



**NORTH–SOUTH CORRIDOR  
LRT PROJECT**  
(Rideau Centre to Barrhaven Town Centre)

**ENVIRONMENTAL ASSESSMENT**

**Response to Council Resolutions  
of July 15, 2005**



**October 2005**



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## 1.0 Introduction

At its July 15, 2005 meeting, Ottawa City Council approved the recommendations of the staff report for the North-South Corridor Light Rail Transit Project Environmental Assessment Study. Council also approved six additional resolutions that required further work to be completed. The six resolutions are listed below.

- a. That OC Transpo be directed to ensure that a minimum of 30% of bus traffic be removed from Albert and Slater streets by end of 2009, and that city staff be directed to cause a full evaluation to remove up to 100% of buses from the Slater and Albert corridor by the end of 2009, and that the findings be presented to Transportation Committee by September 30, 2005.
- b. That as part of sub-paragraph (a) above, the LRT Project Team prepare a technical report on the possibility of using Hurdman and Bayview stations as transfer stations to assist in the reduction of bus volumes on Slater and Albert Streets, with the possibility of retaining the 90 series, but short-turning all local buses at hub stations.
- c. That the LRT Project Team together with its consultants prepare the terms of reference for a study to determine the ways and means to construct a bus and/or LRT tunnel to accommodate longer term transit including interprovincial transit need in the city core and to present same to Council by September 30, 2005.
- d. That the LRT Project Team provide all business in the Albert Slater streets corridors with budget estimates for the capital costs for streetscaping Albert and Slater streets and the operating costs of maintaining same.
- e. That by September 30, 2005 the University of Ottawa including the Transitway Station be evaluated as a terminal point for the North-South Light Rail service.
- f. That by September 30, 2005 the LRT Project Team evaluate options that Mackenzie King Bridge can accommodate vehicular traffic as well as LRT service.

As the lead consultant for the City of Ottawa for the North-South Corridor Light Rail Transit Environmental Assessment Study, McCormick Rankin Corporation (MRC) was asked to assist in responding to these six Council resolutions. The chapters of this report present the results of MRC's technical work related to these resolutions, with one chapter dedicated to each of the resolutions.

## 2.0 Resolution A

Council resolution (a) states “That OC Transpo be directed to ensure that a minimum of 30% of bus traffic be removed from Albert and Slater streets by end of 2009, and that city staff be directed to cause a full evaluation to remove up to 100% of buses from the Slater and Albert corridor by the end of 2009, and that the findings be presented to Transportation Committee by September 30, 2005.” There are two distinct components to this resolution:

- a. That OC Transpo be directed to ensure that a minimum of 30% of bus traffic be removed from Albert and Slater streets by the end of 2009; and,
- b. That city staff be directed to cause a full evaluation to remove up to 100% of buses from the Slater and Albert corridor by the end of 2009.

Each of these components is discussed separately in the following sections.

### 2.1 Removal of 30% of Buses

Work to address this component of resolution (a) is being led by City Staff, and is presented in a separate document.

### 2.2 Removal of Up To 100% of Buses

This section examines the various options for reducing the number of buses on Albert and Slater Streets by up to 100% by the end of 2009.

#### 2.2.1 Identification of Options

Three groups of options for removing up to 100% of buses from Albert and Slater Streets have been identified:

- Removing all buses on Albert and Slater Streets and operating them on other east-west streets in downtown Ottawa;
- Removing a percentage of buses (greater than 30% but less than 100%) and operating them on other east-west streets; and,
- Creating transfer hubs and Hurdman and Bayview Stations, and providing an alternative transit service from these stations into and across downtown.

The first two options are examined below, while the third option (creating transfer hubs at Hurdman and Bayview Stations) is examined in chapter 3 as part of Council resolution (b).

#### 2.2.2 Background & Assumptions

In examining the options identified in section 2.2.1, the following assumptions were made:

- As many cross-town transit trips as possible that currently travel through downtown have been diverted using new or enhanced services on the Queensway corridor and/or the Baseline/Heron Road corridor;
- A “hub and spoke” system of bus operation has been implemented where it is appropriate to do so;
- The bus volumes on Albert and Slater Streets have already been reduced by 30% or more as part of City Staff’s work on the first component of Council resolution (a);
- As many out of service (deadhead) buses as possible have been removed from Albert and Slater Streets;
- The bus system will be designed to carry the future 2009 passenger volumes as anticipated in the Transportation Master Plan (approximately nineteen percent more people leaving downtown on Transitway and O-Train services compared with 2004);
- The direction and operation of the existing street system will not be changed (i.e. current one and two-way street operation and existing turning movements would be maintained).

It has also been assumed that only Wellington Street, Queen Street, and Laurier Avenue will be considered as alternate streets for bus operation in downtown. Sparks Street was not considered because of its current configuration as a pedestrian mall and the unlikelihood of being able to change its configuration by 2009. Also, streets to the south of Laurier Avenue were not considered for additional bus operations because they are too far south of the primary downtown transit demand, and the streets are generally narrower and more residential in character.

### 2.2.3 Analysis of Options

#### Option 1:

This option assumes that all buses are removed from Albert and Slater Streets and would operate on one or a combination of Wellington Street, Queen Street, or Laurier Avenue. The full range of options is listed below and illustrated in figures 2.1, 2.2, and 2.3:

- All buses in both directions diverted to Wellington Street;
- All buses in both directions diverted to Queen Street;
- All buses in both directions diverted to Laurier Avenue;
- All buses in one direction diverted to Wellington Street and all buses in the other direction diverted to Queen Street;
- All buses in one direction diverted to Wellington Street and all buses in the other direction diverted to Laurier Avenue;
- All buses in one direction diverted to Queen Street and all buses in the other direction diverted to Laurier Avenue.

Figure 2.1 – Albert/Slater Routing Option – Wellington Street



Figure 2.2 – Albert/Slater Routing Option – Queen Street



Figure 2.3 – Albert/Slater Routing Option – Laurier Avenue



Assuming that the 30% reduction in the number of buses operating on Albert and Slater Streets is achieved by 2009, this would leave approximately 120 buses per hour to be diverted using one of the options described above. The impacts of this diversion would be similar on any of Wellington, Queen or Laurier, and are described below:

- a. An activity level of 120 buses per hour is at the theoretical upper limit of the capacity of a curb-side bus lane, which means that bus lanes would be required during the peak operating hours and possibly beyond those hours. This also means that any current peak period activities that are currently allowed in the curb lanes of the streets would have to be eliminated, and that any illegal stopping or loading would become a significant congestion issue. Therefore a major impact on one or more of these streets would be the elimination of all curbside activity on one or both sides of the street (depending on the option selected) and there would have to be a significant increase in enforcement of the no stopping requirement. As background, the amount of parking, loading, taxi waiting and other space that is currently accommodated on these three streets is summarized in Appendix A. All of this space would be impacted.
- b. Bus platform/stop areas would need to be consolidated and expanded or lengthened to accommodate three buses at a time, with one being articulated. This means that the bus platform/stop area would need to be a minimum of 42 metres in length (two 12 metre long buses and one 18 metre long bus), not including any entrance and exit tapers. Because the stops would be operational in all time periods, this would result in the permanent removal of a number of parking and loading areas adjacent to the platform/stop areas.
- c. More extensive facilities for waiting passenger would be required in these larger stops, which would likely impact on adjacent land use and pedestrian flow through the area. The level of this impact would depend on the particular location of the stop. Note that new stop locations would need to be introduced on Laurier Avenue.
- d. The effect on turning traffic at the intersections along the various roadways would be very disruptive not only to the traffic itself but also to bus operations.

The current traffic volumes operating on each block of each street is provided in Appendix A as background information.

- e. Vehicles accessing the various businesses along each roadway (parking garages, laneways, drycleaners etc.) would be restricted by the bus lanes and the steady flow of buses along the street.
- f. At the east and west ends of the downtown core where the buses would be required to cross the Mackenzie King Bridge or join the Transitway at LeBreton, it would be extremely difficult (if not impossible) to accommodate a high volume of buses making the necessary left turn movements to access Laurier / Queen / Wellington to/from either end of the Transitway.

In summary, removing all of the buses and placing them on Laurier, Queen or Wellington would not be possible without major impacts to the street operations. These include the impact on pedestrian facilities and loss of sidewalk space to bus platforms, the loss of parking and loading zones, and the lack of capacity to accommodate the volume of buses turning to or from the streets. This indicates that placing 120 buses per hour (100% of the Albert/Slater volume) on one or both directions of the three streets is not feasible.

**Option 2:**

In this option, a proportion of the buses on Albert and Slater Streets would be diverted to operate on one or more of Wellington Street, Queen Street or Laurier Avenue. For each street, it is a question of finding the balance between the number of buses and the capacity of the roadways and intersections to accommodate the bus turning movements. Discussion of the potential to accommodate buses in each direction on each street follows.

**Wellington Westbound**

In this option, buses would travel across the Mackenzie King Bridge, turn right on Elgin Street, left onto Wellington and use one of two routes to reach the Transitway west of Bronson – Lyon and Albert, or a new connection following old Wellington/Cliff Street. This is illustrated in figure 2.4. The key issues associated with this option are shown in the figure, and summarized below:

**Figure 2.4 – Wellington Westbound**



- There is regular traffic congestion on Elgin northbound on the east side of Confederation Square that would delay buses.
- There are already in excess of 130 buses per hour operating on Wellington Street westbound between Rideau Street and Bank Street (a combination of transit services provided by OC Transpo and STO). This means that Wellington westbound is already at capacity for bus operations.
- If buses used Lyon southbound to access Albert Street and the west Transitway, they would be confronted by peak period congestion on Lyon Street that already occurs.
- It is not feasible to introduce a left turn for westbound buses onto old Wellington/Cliff Street because of the close proximity to the Lebreton Boulevard/Portage Bridge traffic signal, the curve in Wellington Street at that location, the planned location and alignment of the bus and rail rapid transit facility, and the location of other nearby accesses.

The result of this analysis is that it is not possible to accommodate bus traffic diverted from Albert Street on Wellington Street westbound.

#### Wellington Eastbound

Buses would access Wellington eastbound by using either Slater Street to Bay Street, or by following old Wellington/Cliff Street directly to Wellington. Buses would travel east on Wellington to Elgin, south on Elgin, and turn left onto the Mackenzie King Bridge. Figure 2.5 illustrates this routing. Consideration was given to routing buses directly onto Rideau Street and then using Nicholas and Daly to reach the Southeast Transitway, however, there would be delays to buses getting through the Rideau/Sussex intersection and travelling through the Rideau Centre area.

Figure 2.5 – Wellington Eastbound



It is important to note that the number of buses currently operating on Wellington Street eastbound is not as high as in the westbound direction during the afternoon peak period. As a result, there is some capacity for additional buses to be operating in the eastbound direction in the afternoon.

If a connection between the West Transitway and old Wellington/Cliff Street can be constructed (and this would depend on finding a technically feasible method and reconfiguring proposed plans for the area), then it is possible for buses to merge directly onto Wellington. Buses using Slater and Bay Streets to reach Wellington would be confronted by congestion on Bay, especially during the afternoon peak period.

The left turn from Elgin onto the Mackenzie King Bridge at Slater Street is not currently designed for regular use by buses. The left turn lane is not long enough to accommodate a bus, resulting in buses blocking the left through traffic lane while waiting to turn. This is not currently a significant issue because the number of buses that make this movement is relatively small (approximately 10 scheduled bus trips each day – 5 by OC Transpo and 5 by Leduc Bus Lines providing the Clarence-Rockland transit service). However, a substantial increase in use by buses could create difficulty in the operation of southbound Elgin Street. To address this issue, the following modifications and alternatives have been considered:

- Lengthening the left turn lane by shortening the companion left hand northbound Elgin left turn lane onto Albert Street (this is currently a double left turn lane). This is not recommended because the turn onto Albert has a much higher volume than the turn onto the Bridge. Loss of northbound storage space and the resulting reduction in capacity for the turn would likely cause increased queuing that could impact the operation of transit services travelling from Slater Street onto the Bridge.
- Lengthening the left turn lane by removing the current pedestrian crossing on the north side of the Elgin/Slater intersection and moving the stop bar south. This would be a return to the arrangement that was in place prior to the reconstruction of Elgin Street in the late 1990's. While removing any pedestrian connection is undesirable, it should be noted that pedestrians using this crossing would be continuing to or from locations that are either north of Albert or south of Slater on the east side of Elgin, and these locations can be readily accessed by other pedestrian crossings that are equally convenient.
- Creating a new left turn lane in the wide median on Elgin southbound between Queen and Albert, and introducing an eastbound contra-flow lane for buses on the westbound approach to Elgin from the Mackenzie King Bridge. This would eliminate the ability to accommodate the large planters that are placed on the Elgin median during the spring, summer and fall, and reduce the amount of space on the triangular piece of property between Albert and Slater, east of Elgin. It would also require the introduction of a new traffic signal on the Bridge to allow buses to safely merge with traffic coming onto the Bridge from Slater Street.

