MEMORANDUM

To: Kevin Neatt, Clayton Developments Limited

From: Michael MacDonald, Harbourside Transportation Consultants
Kalle Hakala, Alta Planning + Design, Canada - Inc

Date: June 07, 2021

Re: Kearney Lake Road Interchange Design Recommendations

Introduction

Proposed Development

There are plans to develop the area known as Bedford West Sub Area 10 in Bedford, Nova Scotia. The area is located on Kearney Lake Road west immediately west of the Highway 102 and Kearney Lake Road interchange[1].

The proposed development includes higher density residential, neighbourhood type commercial and institutional land uses. A total of 1,136 residential dwelling units, 15,000 square feet of commercial and 16,000 square feet of recreational community centre are proposed for Bedford West Sub Area 10.

The proposed commercial development will be located in two areas: approximately 5,000 square feet of commercial development will be located on the southeast lands on the property immediately west of the Kearney Lake Road and Highway 102 interchange, the remaining 10,000 square feet will be located on the northwest lands west of Hamshaw Drive. Full build out the development is expected by 2031.

The preliminary land use plan for Bedford West Sub Area 10 can be found in Appendix A. It is noted that the plan will be updated to extend the proposed multi-use pathway further east to reach the Highway 102 interchange.

Traffic Impact Study

As part of the development application for Bedford West Sub Area 10, a traffic impact study was completed in 2018 to quantify the transportation impacts of the proposed development. The study evaluated traffic operations at the Highway 102 and Kearney Lake Road interchange currently controlled by two signalized intersections which are operated by the same traffic controller.

[1] It should be noted that the area includes lands required for the re-aligned portion of Highway 102, an improvement identified in the 2010 Highway 102 study. The lands located adjacent to the interchange are owned by Nova Scotia Power. Although this parcel is included within development area, Nova Scotia Power is unlikely to proceed with development. There remains full ability to widen Highway 102 as required without impacting development on this property.

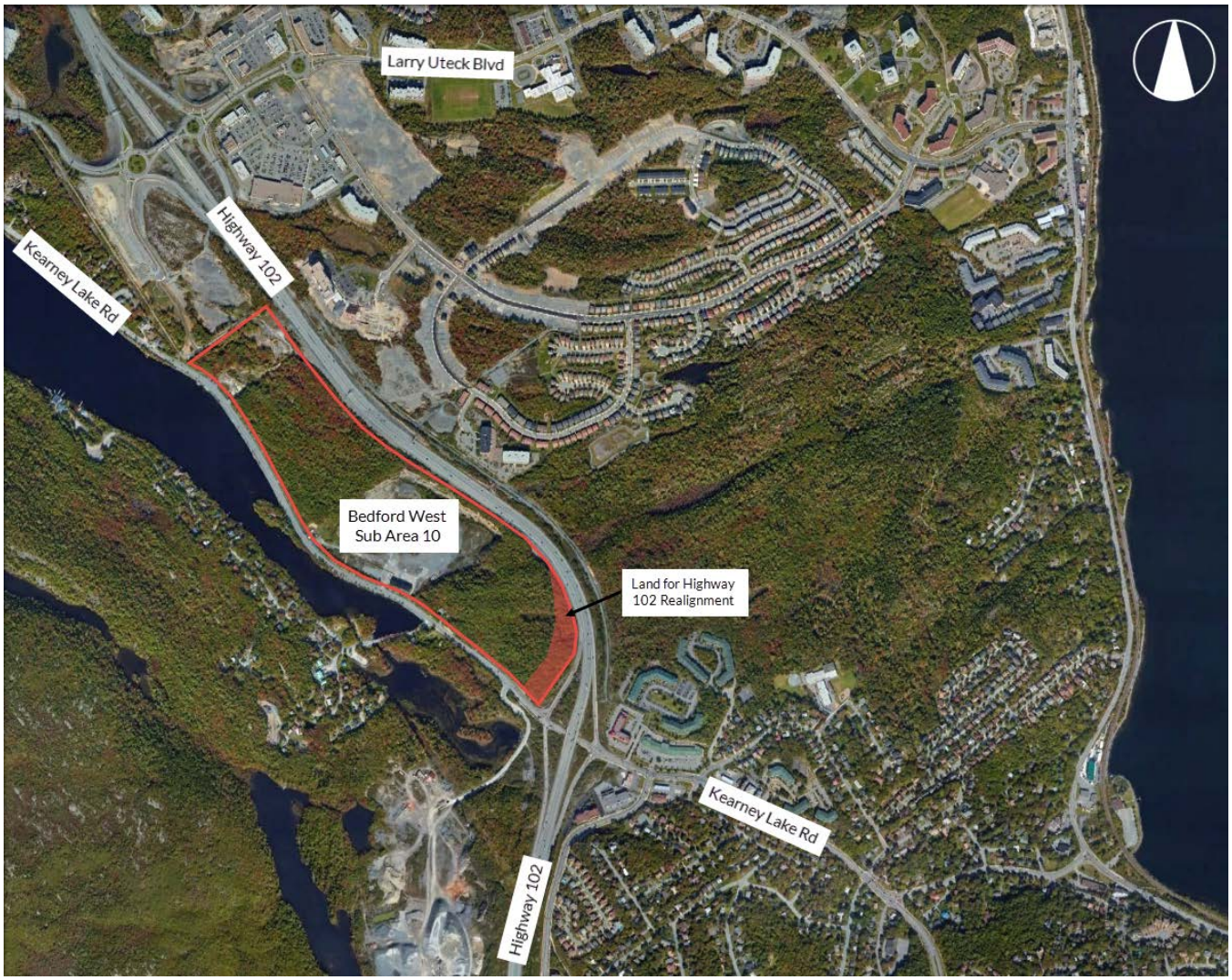


Figure 1 - Location of proposed Bedford West Sub Area 10 development

The study identified existing operational problems at the Kearney Lake Road interchange and projected that with background traffic growth alone, the southbound off-ramp will exceed capacity during both peak hours by 2031. The study concluded that improvements are required at the Highway 102 and Kearney Lake Road interchange to accommodate background traffic growth and the full build out of the Bedford West Sub Area 10 development. The study recommended that the two signalized intersections be converted to roundabouts to accommodate long-term growth at the interchange.

