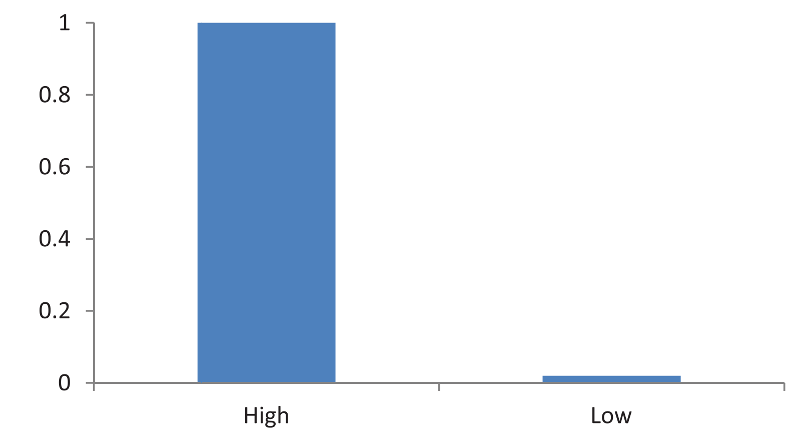


Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C7e	Medium	0.5

Rapid Replacement/Two Lane Detour/Existing Span		
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: Advance signage for cyclists to choose an alternate route as well as pre-event information to the Regional cycling clubs.

Pedestrian/Bicycle Safety

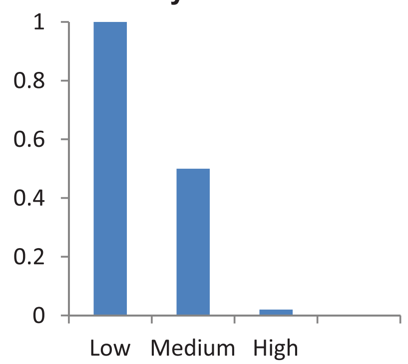


Description: This sub-factor measures if an alternative provides greater lateral space to increase pedestrian and bicycle safety. Those alternatives providing the largest span are preferred (high potential) and those alternatives matching the existing span are not preferred (i.e. low potential).

Alternatives	High/Low	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	0
Alternative A5e Conventional Rehab/Existing Span	Low	0
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Low	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	1
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Low	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Low	0
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	High	1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	High	1
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	High	1
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	High	1

Mitigation: None.

General Traffic Municipal Street Delay

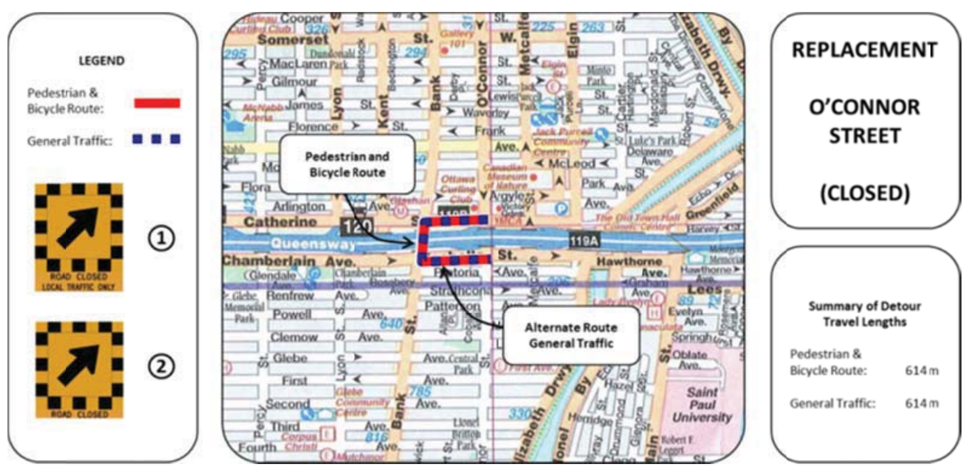


Description: This sub-factor measures the delay during construction that will affect general traffic operations. Categories of effects include:

Low impacts – daily lane closures with flagman for rehabilitation repairs on abutment walls and the bridge soffit over a 6-week period

Medium impacts – Single lane operation with temporary signals while the RBR support towers are installed and then in place awaiting the lift. The duration of the temporary signals will be 6 weeks.