All of these options have significant operational impacts (for example, the traffic signal required in the contra-flow lane concept is likely to be too close to Elgin Street, resulting in insufficient storage space for vehicles on both of the approaches), and it is possible that the best option for accommodating buses turning left onto the Bridge from Elgin may be the status quo with the short left turn lane. This will work provided the number of buses using it is not too high. Detailed traffic analysis will be required to analyse these options in order to determine the best alternative for buses to travel from Elgin southbound onto the Mackenzie King Bridge.

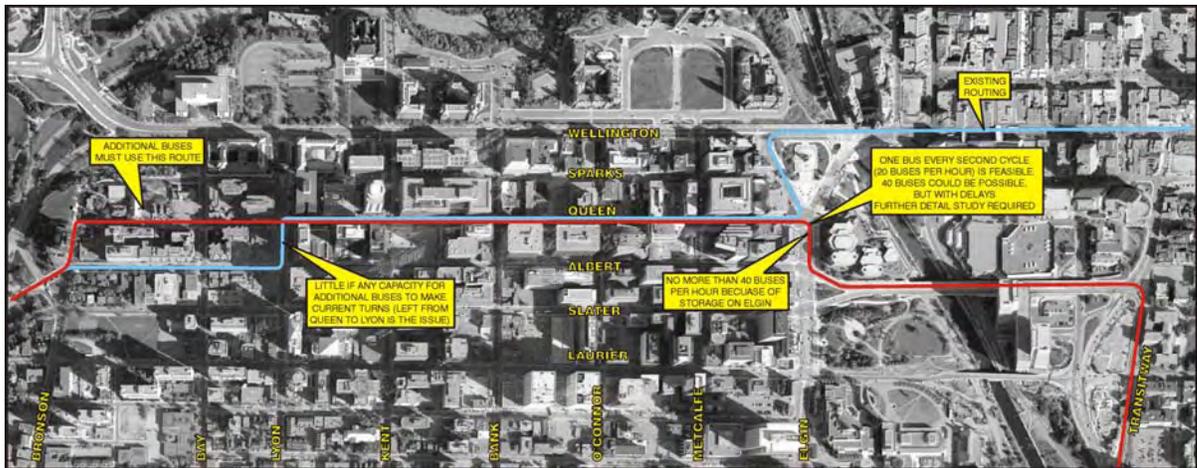
Given these constraints, it is clear that it is not feasible to accommodate a substantial number of buses being diverted from Slater Street onto Wellington eastbound. The limitations at Elgin Street

mean that the most likely buses to be accommodated would be the buses traveling across the Portage Bridge onto Wellington that currently access Slater Street at Lyon. These buses could continue east on Wellington then south on Elgin Street, and would not overwhelm the left turn onto the Bridge at Slater. This will leave the left turn capacity available for more services travelling from Queen Street (see Queen Eastbound discussion beginning on page 11).

**Queen Westbound**

Buses already operate in both directions on Queen Street. Routes 16 and 18 operate all day in both directions, Route 3 operates all day in the eastbound direction, Route 15 operates eastbound during the morning peak period and westbound during the afternoon peak period, and three of the rural express routes use Queen Street eastbound during the afternoon peak period. Westbound service travels between Elgin and Lyon, while eastbound service travels between Bay and Elgin. These services are illustrated in figure 2.6.

**Figure 2.6 – Queen Westbound**



Buses diverted from westbound Albert Street onto Queen would travel from the Mackenzie King Bridge, right onto Elgin and left onto Queen. They would travel west on Queen and travel back to Albert Street at either Lyon (with the existing services) or at Bronson.

At Elgin Street, there is insufficient storage space available to accommodate any more than one bus per signal cycle along with the current volume of traffic that is turning left onto Queen. This is a maximum of 40 buses per hour. To confirm that 40 buses per hour can be feasibly operated through this intersection will require further study, including a simulation of traffic operations. In the meantime, review with Traffic and Parking Operations staff has confirmed that up to 20 buses per hour could be accommodated without additional study.

The current traffic volumes at the Queen/Lyon intersection limit the number of buses making the left turn onto Lyon to the number that are already completing the movement. No additional buses can be accommodated.

Additional buses would have to be accommodated by traveling further west on Queen and turning left at Bronson. This is technically feasible, but has two important issues that should be noted:

- West of Lyon, and especially west of Bay, Queen Street is narrower and has a more residential character than east of Lyon – bus services may not be seen to be desirable;
- The intersection of Bronson and Queen is narrow, and may require modification (one or all of intersection operation, pavement markings, and geometry) to accommodate bus movements.

The conclusion is that Queen Street westbound can accommodate 20 additional buses per hour over and above the number it already accommodates, provided that these buses are able to operate through the Queen and Bronson intersection.

### Queen Eastbound

Queen Street eastbound currently accommodates buses, as described in the previous section. This routing, along with possible routings for additional bus services are illustrated in figure 2.7.

Figure 2.7 – Queen Eastbound



Additional buses diverted from Slater Street would access Queen either on the route followed by the current services (Bay Street), or by using Bronson. There is limited, if any, additional capacity on the Bay Street route over and above the existing services. The Bronson routing is feasible for up to 30 buses per hour, provided that modifications at the Bronson/Queen intersection allow buses to successfully negotiate the right turn, and buses can be introduced onto the western most block of Queen Street.

At the east end of Queen, new buses would turn right onto Elgin southbound, then left onto the Mackenzie King Bridge. The issues associated with access to the bridge were already discussed in the Wellington Eastbound section, above. The 30 buses per hour in the previous paragraph could not be accommodated without one of the modifications described in the Wellington Eastbound section.

Up to 30 buses per hour over and above the current number of buses operating on Queen Street could be accommodated, provided that the issues associated with the Bronson/Queen intersection and with access to the Mackenzie King Bridge can be resolved.

### Laurier Westbound

Transit services do not currently operate in either direction on Laurier Avenue. Thus, introducing transit service will require the introduction of bus stops with the resulting loss of parking, loading, or taxi space. The amount of space lost would depend on the locations that are ultimately chosen for bus stops.

Possible routings for bus services on Laurier westbound are illustrated in figure 2.8. From the Southeast Transitway, buses would either turn left directly onto Laurier, or travel across the Mackenzie King Bridge, left onto Elgin and then right onto Laurier. The direct route onto Laurier is not recommended for two key reasons:

- Buses waiting to turn left onto Laurier Avenue from the Transitway would block the majority of buses that are attempting to travel straight through the intersection. This would substantially delay a significant number of buses and the people on them. It is not possible to overcome this problem by constructing a left turn lane, because there is physically not enough space available.
- Buses directly accessing Laurier would not be able to serve the Mackenzie King Station, integrated into the Rideau Centre. This is the busiest station in the city, and the Rideau Centre is the largest shopping centre that OC Transpo serves. The station is also the largest transfer connection point for passengers transferring to and from OC Transpo and STO services operating on Rideau Street. The closest that buses on Laurier could get to the Rideau Centre would be at possible stops on Laurier at Nicholas or at the pedestrian crossing at Festival Plaza.

Figure 2.8 – Laurier Westbound



Buses traveling across the Mackenzie King Bridge will be easily able to turn left onto Elgin Street and right onto Laurier westbound. The equivalent of one bus per Elgin traffic signal cycle (40 per hour) should be able to complete these turns without significant delay.

At the west end of Laurier, there are two possible routes to get back to Albert Street and the West Transitway – north on Bay or north on Bronson. The Bay Street route is not recommended because of existing congestion that often causes substantial peak period delays, especially in the afternoon. It is possible to accommodate 40 buses per hour turning right from Laurier onto Bronson, however, traffic signal progression and congestion on Bronson, and geometric constraints related to the slopes

on Laurier and on Bronson may limit the practical number of buses that can easily move onto the West Transitway to 20. Detailed traffic flow and signal simulation analysis and geometric investigation would be required to determine if 40 buses per hour are feasible.

It should be noted that the character of Laurier Avenue changes west of Lyon Street. It is narrower and more residential. As a result, bus services may not be seen to be desirable;

Thus, Laurier westbound can accommodate 20 buses per hour, with further study required to determine if it is possible to accommodate 40 buses.

#### Laurier Eastbound

Figure 2.9 illustrates that introducing transit service on Laurier eastbound will require buses to use either Bronson or Lyon to travel from Slater south to Laurier. Bronson is not recommended because of the difficulty in turning left onto Laurier from the steep uphill grade on Bronson. The current traffic signals on Bronson are timed to prevent vehicles from queuing on the steep slope between Slater and Laurier, and if a full bus was forced to stop on the hill while waiting to turn left, it may not be able to get started again. Thus, Lyon Street is the only option that buses have available. Review with Traffic and Parking Operations staff determined that between 15 and 20 buses per hour turning right onto Lyon and then left onto Laurier would be able to be accommodated with the existing traffic.

Figure 2.9 – Laurier Eastbound



Consideration was also given to constructing a new bus roadway across the former Ottawa Technical High School playing field between Slater and Laurier, near Bronson. This was considered during the North-South Corridor LRT Project EA Study for LRT operation on Laurier. Given the relatively small number of buses that are likely to use such a facility if some Slater Street buses are diverted, it was felt that it would be inappropriate to use this land when it might be better used for green space or some form of development (the Downtown Ottawa Urban Design Strategy suggests that this site be used for a mixture of both).

Approaching Elgin Street, three options for buses to reach the Southeast Transitway were considered:

- Traveling straight across the Laurier Bridge directly to the Transitway. This would require reconstruction of the Laurier/Transitway intersection to accommodate buses making right turns onto the Transitway. This is feasible,

although it may result in a somewhat unconventional intersection arrangement because there is already a right turn for vehicles immediately west of the Transitway. This routing straight along Laurier also misses the Mackenzie King Station and the Rideau Centre. The closest stops would be on Laurier at Festival Plaza or between Nicholas and the Transitway. Also, buses using this route would be subjected to the existing congestion at the Nicholas/Laurier intersection

- Turning left from Laurier onto Elgin to access the Mackenzie King Bridge and serve the Rideau Centre. This left turn movement is not currently permitted. Review of traffic at the intersection found that allowing the left turn to occur, even for buses only, would significantly degrade the operation of the intersection. The through and right turn traffic movements are high enough right now that an eastbound bus would be unlikely to be able to complete the turn except on the amber light, causing substantial queues for all eastbound traffic.
- Turning left from Laurier onto Metcalfe and then right onto Slater Street. The left turn movement onto Metcalfe is currently permitted and could accommodate 15 to 20 buses per hour making the turn. A bus stop would likely have to be introduced on Metcalfe, before buses turned right onto Slater.

Given that the first two alternatives have substantial difficulties associated with them, the Metcalfe alternative is the only one that is feasible. Thus, Laurier eastbound can only accommodate between 15 and 20 buses per hour.

## 2.2.4 Conclusions

The analysis of alternatives for diverting buses from Albert and Slater Streets to Wellington, Queen, or Laurier results in the following conclusions:

- It is not feasible to divert all Albert or Slater buses onto any one of the other streets.
- Wellington Street can not accommodate any additional buses in the westbound direction, and only a small number of buses in the eastbound direction during the afternoon peak period.
- Queen Street could accommodate 20 buses per hour in the westbound direction and 30 buses per hour in the eastbound direction, provided that intersection and turning movement issues are addressed at each end of the street.
- Laurier Avenue could accommodate 20 buses per hour in the westbound direction and 15 to 20 buses in the eastbound direction.

While Queen Street and Laurier Avenue are capable of accommodating additional bus services, it should not be assumed that Albert and Slater buses should automatically be diverted. Where buses and passenger are originating from and destined to should be considered before deciding what, if any, routes should be relocated. These decisions should be made as part of OC Transpo's ongoing review of their services and following appropriate customer and community consultation.

## 3.0 Resolution B

Resolution (b) states “That as part of sub-paragraph (a) above, the LRT Project Team prepare a technical report on the possibility of using Hurdman and Bayview stations as transfer stations to assist in the reduction of bus volumes on Slater and Albert Streets, with the possibility of retaining the 90 series, but short-turning all local buses at hub stations”. This means that this option was to be considered as one of the methods reducing the number of buses on Albert and Slater Streets by up to 100%.

### 3.1 Identification of Options

Three different scenarios for operating Hurdman and Bayview stations as transfer stations were developed and evaluated:

- a. Stop all buses from the east and southeast Transitways at Hurdman Station, and all buses from the west and southwest Transitways at Bayview Station. Replace rapid transit service across downtown between the two stations with LRT service.
- b. Stop all Transitway services at Hurdman and Bayview Stations except for the 90 series routes (presently routes 95, 96 and 97) and supplement the 90 series service with LRT service.
- c. Stop all Transitway services at Hurdman and Bayview Stations except for the 90 series routes (same as previous option) and supplement with additional bus service.