Purpose of this Memo

The purpose of this memo is to review options and propose a recommendation for the design of the Kearney Lake Road and Highway 102 interchange and associated connections for walking, cycling, transit, and driving. There are multiple constraints and multimodal considerations and as such, a balanced approach is required.

The Nova Scotia Department of Transportation and Active Transit (NSTAT) has determined that roundabouts are the best option to accommodate long term needs at the intersection based on vehicle capacity requirements and costs. Lane configurations have been established by the province to accommodate projected 2041 traffic volumes.

Improvements at the interchange will have a significant impact on Halifax Regional Municipality (HRM) infrastructure and the Kearney Lake Road corridor. The design of the Kearney Lake Road interchange provides the opportunity to consider the short term and long term needs for alternative modes of transportation at the interchange and HRM's mobility goals for the Kearney Lake Road corridor.

The most significant constraint to the design of Kearney Lake Road interchange is the existing bridge structure and associated Kearney Lake Road underpass. In the near-term, it is likely the NSTAT will seek to maintain the existing bridge structure which will limit the cross section that can be accommodated through the interchange. In the long-term, when the bridge is replaced as part of the Highway 102 widening project, a wider cross section will be possible underneath the bridge. The memo reviews option for both near-term design (existing bridge) and long-term design (new bridge) of the interchange.

Policy Context

Integrated Mobility Plan (2017)

In 2017, HRM published its Integrated Mobility Plan (IMP), a new policy document to guide transportation and land use planning in the region. The plan establishes new modal split targets based on the development area. Bedford West Sub Area 10 is in the Inner Suburban policy context, where the IMP plans for a 2031 modal split of at least 6% of trips by active transportation, at least 20% by transit, and no more than 74% by car.

The IMP is supported by four principles, which are paraphrased to highlight the aspects relevant to this memo:

- **Complete Communities:** ensuring that development supports walking, cycling, and transit access to destinations
- **Move People:** measure the volume of people and goods that a corridor can move, rather than the number of vehicles
- **Manage Congestion:** instead of widening to address congestion, encourage people to use other options and/or travel at different times of day, and providing transit priority measures as well as connected pedestrian and bicycling networks
- **Integrate Solutions:** consider trips that can be taken with a combination of modes, such as walking or biking to transit, and consider the negative feedback loops that can be created by a car-centric approach

Multi-Modal Level of Service (MMLOS) Framework (2019)

HRM's Multi-Model Level of Service (MMLOS) Framework is a tool for identifying and quantifying the level of service (LOS) provided to each mode for given elements of a project.

As this project is in the suburban context, the level of service targets by mode are:

- Pedestrian and Bicycle LOS B or C (depending on whether corridor is "basic" or "priority" for this mode)
- Bicycle LOS B or C (depending on whether corridor is "basic" or "priority" for this mode)
- Transit LOS B (assuming priority corridor due to BRT)
- Goods Movement LOS D or E (depending on whether corridor is "basic" or "priority" for this mode)
- Auto LOS D or E (depending on whether corridor is "basic" or "priority" for this mode)

A full MMLOS analysis was not completed; however, the table below provides examples of performance criteria for meeting the given targets along a segment. These factors were taken into account in the design process.

Table 1 - Performance criteria for MMLOS targets

Road User	MMLOS Target for Context	Example of Meeting Target for Segment
Pedestrian	B or C	Facility width of 1.64 to 1.99 metres, and pedestrian zone width of 2.74 to 3.49 metres
Bicycle	B or C	Fully segregated cycle track or multi-use pathway
Transit	B	Daytime transit lanes travel speed / ideal speed of 0.81 to 0.90
Goods Movement	D or E	Curb lane width of 3.4 to 3.59 metres
Auto	D or E	V/C of 0.80 to 0.99

HRM Rapid Transit Strategy (2020)

HRM's Rapid Transit Strategy, released in 2020, calls for a network of bus rapid transit and ferry routes to serve major travel routes across the region as well as the creation of supportive land uses along those routes (transit-oriented development). The planned Bus Rapid Transit (BRT) Purple Line travels through the study area, with a stop at Kearney Lake Road and Parkland, and a proposed extension to Larry Uteck, either via Highway 102 or Kearney Lake Road.