High impacts: The road will be closed to accommodate scaffolding and falsework for the in-place construction of the conventional bridge replacement for a duration of 16 weeks. For the road closure vehicles will be directed to Bank Street, for a maximum out-of-way travel of 0.6 km. This sub-factor measures a one-way trip only.



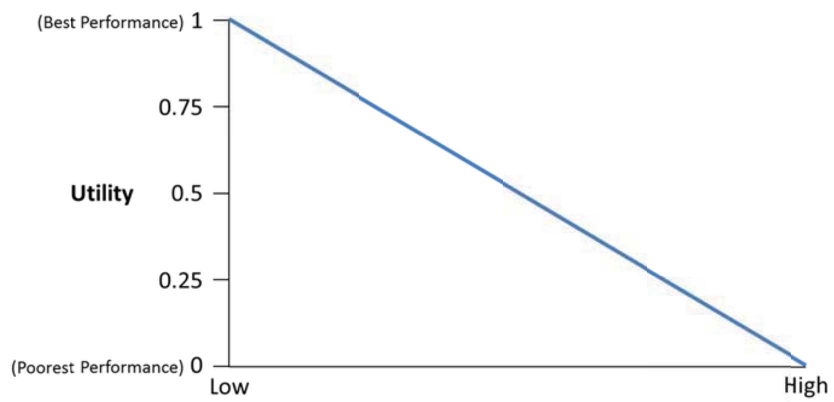
Alternatives	Low/Med/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	Low	1
Alternative A5e Conventional Rehab/Existing Span	Low	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	High	0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	High	0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Medium	0.5
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Medium	0.5

Alternative C6l Rapid Replacement/Full Closure/Longer Span	Medium	0.5
Alternative C7l ***TWIN*** REPLACEMENT Rapid Replacement/Two Lane Detour/Longer Span	Medium	0.5
Alternative D6l Rapid Replacement Semi-integral/Full Closure/Longer Span	Medium	0.5
Alternative D7l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Medium	0.5

Mitigation: The use of advisory signage and potential use of variable message signage can be used to advise drivers before reaching the construction site.

Factor Group: Social and Cultural Environment

Impact to Emergency Response

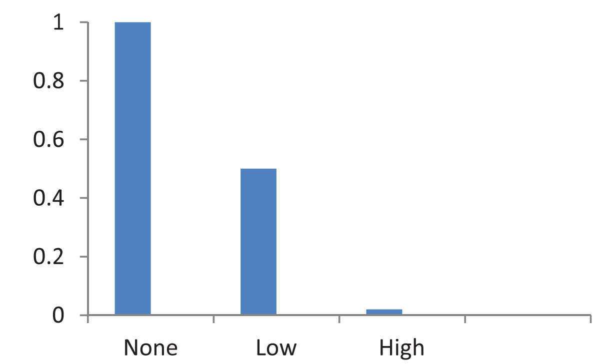


Description: This sub-factor measures the duration of Queensway closure that will affect emergency response service (police, ambulance and fire). Alternatives that reduce the length of time that there are lane closures on the Queensway are preferred.

Alternatives	Days			Utility Score
	Wkday	Wkend	Total	
Alternative A2e Rapid Rehab/Existing Span	10	12	22	0.9
Alternative A5e Conventional Rehab/Existing Span	65	32	97	0.6
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	160	68	228	0.0
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	160	68	228	0.0
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	0	3	3	1.0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	20	12	32	0.9
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	0	3	3	1.0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	20	12	32	0.9
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	0	3	3	1.0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	20	12	32	0.9

Mitigation: Advanced warning of lane closures or detour routes.