### 3.2 Background & Assumptions

Employment in the central business district (CBD) in 2004 was approximately 80,000 jobs. Fifty percent of the people working in these jobs travel to and from work by public transit, using a wide variety of transit and rapid transit services operated by OC Transpo and STO. The Transitways coming into downtown from Bayview in the west and Hurdman in the east carry the largest number of people, approximately 12,600 leaving the downtown during the afternoon peak hour (5,500 traveling toward Bayview and 7,100 traveling toward Hurdman).

The City's Official Plan and Transportation Master Plan state that employment in the CBD is expected to grow to 120,000 jobs by 2021 and that in order to achieve the City's overall 30% transit modal split goal, 80% of these people will take public transit to and from work. This increase in both overall employment as well as transit modal share results in a combined increase in transit activity of 2.4 times over the planning horizon.

If this growth is achieved, then by 2009 there would be as many as 15,000 people using rapid transit services on the Transitway to leave the downtown area during the afternoon peak period. Approximately 6,500 of these people would be traveling west toward Bayview and 8,500 would be traveling east toward Hurdman. It is important to note that these numbers assume that as many

cross-town trips as possible that do not need to travel through downtown have been diverted to other services.

### 3.3 Analysis of Options

#### Option A

This option requires all buses to stop at either Bayview or Hurdman stations. LRT service would connect the two stations through downtown. The LRT service would be provided by an extension of the North-South LRT service supplemented by additional LRT service shuttling between the two stations.

The North-South LRT service is planned to be introduced as a five minute frequency service operated with single vehicles. Each vehicle is assumed to have a design capacity of 145 people. Thus, the twelve vehicles per hour results in an hourly design capacity of 1,750 passengers per hour.

The overall maximum demand that would need to be accommodated in 2009 is 8,500 people. Subtracting 1,750 people being carried by the extended North-South service leaves 6,750 people to be accommodated on the supplemental LRT service. Assuming that the supplemental LRT services are operated with double vehicles (design capacity of 290), then 24 trips in the hour will be required to accommodate the demand. Combined with the North-South LRT service, this results in 36 trips in the hour, or a frequency of less than two minutes.

It is estimated that an LRT vehicle will be able to make the round trip between Bayview and Hurdman in 30 minutes. Thus, each double vehicle shuttle will be able to complete two trips each hour, and, therefore, 12 double vehicle sets will be required to provide the service. This is 24 vehicles. The extension of the North-South LRT service will also require additional vehicles, and an appropriate number of spare vehicles will be necessary. Considering all of these needs, it is assumed that 30 additional LRT vehicles will be required to provide the service between Bayview and Hurdman. At \$4 million to \$5 million per vehicle, the overall cost would be \$120 million to \$150 million.

The LRT shuttle will include track, power facilities, signalling, cross-overs and other necessary infrastructure to be built between the Mackenzie King Bridge and Hurdman Station. LRT station facilities would need to be constructed at Laurier, Campus and Lees Stations. The cost of this necessary infrastructure is estimated to be between \$30 million and \$35 million.

Hurdman and Bayview stations would need to be substantially expanded to accommodate large passenger movements between the LRT and bus services, and to provide waiting and boarding space for multiple buses. Experience in other cities has shown that the best way to accommodate movements of large numbers of people between transit modes is to separate the modes on different levels and provide vertical passenger movement. This reduces the amount of space required for the facility (compared with having everything on a single level), and substantially reduces the transfer distance and time required for customers. It is estimated that constructing such a facility for Hurdman and Bayview would require between \$20 million and \$25 million dollars at each location, or a total of between \$40 and \$50 million.

The key advantages of implementing this option include:

- It removes all of the buses from Albert and Slater Streets. Only frequent LRT vehicles operate on the streets.

- While the approved EA plan requires both bus and LRT stops on Albert and Slater (essentially a stop on each block), this option only requires the LRT stops every second block.
- Passenger waiting time, and as a result, platform and sidewalk congestion, would be minimized because passengers would always take the first LRT vehicle that arrived at their stop.

The key disadvantages of the option include:

- Large passenger transfer requirements at Hurdman and Bayview require large, expensive and complex stations. This uses land that is currently green space and/or has potential for transit friendly development.
- Loss of scheduling efficiency as a result of reduced interline opportunities. This likely means more buses and higher operating and capital costs.
- Trips such as those from the east to Tunney's Pasture would require at least two transfers to cross downtown.
- Increased transferring creates a risk of ridership loss.
- Cost of between \$190 million to \$235 million. Note that this cost does not include additional storage and maintenance yard facilities that may be required over and above those assumed as part of the North South Corridor LRT Project EA.
- LRT conversion of the Transitway or extension to Hurdman was not part of the North-South Corridor LRT Project EA Study, nor is it a proposal in the City's Transportation Master Plan.

### **Option B**

This option is similar to Option A in that it requires LRT facilities to be extended from the Mackenzie King Bridge to Hurdman Station. However, because the 90 series Transitway routes are supplementing the LRT service, it is not necessary to provide as many LRT trips.

This option assumes that the North-South LRT service is extended to Hurdman (1,750 person capacity) and that the 90 series routes are carrying 3,000 people. Thus, to accommodate the remainder of the 8,500 people that need to be carried in 2009, 3,750 people will be served by supplementary LRT service. This will require 13 double LRT vehicle trips in the hour. To provide these trips, the necessary spare vehicles, and provide the necessary extension to the North-South service will require 20 additional LRT vehicles at a cost of between \$80 million and \$100 million.

This option will require the same track, infrastructure and station facilities as in Option A. Thus \$30 million to \$35 million is required for track and stations, and between \$40 million and \$50 million is required for the Hurdman and Bayview stations.

The key advantages and disadvantages of this option are similar to those outlined in Option A, but with the following differences:

- There is a substantial reduction in buses on Albert and Slater Streets, especially during peak periods.
- Separate bus and LRT stops will be required, as in the approved EA.

- Waiting passengers will be split between bus and LRT platforms and will not wait long before boarding a vehicle to leave downtown.
- Large transfer stations still required.
- Still a loss of scheduling efficiency.
- Potential for two transfers to cross downtown is reduced.
- Still a risk of ridership loss, but not likely as high as with Option A.
- Cost of between \$150 million and \$185 million, not including potential yard requirements.
- Same EA and Transportation Master Plan issues as with Option A.

### **Option C**

This option would not involve an extension of LRT service, or any additional LRT facilities. Service between Bayview and Hurdman would be provided by the 90 series routes along with additional supplemental bus services. This is essentially the service arrangement that City staff is developing as part of its response to Council resolution (a). The report that City staff has prepared describing this scenario should be referred to for further information.

## **3.4 Conclusions**

Options A and B are not feasible solutions for implementation in 2009 for the following reasons:

- There is not \$150 million or more available for construction of an extension to Hurdman station along with the necessary station facilities as part of the LRT project budget.
- An individual environmental assessment of an extension of this magnitude would need to be completed and approved before design and construction could begin.
- Such an extension is contrary to the current City of Ottawa Official Plan and Transportation Master Plan.
- They carry a significant risk of ridership loss.
- They would result in less efficient, and as a result, more costly operation of the bus service.

As a result, Option C, the new service plan that City staff is developing and is reporting on as part of Council resolution (a) is the best alternative at this time.

## 4.0 Resolution C

This resolution states “That the LRT Project Team together with its consultants prepare the terms of reference for a study to determine the ways and means to construct a bus and/or LRT tunnel to accommodate longer term transit including interprovincial transit need in the city core and to present same to Council by September 30, 2005.”

A draft terms of reference that addresses all of the technical issues associated with examining a potential tunnel is provided in Appendix B. This document describes the necessary tasks to complete a three step study of a tunnel.

- The first step is a strategic planning study that would examine need and justification to confirm if a tunnel is the best grade separated option for Ottawa, identify what rapid transit services should use a tunnel, identify the technology(s) that should be accommodated in a tunnel, identify the triggers that would cause the full planning for a tunnel to be initiated, and discuss how transit services remaining at grade should continue to operate.
- The second step would take the results from step one and determine the best alignment and method for implementing a tunnel.
- The third step would take the preferred alignment and method from the second step and develop a full cost estimate using a work breakdown structure along with a potential planning, design, and construction schedule.

There are a number of considerations that should be taken into account when deciding when one or more of the above steps should be undertaken:

- The City and its partners are currently conducting a comprehensive survey of travel demand throughout the National Capital Region. The data collection will be completed in November 2005, and the initial primary results are scheduled to be ready in July 2006. Work on the planning study component of a tunnel study should not begin until this up to date travel demand information is available and its key impacts on transportation planning in Ottawa are understood.
- The East/West LRT Environmental Assessment is currently underway, and EA studies for the Carling and Rideau/Montreal corridor LRT projects are scheduled to begin in 2006. All three of these studies are expected to be completed in late 2007 or early 2008. The resulting plans will impact the overall transit demand in downtown, and will influence the number of buses and LRT vehicles within the downtown. This information is a key input to the planning component of a tunnel study.
- An Interprovincial Rapid Transit Study is scheduled to get underway in late 2005 or early 2006. This study will address how to move large numbers of people between Ottawa and Gatineau in the future, including an examination of how the service might be accommodated within the downtowns of each City. Clearly, information about a possible interprovincial rapid transit service will be an important input to the planning component of a tunnel study.

- The City of Ottawa will begin background work with a view to completing an update of the City's Official Plan by 2008. Part of this review will include an examination of the inputs and assumptions associated with the Transportation Master Plan, such as population and employment projections, policies, and modal split targets.

## 5.0 Resolution D

This resolution states “That the LRT Project Team provide all business in the Albert Slater streets corridors with budget estimates for the capital costs for streetscaping Albert and Slater streets and the operating costs of maintaining same.”

The complete cost estimate for the implementation of LRT on Albert and Slater Streets is provided in the following table.

**North-South LRT EA Cost Estimate – Bronson to Mackenzie King**

Item	Cost
Civil Works (clearing, grading, excavation, fencing, mob/demob)	\$6.0M - \$7.0M
Road Works (asphalt, granular, platforms, lighting) including Track and Roadbed	\$17.0M - \$19.0M
Downtown Improvements (landscaping, platforms, walkways)	\$16.0M - \$17.0M
Utility Relocations (water, Bell, Hydro, gas, sanitary)	\$45.0M - \$50.0M
Stations	\$5.0M - \$6.0M
Traction Power and Electrical	\$11.0M - \$12.0M
Signals and Communications	\$10.0M - \$11.0M
<b>Total (includes contingency, engineering and project management)</b>	<b>\$110M - \$122M</b>

This cost estimate was developed during as part of the North-South Corridor LRT Project EA Study. The streetscaping component is included in the downtown improvements line in the table. This line indicates that the capital cost of implementing landscaping/streetscaping, platform, and sidewalk treatments that are consistent with an urban design standard beyond what is normally expected is between \$16 million and \$17 million. This is the total for both Albert and Slater Streets from Bronson east to Elgin and the Mackenzie King Bridge from Elgin to the end of the LRT facility.

As part of the LRT procurement process, the bidding teams are being asked to propose improvements/enhancements over and above the design proposed during the EA. The estimated operating costs of the planned and potential improvements can not be estimated until the bidding teams have submitted their proposals.

## 6.0 Resolution E

This resolution states “That by September 30, 2005 the University of Ottawa including the Transitway Station be evaluated as a terminal point for the North-South Light Rail service.”

### 6.1 Background

The recommended plan of the North-South Corridor LRT Project EA study that was approved by Council on July 15 has the northern/eastern terminal location on the Mackenzie King Bridge adjacent to the Rideau Centre. The Rideau Centre was defined as the northern/eastern limit to the EA study, and as a result, investigation of rail infrastructure and stations east of the Mackenzie King Bridge was not part of the recently completed EA.

Due to the close proximity of the University of Ottawa to the Mackenzie King Bridge, and given the large potential transit market that the University population represents, Council requested that opportunities for extending the LRT facility east of the bridge to the University be investigated and evaluated.