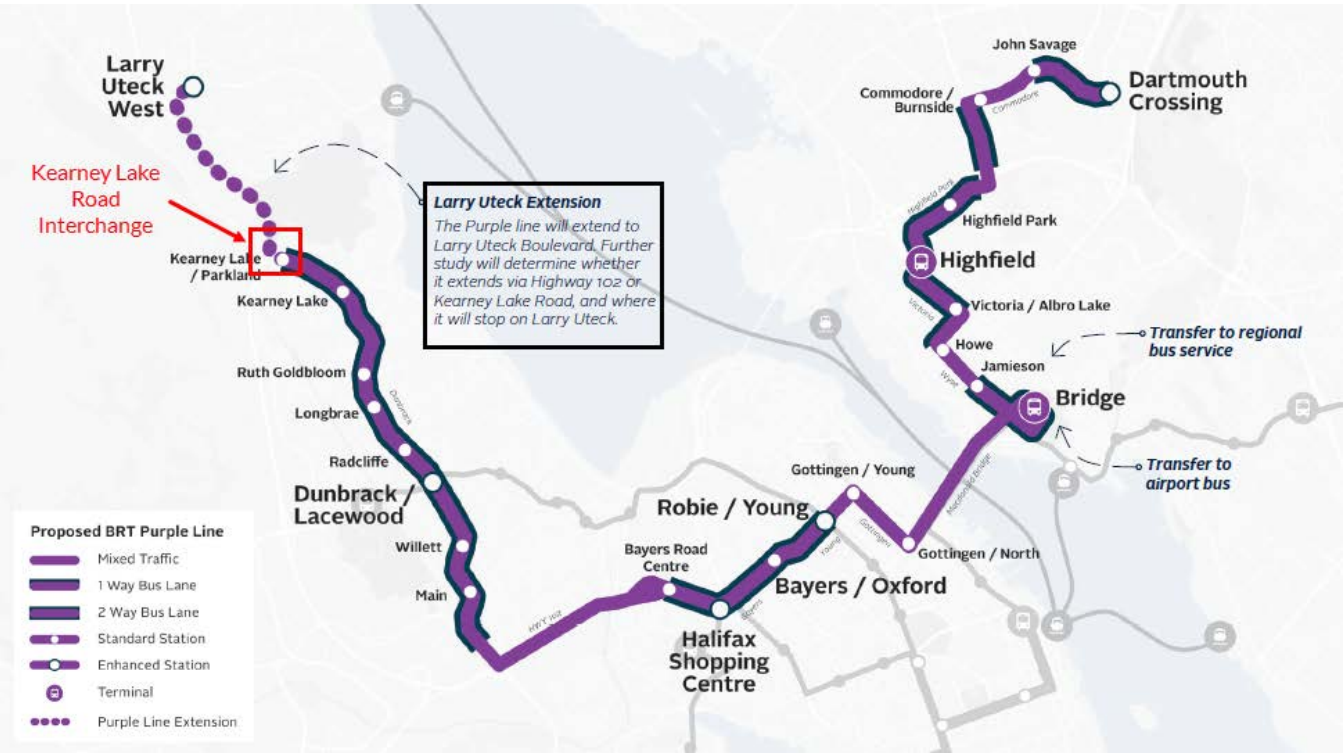


*Figure 2 - Proposed routing for the BRT Purple Line (Source: **HRM Rapid Transit Strategy (2020)**)*

Transit-Supportive Land Use

The strategy calls for transit-supportive land-use patterns, for which the following are essential:

- Plan for higher-density mixed-use development around rapid transit (within 800 metres of rapid transit stops/stations)
- Improve the connectivity of streets and the quality of active transportation infrastructure near stations and terminals

The implementation of a rapid transit station at Kearney Lake Road and Parkland will create a natural travel demand for people to walk or cycle to the station from the proposed development. In addition, the strategy identifies this station area as a *potential transit-oriented community*, which means that further mixed-use redevelopment can be anticipated in the future in the immediate station area, creating further demand for people to access this area on foot or by bike.

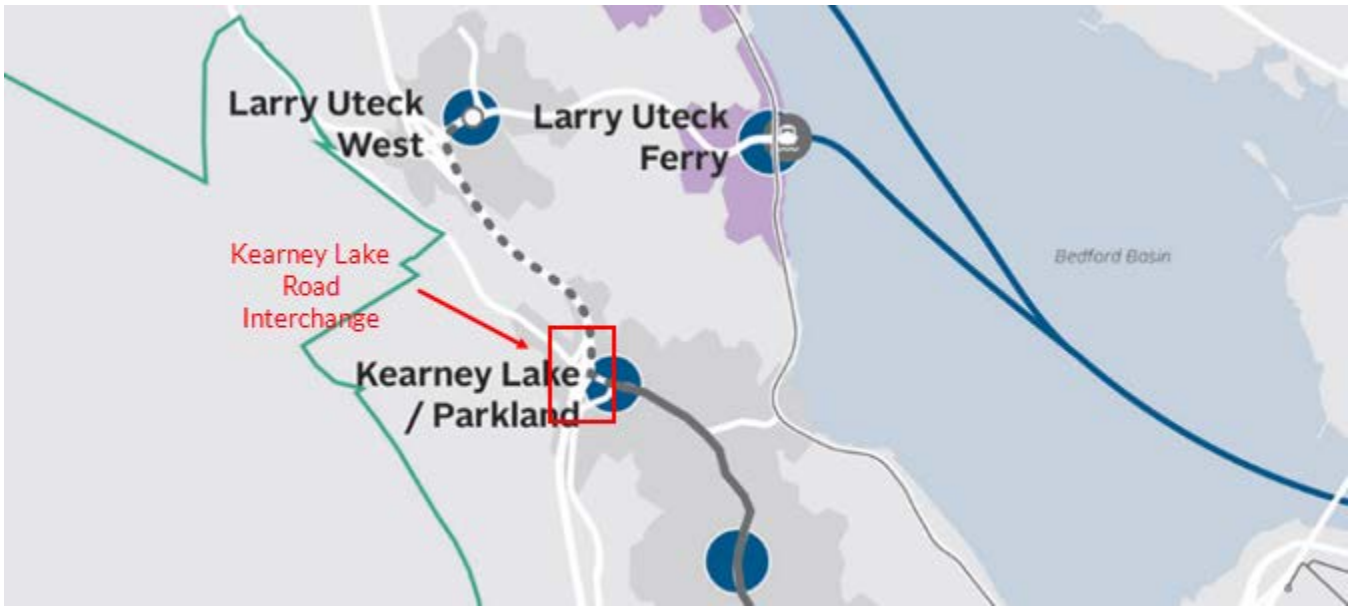


Figure 3 - The HRM Rapid Transit Strategy identifies the area surrounding Kearney Lake and Parkland as a potential transit-oriented community

Making Connections: Halifax Active Transportation Priorities Plan (2014-19)

The focus of the AT Implementation Plan is to increase the rates of walking and cycling for utilitarian purposes within the region. Relevant goals to this project include addressing sidewalk gaps on major roadways, implementing bikeway connections to local destinations and transit hubs, and implementing more AT crossings of 100 series highways. The plan includes a map of existing and desired bikeway routes across the region. The plan identifies that a bikeway is desired to connect the existing bike lanes on Kearney Lake Road across the Highway 102 interchange, with further connections east on Kearney Lake road and south on Parkland Drive.