Potentially Contaminated Property



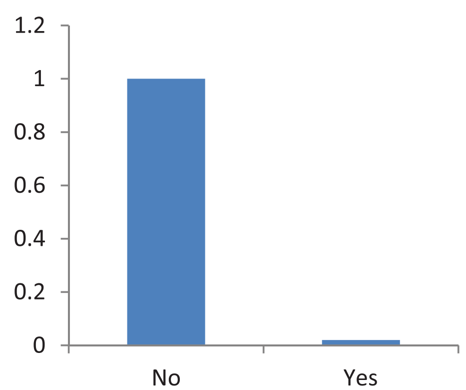
Description: This sub-factor measures whether there is potential to encounter potentially contaminated property during the construction of an alternative. Alternatives that minimize excavation are preferred. RBR staging sites have high potential (i.e. large footprint of excavation) to impact potentially contaminated property. Any alternative excavating in place has low potential to impact potentially contaminated property. The rehabilitation options have no potential to impact potentially contaminated property due to the small footprint of works.

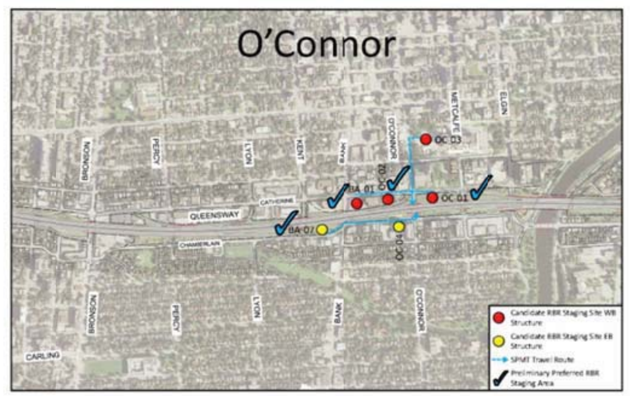
Alternatives	No/Low/High	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Low	0.5
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Low	0.5
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	High	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	High	0
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	High	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	High	0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	High	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	High	0

Mitigation: Avoidance.

Factor Group: Land Use and Property

Temporary Property Impacts





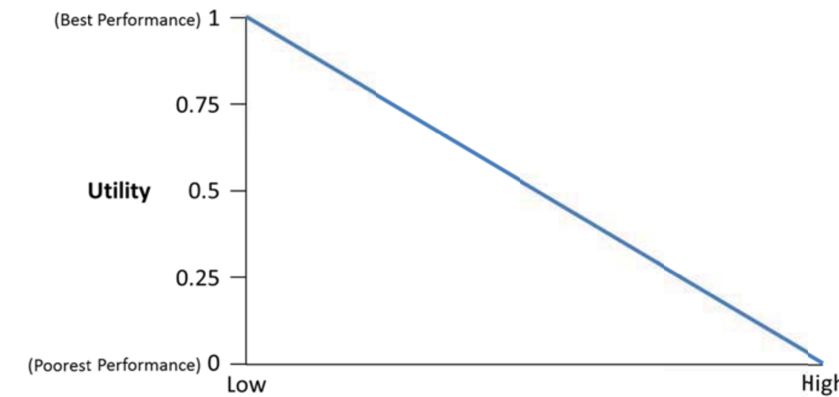
Description: This sub-factor measures whether property (i.e. parking lot) is required for temporary use as a bridge staging area (BA-07 EB staging area candidate site, BA-01/ OC-01/ OC-02 WB staging area candidate site), as per the RBR Structure Staging Sites memo.