### 6.2 Identification of Options

The following assumptions were made in developing alternatives that accommodated LRT service to the University of Ottawa:

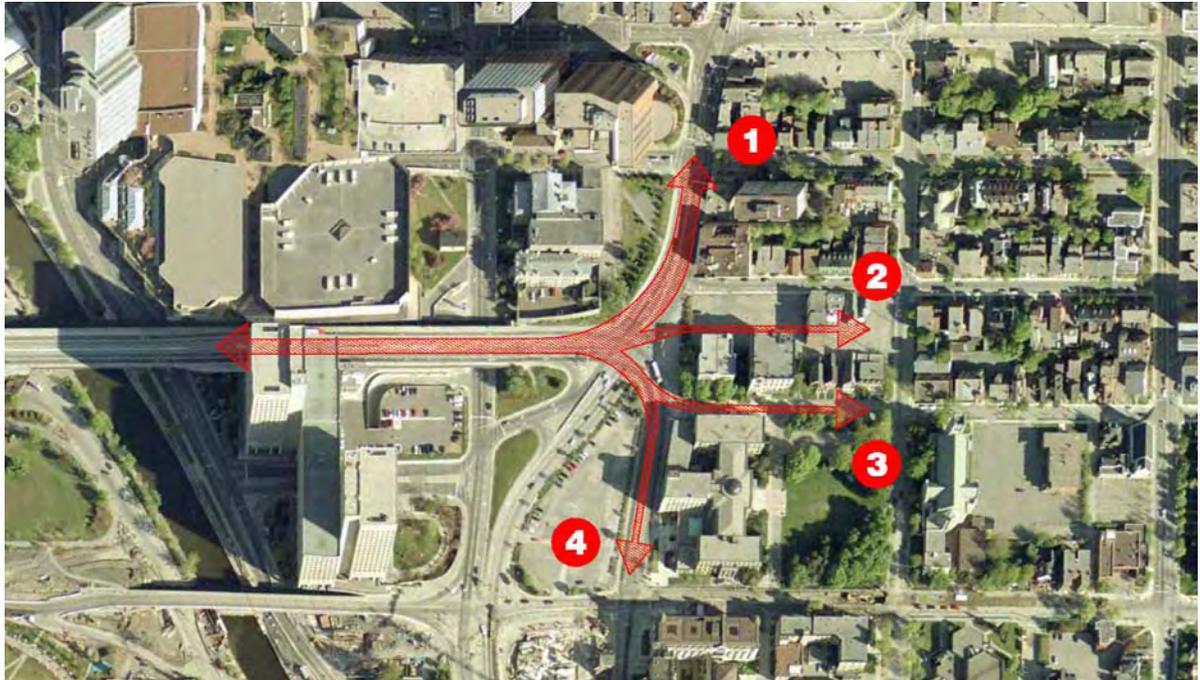
- An LRT station would be provided adjacent to or within University of Ottawa property, and would be well connected to the University’s current or planned primary pedestrian network;
- The space, design and infrastructure requirements necessary for an LRT station could be accommodated;
- A change of direction rail cross-over would be provided between the east end of the Mackenzie King Bridge and the University LRT station, and the cross-over on the Mackenzie King Bridge is removed;
- An LRT Station is maintained on the Mackenzie King Bridge to serve the Rideau Centre, Congress Centre and the Department of National Defence;
- The alternative would fit in with or complement current approved plans outlined in the City’s Official Plan and Transportation Master Plan;
- It would be possible from a construction and funding perspective to implement the alternative as part of the North-South Corridor LRT Project;
- The ability to maintain current transit and rapid transit services would not be compromised.

Four preliminary alternatives that satisfied these assumptions were developed. These are illustrated schematically in figure 6.1 and listed below:

- Alternative 1 – Waller Street, north of the Mackenzie King Bridge;

- Alternative 2 – Stewart Street, east of Waller Street;
- Alternative 3 – Seraphin Marion/Wilbrod Street, east of the Transitway;
- Alternative 4 – The Transitway in the vicinity of Laurier Station.

Figure 6.1 – University of Ottawa Alternatives



Each alternative was reviewed with University of Ottawa staff and is discussed in detail below.

## 6.3 Analysis of Options

### Option 1

In this alternative, the planned LRT service would be extended from the Mackenzie King Bridge onto Waller Street to the north. This routing is consistent with the City’s Transportation Master Plan and a connection to the proposed Rideau Street/Montreal Road LRT facility.

In order to provide a station that is reasonably close to the University of Ottawa, the station should be located as close to Stewart Street as possible. Unfortunately, the blocks between Stewart and Daly, Daly and Besserer, and Besserer and Rideau are not long enough to fit the required station length, or the required rail cross-over length. Thus, this alternative can not provide a station close to the University of Ottawa.

### Option 2

Using Stewart Street for the LRT was considered as an initial option. This would require the closure of Stewart Street to vehicular traffic in order to accommodate the two tracks, the change of direction cross-over, and passenger platforms. This would also result in the removal of the bicycle lane on Stewart and the loss of accesses to adjacent properties. Modifications to the Waller/Mackenzie King

Bridge intersection would be required in order to allow LRT vehicles to travel between the east end of the bridge and Stewart Street.

While the option of using Stewart Street for LRT is technically feasible, an alternative to this arrangement using the University of Ottawa parking lot located immediately south of Stewart Street was considered. With this alternative, the LRT service would cross Waller Street from the Mackenzie King Bridge and travel along the south edge of the parking lot. The change of direction cross-over would be immediately east of Waller in the western portion of the parking area while the station area would be positioned in the east end of the block, close to Cumberland Street. This would require the removal of some of the older office facilities that the University currently maintains on the south side of Stewart, close to Cumberland. These are lands that the University intends to redevelop at some point in the future. The station would also connect directly to the University's current pedestrian network. A preliminary meeting was held with University of Ottawa staff to discuss this option, and the University was open to further exploring this alternative with the City of Ottawa.

This alternative is compatible with a potential future eastern extension of the LRT

This alternative using University of Ottawa property is viable, and the opportunity for the City and University to jointly develop the concept should be considered further.

### **Option 3**

This alternative would see LRT service travel from the Mackenzie King Bridge, across the Transitway and onto Seraphin Marion (formerly Wilbrod Street). An LRT station and rail cross-over could be accommodated between the Transitway and Cumberland Street, and would be well connected with the University's pedestrian network. Even though these facilities could be accommodated, the University did not support this location because of the current quiet pedestrian nature of the street and the availability of potentially better alternatives.

The key challenge with this alternative is providing the rail infrastructure to connect Seraphin Marion with the bridge. It is not actually possible to connect the two using even minimum curve radii without requiring widening/modifications to the bridge over Nicholas Street and without seriously impacting the ability to maintain the truck ramp from Waller onto Nicholas. These impacts are significant enough that the alternative was not considered further.

### **Option 4**

In this alternative, LRT service would follow the same routing as Transitway buses traveling down the Southeast Transitway. Several potential locations for an LRT station along the Transitway were considered (note that potential locations south of Laurier Avenue would likely be outside the scope of what could be accommodated within the North-South Corridor LRT Project EA terms of reference, and a new EA study would likely have to be initiated if one of these locations were selected):

- North of Laurier, as part of the Laurier Transitway Station. Buses and LRT vehicles cannot share the same stop locations because of the different curb heights required. As a result, there is insufficient curb space on the Transitway north of Laurier to accommodate both the existing Transitway stops and a new curbside LRT stop in each direction. Consideration was given to providing an island LRT stop in the centre of the Transitway, however there is insufficient width between existing and about to be constructed buildings to accommodate

both the bus and LRT lanes and passenger facilities. Thus, north of Laurier is not a feasible location for an LRT stop and cross-over.

- Immediately south of Laurier. This area is constrained by the adjacent University building to the east, and the one way southbound road that provides access to the development to the west. There is insufficient width available to accommodate both bus operations and an LRT station in this area without severely hindering or eliminating one or more of the east sidewalk and access to the west development. Thus, immediately south of Laurier is not a feasible location for an LRT and cross-over.
- Further south in the University. It is not possible to provide a change of direction cross-over for LRT on the current Transitway alignment without seriously impacting and delaying bus operations. The only location off of the Transitway that could be considered for a separate LRT station and cross-over is a parking lot east of the Transitway, north of the Campus Station. Unfortunately, this lot is not large enough to accommodate the necessary infrastructure.
- Between the University and the Rideau River, along the Transitway. This area is constrained by the adjacent highway interchange, road patterns, Transitway profile and structures. As a result there is insufficient space or length of tangent to accommodate a station and cross-over, and maintain Transitway operations north of the Rideau River. Consideration was also given to providing a separate LRT station and cross-over somewhere south of Mann Avenue and east of the Transitway. It is not clear how this arrangement could be implemented without significant changes to the road patterns and development potential of this area.

Thus, there are no alternatives along the current Transitway corridor that can accommodate an LRT station and change of direction cross-over while maintaining Transitway operations.

## 6.4 Conclusion

The above analysis and discussion has demonstrated that the only viable alternative for providing an LRT Station and change of direction cross-over within the scope of the approved environmental assessment is option 2, on University of Ottawa lands south of Stewart Street. The cost of the additional track and station necessary to construct this option is \$5 million including engineering and project management costs, but excludes property.

## 7.0 Resolution F

This resolution states “That by September 30, 2005 the LRT Project Team evaluate options that Mackenzie King Bridge can accommodate vehicular traffic as well as LRT service.” The current planned arrangement on the bridge that has been approved by City of Ottawa Council provides for a curbside bus only lane and an adjacent LRT lane in each direction. General traffic is not accommodated and bicycles are partly accommodated. Sidewalks for pedestrians continue to be provided.

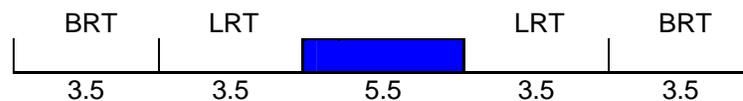
### 7.1 Identification of Options

Three primary scenarios for accommodating traffic on the bridge, along with both LRT and bus services have been considered:

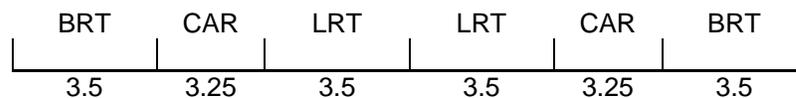
- Allowing general traffic to operate in either the bus or LRT lane;
- Providing bus lanes against the curb, vehicle lanes next to the bus lanes, and LRT lanes in the centre of the bridge; and
- Providing bus lanes against the curb, LRT lanes next to the bus lanes, and vehicle lanes in the centre of the bridge.

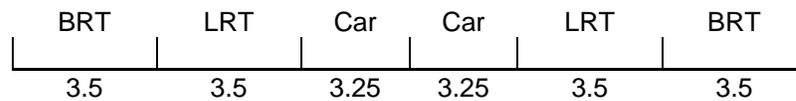
Figures 7.1, 7.2 and 7.3 schematically illustrate these potential cross sections.

**Figure 7.1 – Traffic Sharing Bus or LRT Lane**



**Figure 7.2 – Traffic Lanes between Bus and LRT Lanes**



**Figure 7.3 – Traffic Lanes in Centre of Bridge**


All three of these alternatives, along with any variations or sub-alternatives, are discussed in the following sections. For all of the options, low profile rails mounted flush with a raised pavement surface on the bridge are required.

## 7.2 Discussion of Options

### Option 1 – Traffic Operating in Bus or LRT Lanes

This option assumes that the plan for the bridge that has already been approved as part of the North-South LRT EA Study is maintained but general traffic is permitted to use either the LRT lanes in the centre of the bridge, or the bus lanes at the curb. Each of these options are discussed below.

#### Traffic Sharing the Bus Lane

In this option, traffic would share the curb lane with buses in both directions on the bridge. These bus lanes are expected to carry more buses per hour in each direction during the peak period than Albert and Slater Streets, and as a result, traffic would experience significant delays as these buses serve customers at the Mackenzie King Station. In addition, traffic would sometimes delay buses from serving the station stops, resulting in further congestion in the lane.

Entering the bridge from Slater Street will require traffic to merge into the bus lane at the same time as the LRT vehicles are leaving the Slater transit lane to go into the LRT lane on the bridge. This weaving movement cannot be safely accommodated without complex traffic signal arrangements that would be unconventional in their design and create delays for traffic, LRT and buses. The same LRT and traffic cross-over will need to occur travelling westbound from the bridge onto Albert Street, and will require equally unconventional, mode specific traffic signals.

As a result of the likely congestion and the difficult weaving movements, this option is not recommended for further consideration.

#### Traffic Sharing the LRT Lane

Congestion is unlikely to be in issue with this option. The LRT service will initially operate at a five minute frequency, and is planned to be as frequent as every three minutes. Combined with no more than 500 vehicles (the maximum volume in a single hour that the bridge currently experiences), the flow in these lanes will be much smoother than if traffic were sharing the bus lanes. Vehicles will still be delayed by LRT vehicles serving customers at their stops, and LRT vehicles may experience some delay due to vehicles as the crosswalk signal.

In order for this option to work, the change of direction rail cross-over planned on the bridge will have to be moved off of the bridge using the University of Ottawa LRT Station location described in Chapter 6.

Vehicles sharing the LRT lane will have easier merge movements at the west end of the bridge, compared with the full weave movements required if traffic were to share the bus lanes. Travelling eastbound from Slater, vehicles will move directly onto the bridge and LRT vehicles will merge over into the lane with the vehicles. This merge will need to be signalized, but will be much simpler and cause less delay than the full weave arrangement.

This option is a feasible option for further consideration.