HalifACT 2050: Acting on Climate Together (2020)

In 2020, Halifax Regional Council declared a climate emergency. HalifACT 2050: Acting on Climate Together is HRM's climate action plan. The plan is a commitment to reducing emissions, switching to clean and reliable energy sources and demonstrating local government leadership. HalifACT assumes the IMP has been implemented by 2031 as the baseline.

Nova Scotia Provincial Climate Emergency (2019)

Nova Scotia is actively fighting climate change and has become a national leader in this effort with the most ambitious targets in the country.

In September 2019, the Declaration of Climate Emergency Act was introduced to the provincial legislature, and if passed, will recognize a state of climate emergency across the province and establish a target to reduce provincial greenhouse gas emissions to at least 50 percent below 1990 levels. This would follow similar climate emergency declarations in the communities of Halifax, Mahone Bay, Wolfville, Annapolis, and Berwick, as well as the Cape Breton Regional Municipality.

Minister of Transportation and Active Transit Mandate (2021)

In 2021, the provincial government created the Department of Transportation and Active Transit. The mandate for Minister Hines, the Minister of Transportation and Active Transit includes the following priorities with respect to active transportation:

- As Minister of Transportation and Active Transit, you are the steward of a transportation network for the safe, sustainable, and efficient movement of people and goods. As Minister, you will work to connect people and the communities in which they live. In the process, you will emphasize social equity, accessibility, and inclusion, and ensure Nova Scotia's different modes of transportation contribute to a cleaner and better future.
- Moving forward, you will promote and encourage active transportation to transform how we move people and goods throughout the province.
- You will work with your Ministerial colleagues to foster the development of Nova Scotia active transportation infrastructure network including the Blue Route, walking, and hiking trails, bikeable shoulders, and over and underpasses.

Network Context

Highway Operations

Access to the Highway 102 at this interchange is currently controlled by two signalized intersections with a shared traffic controller. Existing vehicle operations at the interchange were evaluated in 2018 in the Bedford West Sub Area 10 traffic impact study.

The analysis indicated that the interchange experience operational problems during the morning and afternoon peak hours. The Kearney Lake Road and Highway 102 southbound ramps intersection experiences congested conditions (LOS E) during morning peak hour on the Kearney Lake Road eastbound approach (through movement) and the Highway 102 southbound off-ramp approach (left turn movement). The intersection also experiences congested conditions (LOS E) during the afternoon peak hour on the Highway 102 southbound off-ramp approach (left turn movement).

The left turn movement on the Highway 102 southbound off-ramp approach are almost at the capacity of the approach, with a volume-to-capacity ratio of 0.96 during the morning peak hour and 0.99 during the afternoon peak hour. The approach experiences 95th percentile queue lengths of approximately 200 metres during both peak hours. The analysis queues are consistent with observed operations.

NSTAT reports that during peak periods, queues periodically spillback onto Highway 102 at the southbound off-ramp. It is strongly desired that the intersection reconfiguration addresses this issue and helps mitigate against it in the future.

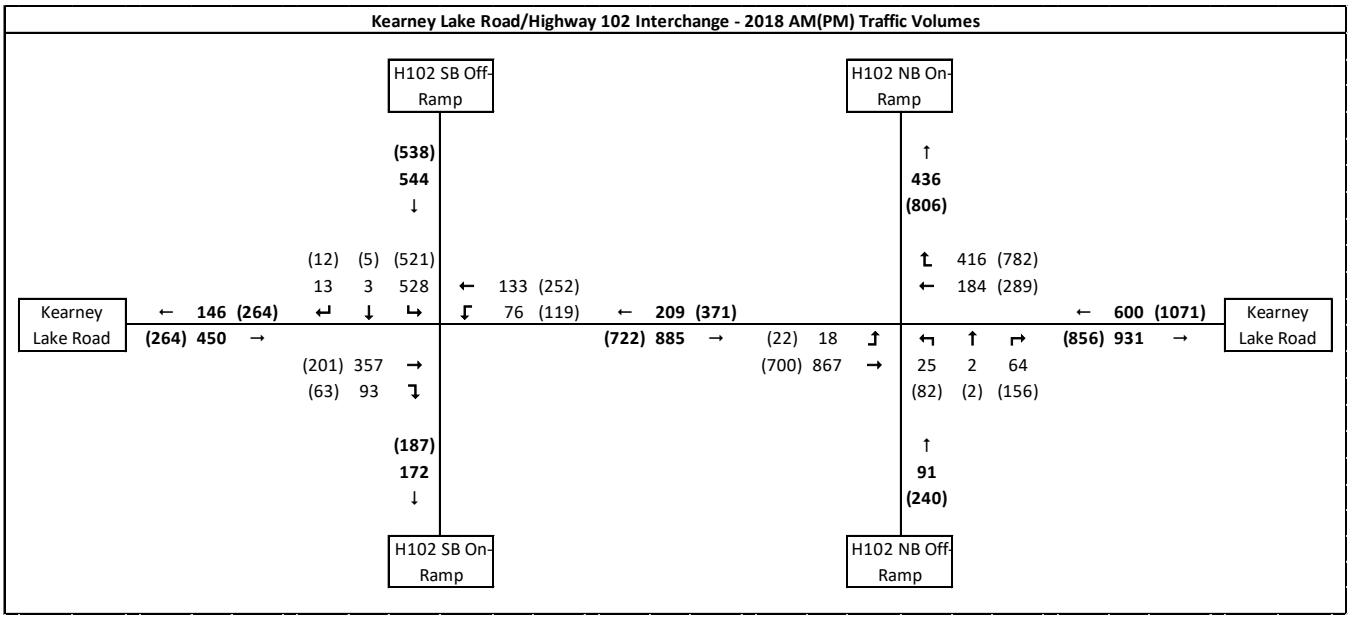


Figure 4 - Existing traffic volumes at the Kearney Lake Road/Highway 102 Interchange