Alternatives	Yes/No	Utility Score
Alternative A2e Rapid Rehab/Existing Span	No	1
Alternative A5e Conventional Rehab/Existing Span	No	1
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	No	1
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	No	1
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Yes	0
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Yes	0
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Yes	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Yes	0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	Yes	0
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Yes	0

Mitigation: N/A

Factor Group: Cost

Capital Cost



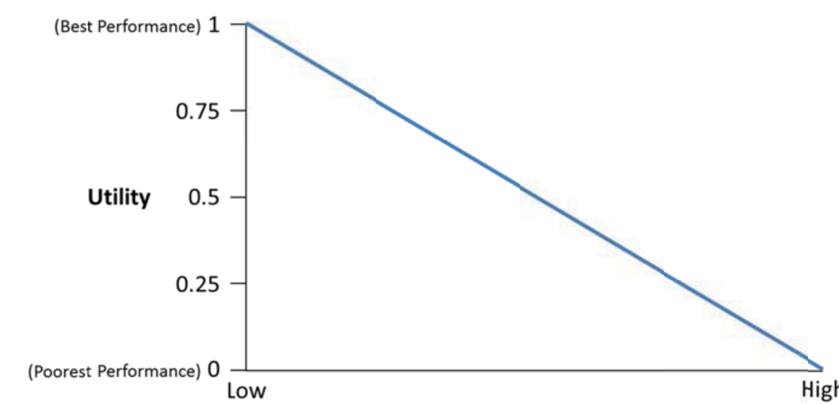
Description: This sub-factor measures the difference in initial capital cost of the alternative (bridge, traffic staging, staging area, and property costs). Those alternatives with the lowest capital cost are preferred. These costs do not include Engineering Costs. Costs are for both the EB and WB structures.

Alternatives	$M		Utility Score
Alternative A2e Rapid Rehab/Existing Span	Structure 0.80 Staging 0.6 Property 0	1.4	1
Alternative A5e Conventional Rehab/Existing Span	Structure 0.80 Staging 1.25 Property 0	2.05	0.9
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	Structure 3.66 Staging 1.2 Property 0	4.86	0.6
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	Structure 4.57 Staging 1.2 Property 0	5.77	0.5
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	Structure 7.87 Staging 0.60 Property 0.20	8.67	0.2
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	Structure 7.87 Staging 0.60 Property 0.20	8.67	0.2
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	Structure 9.55 Staging 0.60 Property 0.20	10.35	0
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	Structure 9.55 Staging 0.60 Property 0.20	10.35	0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full	Structure 7.55 Staging 0.60	8.35	0.2

Closure/Longer Span	Property 0.20		
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	Structure 7.55 Staging 0.60 Property 0.20	8.35	0.2

Mitigation: N/A

Future Life Cycle Cost



Description: This sub-factor measures the difference in future life cycle costs (maintenance, operating costs and long term replacement and rehabilitation in the 40 year planning horizon). Those alternatives with the lowest long term life cycle cost are preferred. A 5% discount rate was used. Costs are for both the EB and WB structures.

Alternatives	$M	Utility Score
Alternative A2e Rapid Rehab/Existing Span	4.5	1
Alternative A5e Conventional Rehab/Existing Span	5.15	0.9
Alternative B9e Conventional Replacement/Three Stage Detour/Existing Span	5.62	0.9
Alternative B9l Conventional Replacement/Three Stage Detour/Longer Span	6.64	0.7
Alternative C6e ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Existing Span	9.74	0.3
Alternative C7e Rapid Replacement/Two Lane Detour/Existing Span	10.30	0.2
Alternative C6l ***TWIN*** REPLACEMENT Rapid Replacement/Full Closure/Longer Span	11.63	0.1
Alternative C7l Rapid Replacement/Two Lane Detour/Longer Span	12.19	0
Alternative D6l ***TWIN*** REPLACEMENT Rapid Replacement Semi-integral/Full Closure/Longer Span	9.38	0.4
Alternative D7l Rapid Replacement Semi-integral/Two Lane Detour/Longer Span	9.94	0.3

Mitigation: N/A