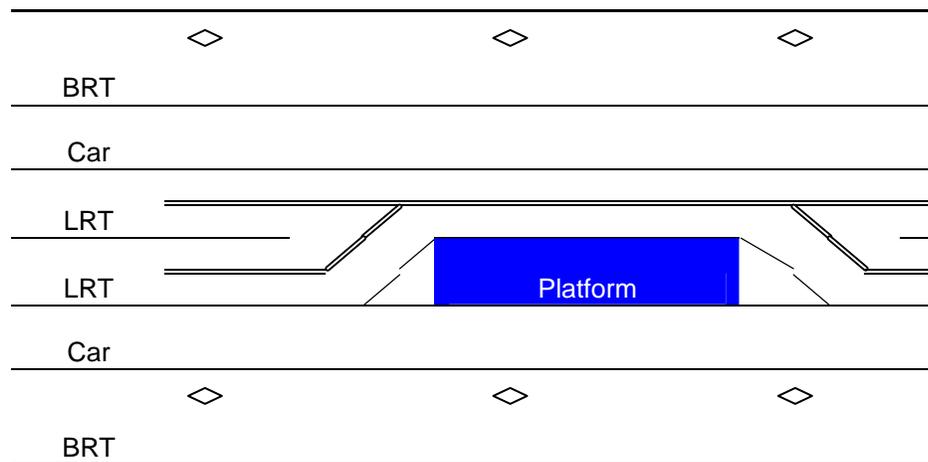
### **Option 2 – Vehicle Lanes Between Bus and LRT Lanes**

This arrangement requires six travel lanes, with the lane widths being 3.5 metres for bus and LRT lanes and 3.25 metres for the vehicle lanes. Thus, the required width is 20.5 metres between curbs. This compares with 18 metres between curbs over the canal and 19.5 metres adjacent to the Rideau Centre. Thus, to accommodate this option would require 0.5 metres to be removed from each sidewalk around the Rideau Centre and NDHQ, and 2.5 metres from a total of 8.26 metres of sidewalk over the canal (the equivalent of two equal sidewalks approximately 2.9 metres in width). If these sidewalk reductions are acceptable, then these options can be considered further. However, it is unlikely that this significant reduction in sidewalk space west of the Rideau Centre and over the Canal would be viewed favourably by a wide variety of interests.

This alternative would completely remove cycling lanes. Cyclists would be accommodated in the 3.25 metre wide vehicle lane, with no special provisions. In addition, the current median in the roadway would be removed, eliminating the current refuge for pedestrians crossing the bridge away from the signalised crossings. Maintaining the median would be possible, but at the expense of a further reduction in sidewalk space.

The scenario with both LRT lanes in the centre of the bridge does not provide any space to accommodate a station platform in the vicinity of the Rideau Centre. This is a fatal flaw, in that the LRT facility must be able to serve the Rideau Centre/NDHQ/Congress Centre complex.

To overcome this fatal flaw, consideration could be given to merging the two LRT lanes into one at the Rideau Centre Station area and providing a platform in the space formerly occupied by the other LRT lane. This is illustrated in Figure 7.4.

**Figure 7.4 – Single Track Platform Alternative**


There are a number of concerns with this arrangement:

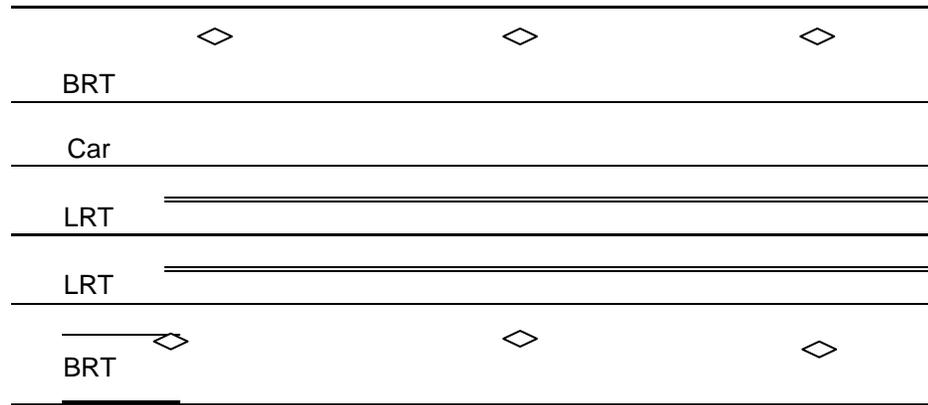
- The platform width available of 3.5 metres is too narrow, especially after a railing/barrier is installed at the back of the platform to protect waiting passengers from traffic in the adjacent vehicle lane. This would be especially true in the future when the LRT service is extended farther east.
- The single track at the platform would be a choke point in the future when LRT service is extended to the east.
- The single track at the platform would create an operating constraint at the end of the line (before extension to the east) – Only one vehicle could be served at a time, and an incoming vehicle would have to wait until the outgoing vehicle has departed before moving to the platform. This reduces service scheduling flexibility and restricts the ultimate frequency that can be operated.

Based on these concerns, this arrangement also appears to have at least one fatal flaw. Thus, the option of operating a curb bus lane, vehicle lane and centre LRT lane in each direction on the bridge is not feasible.

General traffic volumes are typically higher in the eastbound direction of the bridge. This brings to light a sub option to the one just described as not feasible. Operate an eastbound curb bus lane, vehicle lane and centre LRT lane, and a westbound shared bus/vehicle lane and centre LRT lane – a five lane cross-section. This is illustrated in Figure 7.5. This would require 3.5 metres for each of the LRT lanes, 3.5 metres for the eastbound bus lane, 3.25 metres for the eastbound car lane, and a recommended 4.25 metres for the shared lane. The extra width is recommended for the shared lane to accommodate bicycles, and provide space for vehicles to comfortably pass them. This results in an overall width of 18 metres, the same as over the canal today. Unfortunately, this arrangement does not leave sufficient space to accommodate an LRT station platform in the vicinity of the Rideau Centre. Even carving a metre out of each sidewalk leaves only a 3.5 metre wide platform (too narrow as discussed above, especially when the platform between the two tracks would be accommodating two directions of customers in the future), and carving a metre off of each sidewalk

would leave insufficient space, especially on the south side of the bridge. Thus, this five lane arrangement is also fatally flawed.

**Figure 7.5 – Eastbound Only Traffic Lane**



Therefore, neither option 2 nor any of its variations are feasible.

**Option 3 – Vehicle Lanes in the Centre of the Bridge**

In this option, a separate vehicle lane is provided in each direction in the centre of the bridge. Bicycles would share the vehicle lane. West of the Rideau Centre, a single transit lane shared by buses and LRT vehicles is provided – essentially the same operation that is planned for Albert and Slater Streets. Passenger platforms for the LRT service would be provided at each curb, immediately west of the pedestrian crosswalk at the Rideau Centre. Buses would use the same stop areas that they currently use. LRT vehicles would stop in the transit lane to serve their platform while buses would pull into a separate lane to serve their platform. The separate bus lane would continue east to the Waller intersection. Similar arrangements would be provided in the westbound direction, with separate bus, LRT and vehicle lanes east of the pedestrian crosswalk and the buses and LRT service combining into a single lane west of the crosswalk.

The six lane cross-section east of the cross-walk would reduce the amount is bus platform and sidewalk space. East of the bus stop areas, new cantilever sections would need to be added to the bridge in order to provide sufficient sidewalk space.

This option requires the change of direction rail cross-over to be provided off of the bridge, using the University of Ottawa arrangement described in the previous chapter.

Thus, this option is a feasible option.

## 7.3 Analysis of Options

The previous section identified two feasible options for accommodating general vehicle traffic on the bridge, along with bus and LRT service. These options are illustrated in Appendix C, and listed below:

- The approved EA plan, but with vehicles sharing the LRT lanes;
- Vehicles using their own lanes with buses and LRT either sharing or in separate lanes, depending on the location on the bridge.

The criteria used to compare these options with the approved EA plan were:

- Pedestrians and Passengers – amount of sidewalk space, amount of transit platform space, transit platform locations, access to transit platforms, median provision
- Cyclists – availability of separate cycling facilities, accommodation for cyclists
- Transit Operations – exclusivity of transit facilities, potential delays to buses and LRT, operations around stops, accommodation of LRT change of direction
- Traffic Operations – accommodation for vehicles, vehicle congestion and delay impacts, turn lane and access arrangements at each end of bridge, potential for violation, truck route impacts
- Property and Business – accommodation of access links for businesses
- Cost – capital and operating/maintenance cost impacts

Other comparison criteria such as impacts on the natural environment, impacts on ground water and a wide variety of other physical, social and environmental impacts were not used for comparison because they would be the same for all three of the options.

Appendix D contains a table summarizing the analysis of the three options using the comparison criteria described above.

## 7.4 Evaluation of Options

The evaluation of the options was completed using the following steps:

- The analysis table provided in Appendix D was reviewed in detail by a study team consisting of City of Ottawa staff from Traffic and Parking Operations, Transit Services, Infrastructure Planning, and the Light Rail Project Office, as well as staff from McCormick Rankin Corporation.
- The study team evaluated each of the options by identifying which option was the best one from the perspective of each of the comparison criteria, and then providing a relative ranking for each of the other options. Each individual member of the study team completed this evaluation step and the results were aggregated into an overall evaluation.
- The study team weighted the comparison criteria in order to provide perspective on which of the criteria might be more important than others. Each

individual member of the study team completed this evaluation step and the results were aggregated into an overall weighting.

- Members of the Albert/Slater business community were asked to provide their weighting of the comparison criteria, in order to provide a sensitivity test to the results of the study team. The individual weightings received from the business community were aggregated into an overall business community weighting.

The results of this process determined that the option of vehicles sharing the LRT lane was the best overall option. Both the overall study team weighting and the business community weighting confirmed this.

## 7.5 Conclusion

The approved recommended plan for the North-South Corridor LRT Project EA should incorporate the above-noted feature to allow traffic to use the Mackenzie King Bridge by sharing the LRT lane. This requires a rail change of direction cross-over and station to be situated east of the Mackenzie King Bridge, likely adjacent to the proposed University of Ottawa LRT Station.

## 8.0 Appendix A

This appendix contains tables that provide background information on Wellington Street, Queen Street and Laurier Avenue. The first tables summarize curb side use on Queen and Laurier (There are no parking, loading or taxi zones on Wellington). The second set of tables provides peak hour travel information for all three of the streets.



**Peak Hour Traffic on Wellington, Queen & Laurier**

		Bay to Lyon		Lyon to Kent		Kent to Bank		Bank to O'Connor		O'Connor to Metcalfe		Metcalfe to Elgin		Elgin W-E	
		←	→	←	→	←	→	←	→	←	→	←	→	←	→
<b>Wellington</b>	AM	841	1862	1017	921	576	943	640	975	1186	645	909	661	1702	560
	PM	1579	1207	1586	543	800	684	663	858	917	660	851	895	1335	737

		Bronson to Bay		Bay to Lyon		Lyon to Kent		Kent to Bank		Bank to O'Connor		O'Connor to Metcalfe		Metcalfe to Elgin	
		←	→	←	→	←	→	←	→	←	→	←	→	←	→
<b>Queen</b>	AM	149	439	206	358	448	547	641	732	673	549	408	315	275	262
	PM	266	288	540	207	244	397	610	544	437	564	557	497	572	563

		Bronson to Bay		Bay to Lyon		Lyon to Kent		Kent to Bank		Bank to O'Connor		O'Connor to Metcalfe		Metcalfe to Elgin	
		←	→	←	→	←	→	←	→	←	→	←	→	←	→
<b>Laurier</b>	AM	244	259	275	213	299	413	515	605	640	575	420	378	401	518
	PM	261	225	448	231	289	341	413	486	494	494	451	490	627	1037

<b>AM</b>	<b>07:30 - 08:30</b>
<b>PM</b>	<b>16:00 - 17:00</b>

## 9.0 Appendix B

This appendix provides the key technical material that needs to be included in a terms of reference for a tunnel study. The following material forms the core of this terms of reference.

### Terms of Reference

#### Ottawa Downtown Underground Transit Facility Study

##### Background

Ottawa's Central Business District currently enjoys more than a 50% transit mode share for 80,000 jobs during the peak periods. This has been achieved by the operation of innovative and extensive bus services by both the City of Ottawa's transit service (OC Transpo) and the Société de Transport de l'Outaouais (STO, the transit service provider in the neighbouring City of Gatineau). Ottawa's transit service is enhanced by the Transitway, the most comprehensive bus rapid transit system in North America, and the O-Train, a diesel powered rail service that was introduced in 2001, which connects the Southeast and West Transitways with Carleton University.

The City of Ottawa Official Plan anticipates that employment in the Central Business District will grow to 120,000 jobs and that the transit modal share will increase to 80%. To accommodate this and other growth in the City, the Official Plan and the Transportation Master Plan identify a network of rapid transit facilities that includes extensions and improvements to the Transitway system and the implementation of a number of LRT corridors throughout the urban area. The first LRT corridor, an expansion of the O-Train using electric powered technology and extended to downtown in the north and Riverside South and Barrhaven in the south, is expected to begin operation in late 2009. In addition, STO is currently developing a bus rapid transit service that will serve downtown Ottawa.