NSTAT is undertaking an update to the 2010 Highway 102 study which will be investigating highway network changes, some of which include the cross section of Highway 102. The 2010 study included recommendations for future widening of Highway 102 from four lanes to six lanes through this interchange, as well as a realignment of the horizontal curve immediately north of the interchange, which would likely include a replacement of the Kearney Lake Road bridge structure. As was indicated in the 2010 study, this widening would trigger the need to upgrade the intersections at the interchange.

In the near-term, it is likely the NSTAT will seek to maintain the existing bridge structure and associated Kearney Lake Road underpass, which presents the most significant constraint to the design of Kearney Lake Road. The clear width underneath the bridge is measured at 15.8 metres wide which will limit the cross section that can be accommodated in the near-term. In the long-term, when the bridge is replaced, a wider cross section may be possible.

The near-term design for the interchange will consider long-term changes such as the widening and realignment of Highway 102. This will ensure the near-term design is compatible with the long-term design and that the highway ramps at the roundabouts can be expanded to meet long-term changes, minimizing the need for reconstruction.

Figure 5 - Photo of existing Kearney Lake Road underpass (Google Maps)

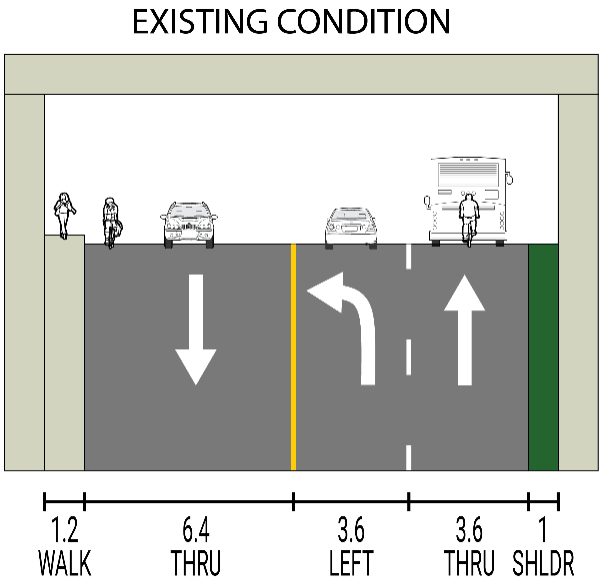


Figure 6 - Cross section of existing underpass (looking west)

Transit Operations

West of the interchange, Kearney Lake Road is currently served by Halifax Transit Route 433 Tantallon, which operates four AM inbound trips and four PM outbound trips from Monday to Friday.

As mentioned above, the HRM Rapid Transit Strategy identifies the BRT Purple Line running through the study area, with a station planned at Kearney Lake and Parkland. The route will provide one-transfer rides to downtown Halifax and a connection at Bridge Terminal for a one-transfer ride to destinations throughout Dartmouth. The BRT network is proposed to operate at 10-minuite frequency from 9AM to 10PM, with enhanced platforms and boarding areas. To improve travel times, transit priority lanes are proposed on Kearney Lake Road east of Parkland.

An extension is proposed to connect the BRT Purple Line further to Larry Uteck. The alignment of this extension is yet to be determined, but will either follow Kearney Lake Road, or Highway 102. The extension being routed along Kearney Lake Road would connect the BRT Purple Line to the new Bedford West Sub Area 10 development and all of its potential transit users. As such, the interchange design will seek to minimize delay for transit vehicles, and priority measures will be considered where they provide travel time benefits.

The HRM Rapid Transit network is currently awaiting a funding commitment. If funded, the BRT Purple Line through the project area is identified as a "secondary" transit priority project, with implementation beginning in Year 5 of the strategy.

Active Transportation

West of Highway 102, there are painted bicycle lanes on Kearney Lake Road, and as part of the proposed development, a multi-use pathway will be constructed on the east side of the road, providing a connection to Hogan Court to the north-west, and to the Highway 102 interchange to the south-east. In addition, HRM is planning to construct a north-south multi-use pathway along the east side of Highway 102 which would cross Kearney Lake Road at the interchange. There are design challenges to providing the connection for the planned multi-use pathway across Kearney Lake Road, particularly on the north side. The interchange design will require careful consideration in the area to protect for this future connection.

Under the Highway 102 bridge, there is a substandard 1.2 metre sidewalk on the south side of Kearney Lake Road and no facility on the north side. East of the interchange, the Mainland North Linear Parkway, a 4.7 kilometres active transportation corridor, terminates at Kearney Lake Road and Parkland Drive. The Parkway provides connections to many regional destinations including the Canada Games Centre, the Keshen Goodman Library, and the BMO Soccer Centre.

Key Origin-Destination Pairs

The implementation of the proposed development and rapid transit surrounding the Highway 102 interchange will create new origin destination pairs, all of which are short distances making them well-suited to walking and cycling These pairs include trips between Sub Area 10 and:

- The BRT Purple Line stop at Kearney Lake Road and Parkland Drive
- The retail area on the east side of the highway
- The proposed trail along the east side of Highway 102
- The Mainland North Linear Parkway and associated destinations along the trail
- Kearney Lake Beach
- Hogan Court and the associated retail development there

It is also important to note that, while Sub Area 10 is situated only on the north side of Kearney Lake Road, many of the destinations identified are on the south or both sides of the corridor, emphasizing the importance of providing connectivity on both sides.