As proposed in the TMP, it is expected that public transit travel demands will be accommodated by a combination of Bus Rapid Transit and Light Rail Transit operating at street level for the foreseeable future. However, beyond the present planning period it is expected that transit demand to and from the downtown will continue to grow. As a result, it will become increasingly difficult to accommodate all of the bus and light rail vehicles on the downtown streets. It will be necessary to construct a facility which will grade separate the BRT and/or LRT service (and/or possibly some other form of rapid transit) from the general traffic.

Previous studies by the former Region of Ottawa-Carleton examined various methods for grade separating transit services in downtown Ottawa and determined that an underground alternative was more appropriate than an above-grade alternative.

The purpose of this study is to examine the need for a tunnel, the purpose of the tunnel, the various alternative tunnel configurations, the timing of construction, the type of facility required, and all of the implications and issues associated with placing some transit services underground in downtown Ottawa.

### Scope of Work

The study is focused on answering three key questions:

- What is the need and justification for, and likely use of a tunnel;
- Identifying the most likely alternative and route for accommodating rapid transit services underground;
- Costing the preferred alternative and describing the issues associated with implementing it.

### Project Tasks

#### Task Group 1 – Need, Justification & Use of a Tunnel

This task group examines the need and justification for a tunnel, and identifies the rapid transit services which are most appropriate for location in an underground facility. It examines the problems, opportunities, and broader implications associated with a tunnel. It is expected that answering these questions and issues will include, but not be limited to the following subtasks:

- Identifying current and future transit passenger demands to, from and within the downtown.
- Identifying all existing and possible future transit services that will enter and exit downtown Ottawa and accommodate all of the identified transit passenger demands. Estimate the likely peak hour bus, LRT and other transit vehicle volumes associated with each of these transit services. Transit services will include OC Transpo and STO bus services, privately operated commuter bus services, current and planned rapid transit services outlined in the Ottawa Official Plan/Transportation Master Plan, and potential but currently undefined services such as an interprovincial rapid transit service.
- Examining the downtown street network to identify the practical capacity for transit and rapid transit services on the streets, as well as accommodating all of the necessary traffic flow, turn movements and property accesses.
- Developing appropriate indicators that can be used to identify when planning and design of a
- Identifying likely rapid transit technologies that could be used to accommodate the future transit demands, and identify which ones may need to be accommodated in a future grade-separated facility.
- Reviewing and updating the results of previous work that concluded that an underground transit facility was the best approach for grade separating transit services.
- Developing appropriate indicators that can be used to identify when planning and design of a tunnel might need to begin. These triggers could include a combination of City population, central business district employment levels, central business district transit demand, Albert/Slater transit travel times, and downtown traffic/turning movement levels.
- Developing and documenting up to three viable transit service scenarios that accommodate buses and/or LRT vehicles or some other rapid transit facility such as a subway in an underground facility. Each scenario must also include

a detailed description of appearance, facilities and operation of the surface streets.

- Analysing and evaluating the viable transit service scenarios and comparing them to the existing/planned situation using appropriate criteria and measures that include but are not limited to economic costs and benefits, transit operations, traffic operations, pedestrian and passenger access, cost, constructability, and other physical, social and economic environment impacts.
- Recommending the preferred combination of transit services (bus, LRT, subway) that should be included in an underground facility.

#### Task Group 2 – How Do We Go Underground

The purpose of this task group is to identify the most likely alternative and route for accommodating the preferred transit services (from task group 1) underground. To accomplish this, it is expected that work will include, but not be limited to the following subtasks:

- Identifying and documenting appropriate design requirements and criteria. This will include, but not be limited to the following:
  - All appropriate and necessary codes and standards that must be followed;
  - Geometric requirements;
  - Station and platform requirements;
  - Electrical, mechanical, ventilation, fire suppression requirements.
- Obtaining and summarizing information and plans on underground constraints within the downtown, including underground utilities, building and bridge foundations, and the Rideau Canal.
- Identifying opportunities for integrating access to and from an underground facility with existing and potential development.
- Developing and documenting up to three feasible alternative alignments for an underground transit facility. These may be shallow (cut and cover) and/or deep, and will be fully described in terms of portal locations, passenger access locations, station locations, geometry, and a conceptual level comparative cost.
- Analysing and evaluating the alternative alignments using appropriate criteria and measures. Appropriate criteria includes but is not limited to impacts on pedestrians, cyclists, transit users, transit operations, traffic operations, utilities, businesses, and property owners, as well as the typical range of key physical, social, environmental, construction and cost impacts commonly considered in environmental assessment studies.
- Recommending the preferred underground alignment.

#### Task Group 3 – Refining the Underground Alternative

This task group takes the recommended underground alignment from task group 2 and develops it further in order to provide a more detailed cost estimate as well as a description of how the facility might be constructed, and the studies and approvals that will be necessary in order to proceed with construction. The following subtasks are expected to be completed:

- Develop the preferred conceptual plan from task group 2 to a functional design standard.
- Develop a facility cost estimate based on the functional plan, using a work breakdown structure approach.
- Identify potential funding opportunities for the facility, including existing sources of municipal, provincial and federal funds, as well as private sector partnership opportunities for the overall facility implementation and management, and individual joint development integration opportunities.
- Document the likely method and schedule for constructing and commissioning the underground facility, including a description of on-street detours and other impacts on land use and business.
- Document and explain the purpose of necessary studies, processes and approvals that would be necessary in order to take the underground facility from the functional stage developed as part of this task group to be ready for construction. This task should include a realistic schedule for completing the necessary studies and processes, and obtaining the required approvals.

### **Consultation**

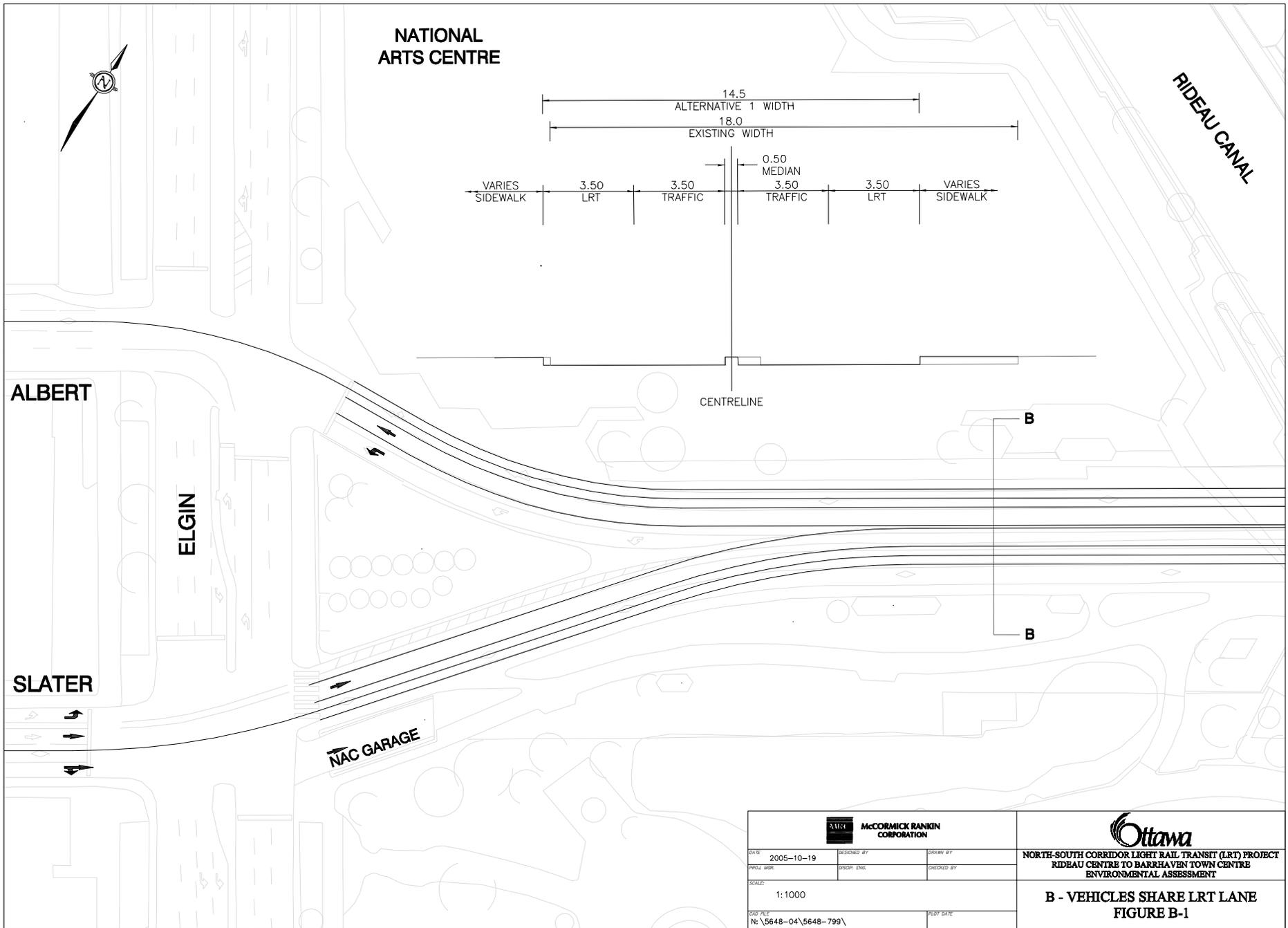
Due to the complex nature of this project, and the potential impacts on a large number of stakeholders, a consultation program will be required. The consultant should propose an appropriate program of public consultation group meetings, agency consultation group meetings and public open house meetings that provide for information exchange and input at key points in the study. The consultant should identify the individuals, groups and agencies that it recommends should be included in the consultation groups.

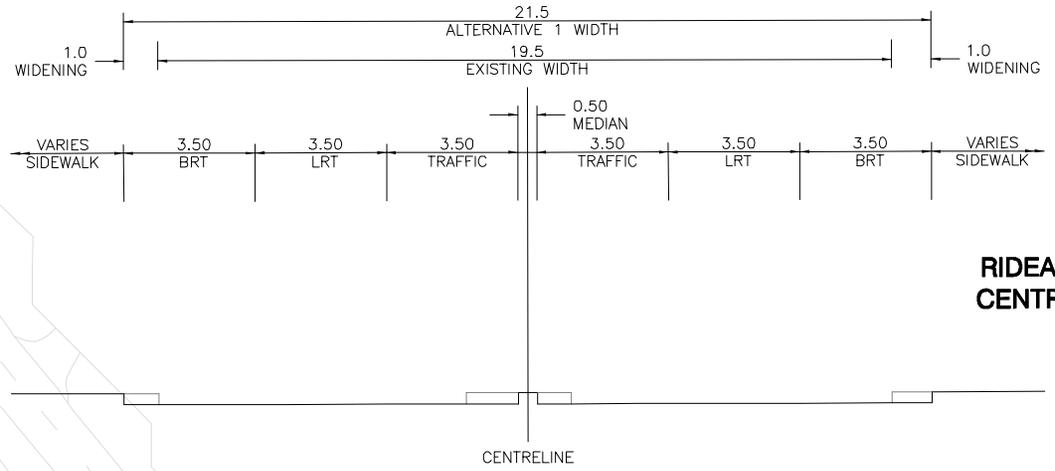
### **Study Duration**

It is expected that the study will be completed within 18 to 24 months following award to a consulting team.

## 10.0 Appendix C

This appendix contains drawings that illustrate the two viable options for accommodating traffic on the Mackenzie King Bridge, along with the bus and LRT services. Four plates illustrating alternative B and four plates illustrating alternative C are provided.





RIDEAU CANAL

RIDEAU CENTRE

CONGRESS CENTRE

BRT & LRT 3.5  
 CAR 3.5  
 CAR 3.5  
 BRT & LRT 3.5

A

5

55m BRT PLATFORM

A

DEPARTMENT OF NATIONAL DEFENCE

			<p><b>NORTH-SOUTH CORRIDOR LIGHT RAIL TRANSIT (LRT) PROJECT</b>          RIDEAU CENTRE TO BARRHAVEN TOWN CENTRE          ENVIRONMENTAL ASSESSMENT</p> <p><b>B - VEHICLES SHARE LRT LANE</b>  <b>FIGURE B-2</b></p>
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RIDEAU CENTRE

NICHOLAS

ARTS COURT

OTTAWA JAIL HOSTEL

Parking Lot

55m BRT PLATFORM

BRT 3.5  
LRT 3.5  
CAR 3.5  
CAR 3.5  
LRT 3.5  
BRT 3.5

55m BRT PLATFORM

DEPARTMENT OF NATIONAL DEFENCE

Parking Lot



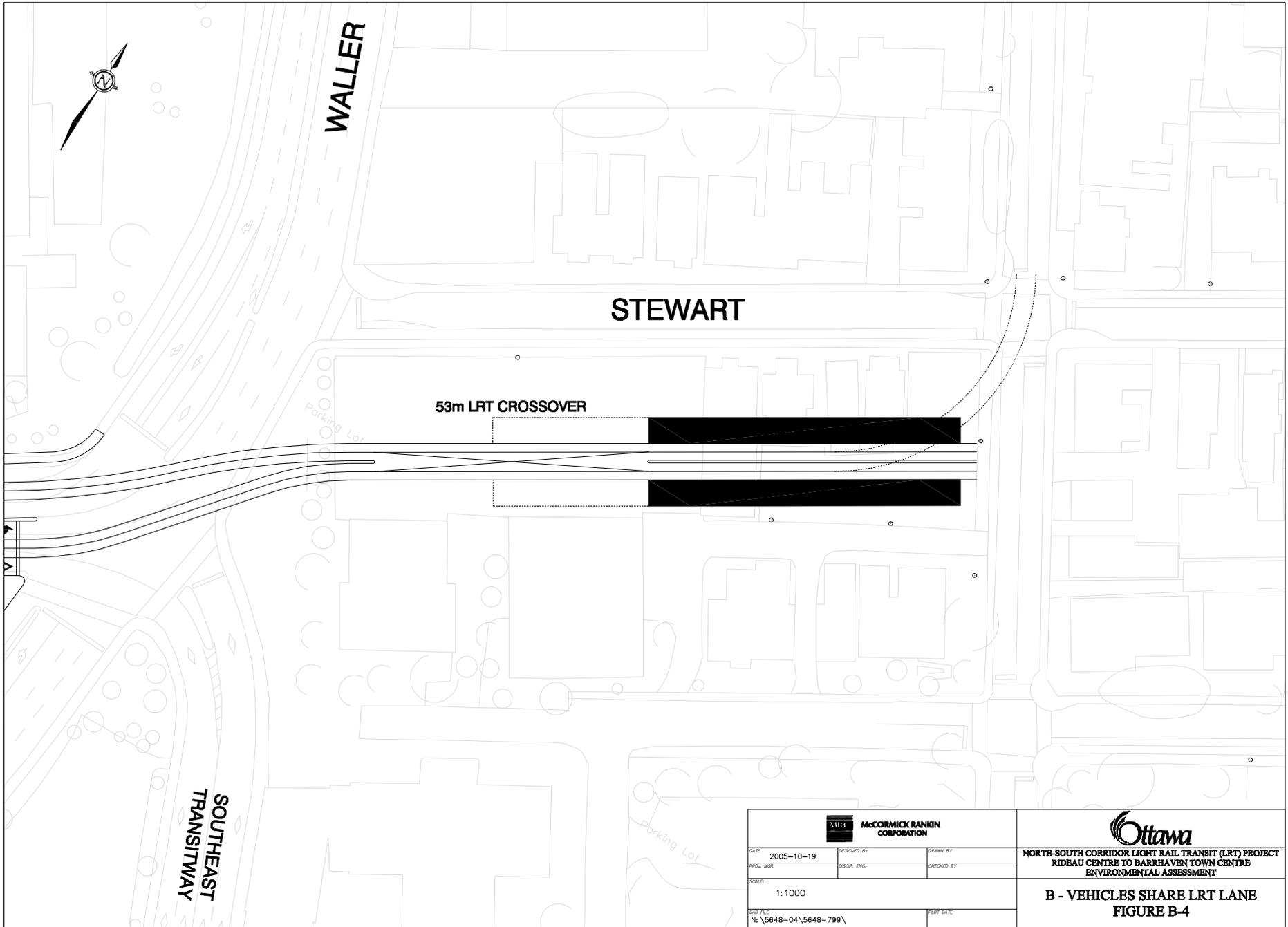
McCORMICK RANKIN CORPORATION

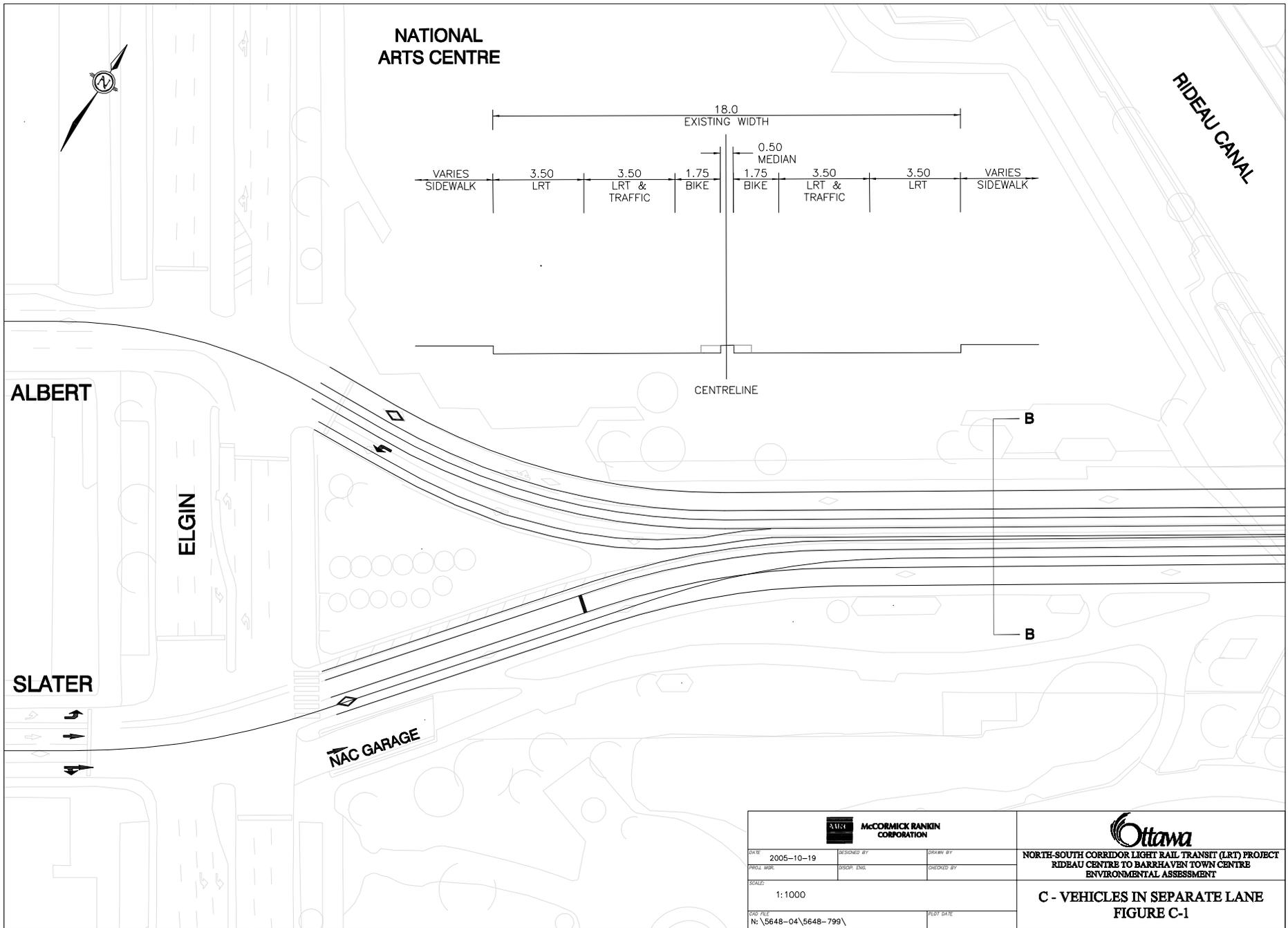
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NORTH-SOUTH CORRIDOR LIGHT RAIL TRANSIT (LRT) PROJECT  
RIDEAU CENTRE TO BARRHAVEN TOWN CENTRE  
ENVIRONMENTAL ASSESSMENT

B - VEHICLES SHARE LRT LANE  
FIGURE B-3



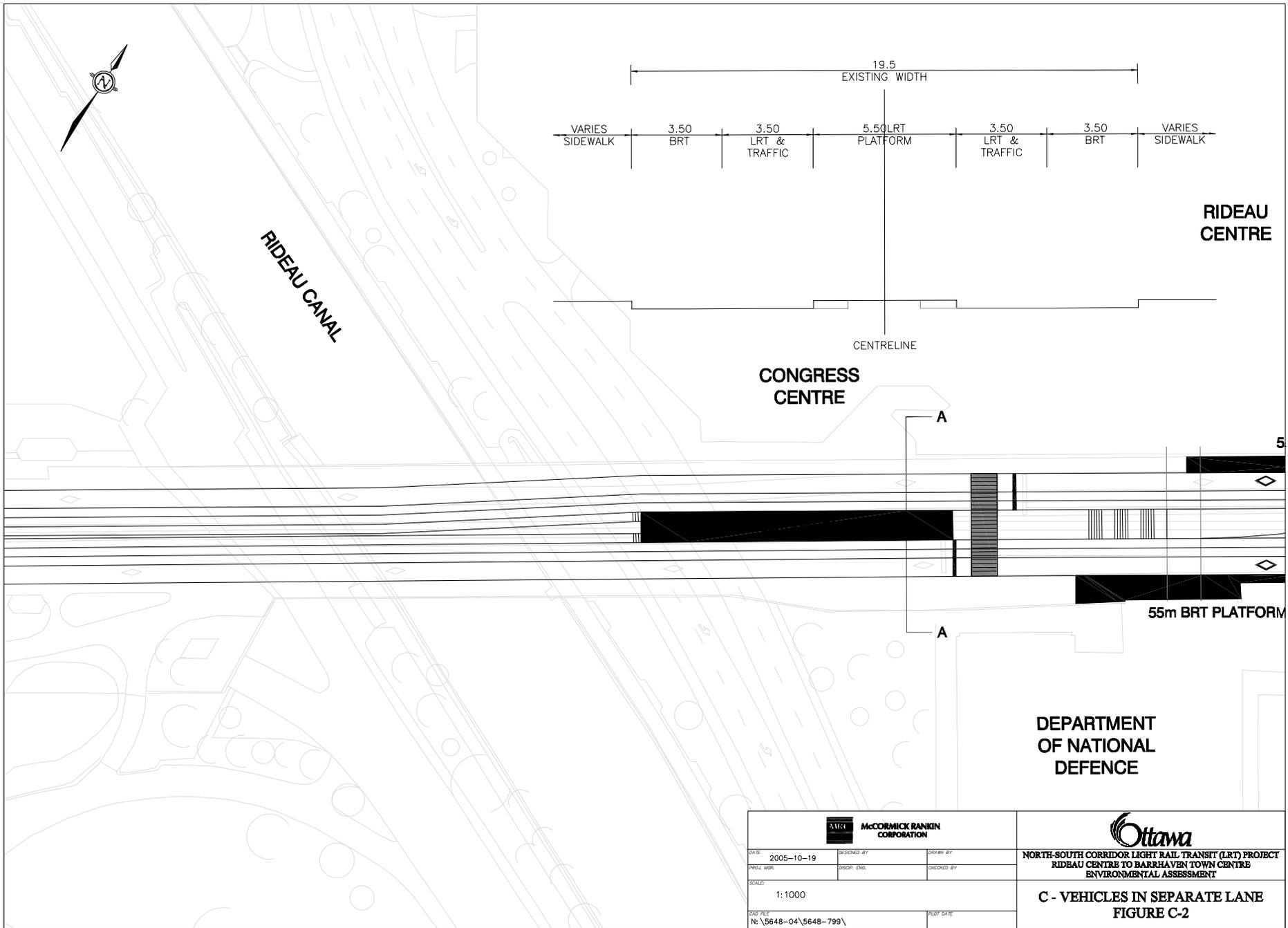


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**NORTH-SOUTH CORRIDOR LIGHT RAIL TRANSIT (LRT) PROJECT  
RIDEAU CENTRE TO BARRHAVEN TOWN CENTRE  
ENVIRONMENTAL ASSESSMENT**