Road Network

HRM does not have any major changes planned to the road network in the area. West of Highway 102, Kearney Lake Road may be widened in select areas to provide left turn storage as new development occurs, but no broader widening is planned.

Near-Term Design

The NSTAT has determined that roundabouts are the best option to accommodate long term needs at the intersection based on vehicle capacity requirements and costs.

The recommended near-term (using the existing bridge) design includes conversion of the two existing signalized intersections at the interchange to four-legged roundabouts to provide sufficient capacity to accommodate background traffic growth and the proposed Bedford West Sub Area 10 development.

The roundabouts will be connected by a short road segment under the existing Highway 102 bridge, through the most constrained portion of the project area.

Active Transportation Facility Design

The connectivity considerations for active transportation through the interchange are summarized in the figure below.

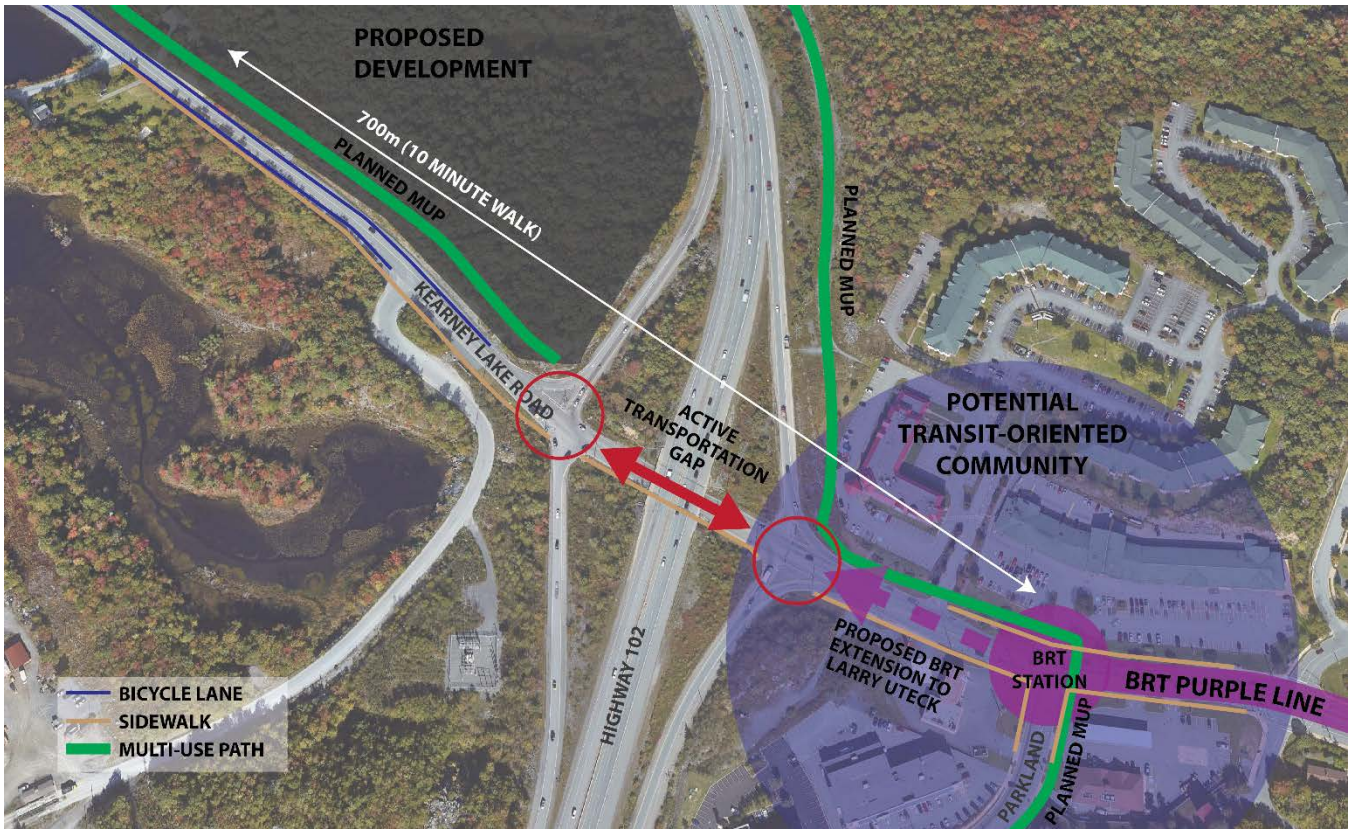


Figure 7 - Existing active transportation connectivity through the interchange

In order to provide a cohesive walking and cycling network that connects the proposed development to the key destinations on the east side of the highway and supports the use of public transit, a comfortable and convenient active transportation connection across the interchange is needed. For consistency with the planned facilities in the area, multi-use pathways and/or sidewalks are the recommended facility types.

Alternative: Multi-use Pathway on Both Sides

Multi-use pathways could be provided on both sides of the underpass to maximize convenience and connectivity across the highway for pedestrians and cyclists. Providing multi-use pathways on both sides ensures that cyclists approaching the interchange in vehicle lanes have the opportunity to travel through the roundabouts outside of the vehicle lanes.

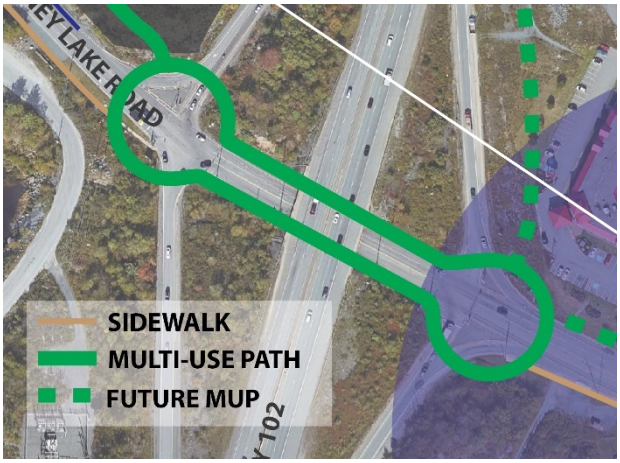


Figure 8 - Active transportation facilities associated with the multi-use pathway on both sides alternative

Figure 9 - Example of highway interchange with multi-use pathways - King Street & Highway 85, Waterloo, ON

The preferrable width for multi-use pathways is 3.5 to 4.0 metres, and a minimum of 3.0 metres. In addition, a 0.5 metre clearance should be provided between the multi-use pathway and the walls of the structure, to avoid the risk of bicycle handlebars striking the walls[2]. The preferred buffer width between the multi-use pathway and the roadway is 1.0 metres or more, in order to increase separation from traffic and to facilitate placement of signage and lighting, and storage of snow. The minimum buffer that should be considered to provide a basic level of comfort is 0.5 metres.

Under the bridge, where the cross section is the most constrained, the multi-use pathways on both sides alternative would include 0.5 metre buffers provided between the multi-use pathways and the roadway, with 3.8 metre vehicle lanes to provide some opportunity for shoulders and snow storage. The recommended cross section for the alternative is shown below. 3.0 metres multi-use pathways are proposed on both sides through the underpass, transitioning to 4.0 metres multi-use pathways at each end where space is less constrained.

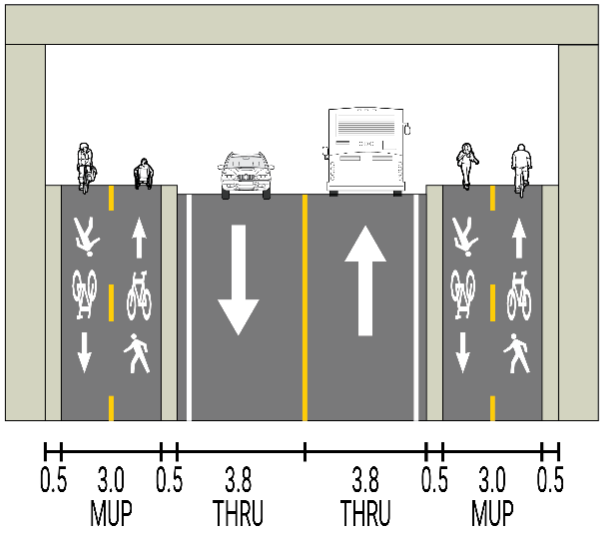


Figure 10 - Near-term cross section at the Highway 102 underpass for multi-use pathways on both sides alternative

Alternative: Multi-use Pathway on One Side

Providing multi-use pathways on both sides provides better connectivity through the interchange but results in a minimum-width buffer between the multi-use pathways and the roadway. Alternatively, consideration can be given to providing a multi-use pathway on one side with a wider 1.5 metre buffer under the bridge, with a sidewalk on the other. To improve continuity with the multi-use pathway at the west end, the preferred side for the multi-use pathway would be the north side. The 1.5 metre buffer area would provide a substantial amount of space for snow storage as well.

[2] TAC Geometric Design Guide for Canadian Roads, Section 5.5.5

If no pedestrian facility (neither multi-use pathway nor sidewalk) were provided on the south side of Kearney Lake Road, it would result in a severe inconvenience and potential safety issue for pedestrians. Pedestrians whose origins and destinations are on the south side of Kearney Lake Road would need to take a far more circuitous route to get to their destination, and would need to cross additional legs of the roundabouts, introducing additional conflict points.

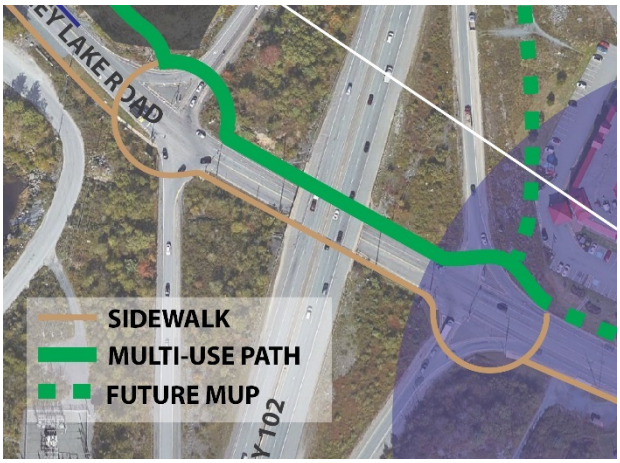


Figure 11 - Active transportation facilities associated with the multi-use pathway on one side alternative

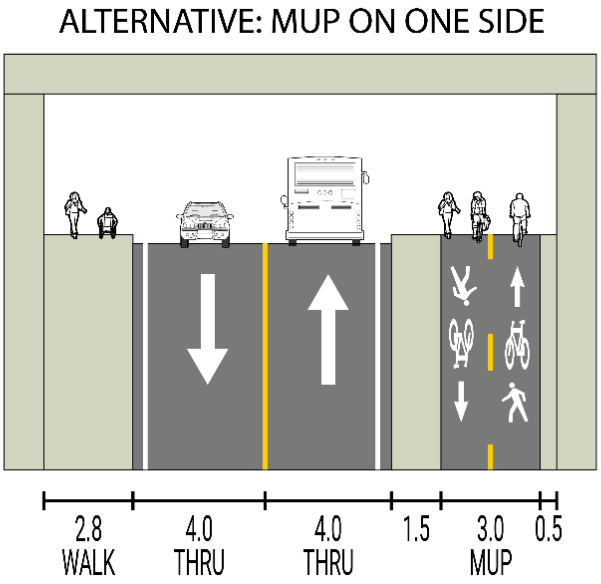


Figure 12 - Near-term cross section at the Highway 102 underpass for multi-use pathway on one side alternative

Rationale

The two alternatives considered for the near-term design were selected based on the following rationale:

- A pedestrian facility of at least 1.64 m wide and a fully segregated cycle track, or a shared use facility such as multi-use pathway is required on both sides of the road in order to meet multi-modal level of service targets for this context.