**C - VEHICLES IN SEPARATE LANE  
FIGURE C-1**





RIDEAU CENTRE

NICHOLAS

ARTS COURT

OTTAWA JAIL HOSTEL

Parking Lot

55m BRT PLATFORM

BRT ONLY 3.5  
LRT & CAR 3.5

LRT & CAR 3.5  
BRT ONLY 3.5

55m BRT PLATFORM

DEPARTMENT OF NATIONAL DEFENCE

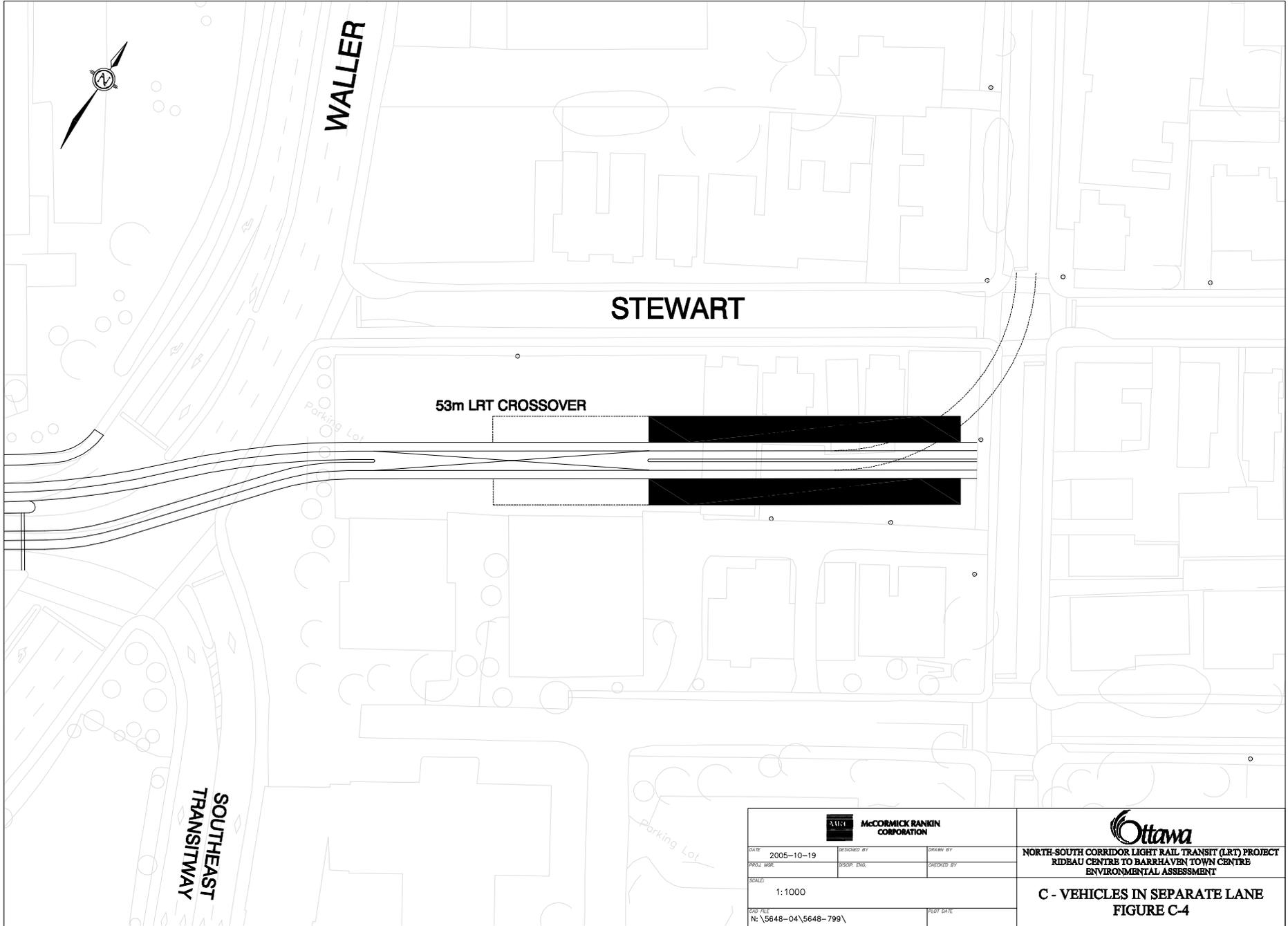
Parking Lot



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**NORTH-SOUTH CORRIDOR LIGHT RAIL TRANSIT (LRT) PROJECT**  
**RIDEAU CENTRE TO BARRHAVEN TOWN CENTRE**  
**ENVIRONMENTAL ASSESSMENT**

**C - VEHICLES IN SEPARATE LANE**  
**FIGURE C-3**



WALLER

STEWART

53m LRT CROSSOVER

Parking Lot

SOUTHEAST  
TRANSITWAY

Parking Lot

 <b>McCORMICK RANKIN CORPORATION</b>		
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**NORTH-SOUTH CORRIDOR LIGHT RAIL TRANSIT (LRT) PROJECT**  
**RIDEAU CENTRE TO BARRHAVEN TOWN CENTRE**  
**ENVIRONMENTAL ASSESSMENT**

**C - VEHICLES IN SEPARATE LANE**  
**FIGURE C-4**

## 11.0 Appendix D

This appendix contains the analysis table comparing the two viable options for introducing traffic onto the Mackenzie King Bridge while maintaining LRT and bus service with the approved EA alternative.

## Mackenzie King Bridge Alternatives Analysis

Factor	Alternative A - Approved EA Alternative Separate Bus & LRT Lanes, No Traffic on Bridge	Alternative B Vehicles Share LRT Lane, Separate Bus Lane	Alternative C - Vehicles in Own Lane, Shared Bus & LRT Lane West of Crosswalk, Separate Lanes East
Pedestrians & Passengers	<ul style="list-style-type: none"> <li>Maintains current sidewalk space across full length of bridge</li> <li>Maintains existing bus stop and shelter areas</li> <li>Access to island LRT platform requires all passengers to use underpass or at grade pedestrian crossing for both directions of their trip</li> <li>LRT vehicles can wait at platform, allowing passengers to wait on the vehicles instead of platforms</li> <li>LRT platform located east of current crosswalk requires additional eastern crosswalk. Flexibility to provide alternate platform location west of current crosswalk – this only requires one crosswalk</li> <li>Median pedestrian refuge maintained away from station area</li> </ul>	<ul style="list-style-type: none"> <li>Maintains current sidewalk space across full length of bridge</li> <li>Maintains existing bus stop and shelter areas</li> <li>Access to island LRT platform requires all passengers to use underpass or at grade pedestrian crossing for both directions of their trip</li> <li>LRT vehicles cannot wait at platform – passengers must wait for passing vehicles</li> <li>Requires LRT island platform to be located west of current crosswalk</li> <li>Median pedestrian refuge maintained away from station area</li> </ul>	<ul style="list-style-type: none"> <li>Reduces sidewalk/bus platform space east of current crosswalk by 1 metre on each side – east of DND &amp; Rideau Centre requires cantilever sidewalk extension in order to continue to provide viable sidewalks. Less than desirable amount of bus platform space remains on south side – congestion will hinder through pedestrians</li> <li>Maintains existing bus stop and shelter areas. LRT platforms located west of crosswalk (beside Congress Centre on north side and on existing widened sidewalk space on south side)</li> <li>Passengers use pedestrian crossing or underpass for one direction of their trip</li> <li>LRT vehicles cannot wait at platform – passengers must wait for passing vehicles</li> <li>LRT platforms on curb – no island platform</li> <li>Not possible to maintain median pedestrian refuge</li> </ul>
Cyclists	<ul style="list-style-type: none"> <li>Existing median cycling lanes could be maintained east &amp; west of crosswalks with east LRT platform location, but are discontinuous at LRT platform – effectively eliminates cycling through traffic and only provides bike access to DND &amp; Rideau Centre complexes. Not a suitable link in the cycling network</li> <li>West LRT platform location eliminates median cycling lanes.</li> <li>Bicycles can not be accommodated in LRT or bus lanes</li> </ul>	<ul style="list-style-type: none"> <li>Existing median cycling lanes could be maintained, but are discontinuous – effectively eliminates cycling through traffic and only provides bike access to DND &amp; Rideau Centre complexes – only possible if island LRT platform is designed to accommodate bicycles being walked through the platform. Not a suitable link in the cycling network.</li> <li>Bicycles can not be accommodated in shared LRT/vehicle lane due to rails or bus lane due to high bus volumes</li> </ul>	<ul style="list-style-type: none"> <li>Exclusive cycling facilities removed</li> <li>Cyclists can share separate vehicle lanes on bridge, but lanes are not wide enough for cars and trucks to pass vehicles. While cycling would not be prohibited, link would not be part of cycling network</li> </ul>
Transit Operations	<ul style="list-style-type: none"> <li>Separate bus and LRT lanes, no conflicts with traffic</li> <li>Separate stop locations so the two modes do not interfere with each other. Potential for right turning traffic from Slater onto Elgin could delay transit vehicles</li> <li>LRT change of direction crossover located on bridge, immediately west of platform</li> </ul>	<ul style="list-style-type: none"> <li>Bus lane operation should be similar to Alternative A, but with potential conflict from vehicles using bus lane to bypass LRT vehicles</li> <li>LRT vehicles could be delayed by vehicles at each end of bridge, and by vehicles queued at crosswalk signal. Potential delay to buses by cars entering bus lane to bypass stopped LRT vehicles, potentially impacting bus stop operation and capacity</li> <li>LRT change of direction crossover required to be located east of Waller Street – may require additional vehicle for operation to maintain frequency</li> </ul>	<ul style="list-style-type: none"> <li>Shared bus &amp; LRT lane west of current crosswalk, separate lanes east of crosswalk</li> <li>LRT stops located west of crosswalk – will delay buses in both directions. Westbound bus bay does not hinder LRT operations. Buses queued to enter eastbound bus bay could delay LRT from each its stop, and LRT progress could be delayed by bus loading in tapered entrance to bus bay. Shouldn't be any vehicle conflicts with buses or LRT vehicles</li> <li>LRT change of direction crossover required to be located east of Waller Street – may require additional vehicle for operation to maintain frequency</li> </ul>

Factor	Alternative A - Approved EA Alternative Separate Bus & LRT Lanes, No Traffic on Bridge	Alternative B Vehicles Share LRT Lane, Separate Bus Lane	Alternative C - Vehicles in Own Lane, Shared Bus & LRT Lane West of Crosswalk, Separate Lanes East
Traffic Operations	<ul style="list-style-type: none"> <li>Bridge closed to vehicles in both directions</li> <li>Intersections on alternate routes are at capacity, diverted traffic will result in increased delays. Likely that some vehicles will find other alternative routes, not make trip, or use different mode</li> <li>Truck route disrupted – discontinuity connecting downtown with Rideau Street</li> <li>Link removed from vehicle network – potential impacts when Laurier Bridge is closed for events</li> </ul>	<ul style="list-style-type: none"> <li>Vehicles share centre lane of bridge with LRT in each direction</li> <li>No significant change in congestion along alternative routes, although vehicular capacity of bridge may be less than existing</li> <li>Left turn lanes required for exit at each end of bridge. Must move island LRT platform to west of crosswalk to provide sufficient storage for eastbound to northbound left turning vehicles at Waller. May not be sufficient capacity in available space</li> <li>Eastbound ramp onto Nicholas should be able to remain open</li> <li>Unconventional merge of vehicles and LRT required eastbound near Elgin requires signals, and results in additional delays, and conflicts</li> <li>Some vehicles (about 20%) may be delayed by LRT at island platform</li> <li>Easy temptation for vehicles to enter bus lane to travel around stopped LRT – increases vehicle conflicts</li> <li>LRT platform height may make car drivers operate more to the right in the lane – closer to buses and potential sideswipe conflicts</li> <li>Truck route maintained</li> <li>Link maintained in vehicle network</li> </ul>	<ul style="list-style-type: none"> <li>Vehicles operate exclusively in each direction in centre lane</li> <li>No significant change in congestion along alternative routes, although vehicular capacity of bridge may be less than existing</li> <li>Eastbound centre lane becomes left turn lane. Westbound left and through lanes should be separate</li> <li>May have to close eastbound ramp onto Nicholas</li> <li>Conventional signals and movements at Elgin/Slater, and across bridge. Conventional operations creates the safest arrangement.</li> <li>No delays to vehicles</li> <li>No need or temptation for vehicles to use transit lanes</li> <li>Median fence on narrow median may make car drivers operate more to the right in the lane – closer to buses and LRT vehicles and potential sideswipe conflicts</li> <li>Truck route maintained</li> <li>Link maintained in vehicle network</li> </ul>
Property & Business	<ul style="list-style-type: none"> <li>Business access routes between Nicholas Street (and most direct Queensway access) and Albert/Slater corridor is cut off – alternate routes include Metcalfe, O'Connor, Bronson direct to Queensway or use Laurier to access Nicholas</li> </ul>	<ul style="list-style-type: none"> <li>Business access route maintained</li> </ul>	<ul style="list-style-type: none"> <li>Business access route maintained</li> </ul>
Cost	<ul style="list-style-type: none"> <li>Base Cost</li> </ul>	<ul style="list-style-type: none"> <li>Base Capital Cost increased due to need to extend tracks and station to east of Waller Street, additional traffic signal requirements at each end of bridge, left turn lanes at bridge ends, and potential for additional vehicle</li> <li>Slight additional O&amp; M cost for additional traffic signals, additional length of track, possible additional vehicle</li> </ul>	<ul style="list-style-type: none"> <li>Base Cost by same as Alternative B plus additional cost of cantilevered sidewalk construction on both sides of Bridge east of DND and Rideau Centre and additional shelter space due to two LRT platforms on bridge</li> <li>Same additional O&amp; M costs as Alternative B plus additional shelter maintenance cost, and winter and road base maintenance for two extra lanes on eastern portion of bridge</li> </ul>



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