- According to TAC Geometric Design Guide, the speed and volume of Kearney Lake Road at the interchange are not appropriate for mixed-traffic cycling facilities. The cycling facility should be completely separated from traffic in the form of a multi-use pathway or physically separated bike facility. While there are on-road painted bike lanes on the two-lane section of Kearney Lake Road west of the interchange, an on-road painted bike lane or mixed-traffic condition is inadequate at the interchange.
- Providing a pedestrian/cycling facility on both sides also provides redundancy in the network, in the event that one of the faculties is out of service (e.g., construction, maintenance issue, etc).
- If no pedestrian facility (neither multi-use pathway nor sidewalk) were provided on the south side of Kearney Lake Road, it would result in a severe inconvenience and potential safety issue for pedestrians. Pedestrians whose origins and destinations are on the south side of Kearney Lake Road would need to take a far more circuitous route to get to their destination, and would need to cross additional legs of the roundabouts, introducing additional conflict points.
- With a multi-use pathway on both sides, cyclists going eastbound in the existing Kearney Lake Road on-road bike lane west of the interchange will be able to continue without having to cross the street twice. If a multi-use pathway was only provided on the north side, then eastbound cyclists would have to cross Kearney Lake Road to the north side west of Highway102 and then cross back to the south side east of Highway 102 to continue proceeding east. This is a major inconvenience to cyclists and introduces additional conflict points that riders would need to navigate through.
- There is sufficient space under the bridge to accommodate a multi-use pathway on both sides while maintaining acceptable vehicle operations. However, this results in a minimum-width buffer between the multi-use pathways and the roadway.

Additional Considerations

- The painted bicycle lanes on Kearney Lake Road currently terminate west of the interchange near Crusher Road. It is desired that these on-road facilities be extended to the new roundabouts where they would transition into the new off-road bicycle facilities at the interchange, providing a continuous facility for cyclists.
- On the east side of the interchange along the north side of Kearney Lake Road, there is a short gap in the sidewalk. It is strongly recommended that a multi-use pathway or sidewalk be constructed here to connect the roundabout to the retail plaza and the existing sidewalk.
- It is noted that the underpass is not currently lighted. To provide a comfortable connection that maximizes safety personal security and supports active travel at all times of day, it is strongly recommended that lighting be added to the underpass.
- Public art can also be considered along the existing structure walls to improve the public realm. Any public art on the structure walls would be subject to review and approval by the Province. Care must be taken to ensure any landscaping or roadside elements do not contribute to overall driver distraction as they navigate the area.

Selected Alternative

After consultation with NSTAT, the multi-use pathway on one side alternative was selected for the near-term design. The alternative meets the multi-modal level of service targets for this context for pedestrians by providing a pedestrian facility of 2.8 m wide on the south side and a shared multi-use pathway on the north side. While the alternative does not meet the multi-modal level of service targets for this context for bicycles since a shared cycling facility is only provided on one side of the roadway, the facility provides a 1.5 m buffer between the multi-use pathways and the roadway that exceeds the minimum width of 0.5 m. The alternative balances active transportation needs and the safety of highway users until the Highway 102 bridge is upgraded.

Roadway Design

A number of design elements were considered in developing the proposed design. For consistency with the policy objectives stated above, the roadway design includes consideration for all modes. Active transportation is an important design consideration at crossings, where pedestrians and cyclists conflict with motorists, and public transit is a consideration in order to ensure that the planned BRT Purple Line is prioritized through the interchange.

The various design elements considered and associated recommendations are presented in the table below.

Table 2 - Roadway design elements

Design Element	Considerations/Impacts	Recommendation
Number of vehicle lanes through underpass	Providing more than two vehicle lanes through the underpass impacts the ability to provide the recommended active transportation facilities Operational improvements due to roundabout reduce the need for vehicle lanes under the bridge	Two-lane cross section under the bridge, which will provide acceptable queues lengths between the two roundabouts and on the Highway 102 ramps and an acceptable vehicle level of service (LOS D or better) through the interchange to 2036.
Single vs. dual-lane roundabout approaches	The safety performance at roundabout pedestrian crossings is much higher for single-lane crossings than dual-lane crossings	Dual-lane approaches are only provided where necessary to maintain acceptable vehicle operations (LOS D or better)
Diameter of roundabouts	Larger diameters improve level of service for vehicles, but occupy more space and result in higher travel speeds at entry and exits where pedestrian and bicycle crossings are located	60 metres diameter recommended to accommodate the physical constraints of the sites and support slower vehicle travel speeds
Right-turn bypasses	Improves level of service for right-turning vehicles, but increases number of crossings for pedestrians and cyclists, and potentially increases motorist speed at crossing points	No right-turn bypasses are recommended in the design; non-segregated right turn lanes are used instead. An acceptable level of service (LOS D or better) can be provided without right-turn bypasses, and accommodating them within the physical constraints would be challenging
Transit priority	It is desired that the design minimize delay for transit vehicles through the interchange From the perspective of transit priority, roundabouts are less advantageous than signalized intersections. Transit priority measures at signalized intersections ensure shorter delays for transit vehicles in comparison to passenger vehicles, while roundabouts improve delay for all vehicles equally	As vehicular delays through the roundabouts will be low (on average 10 to 20 seconds for both roundabouts during peak hours), additional transit priority measures are not required

Recommended Near-Term Design

The preliminary layout for near-term design is shown in the figure below, a full-size drawing can be found in Appendix C. The near-term design includes the following vehicle lane configurations at the roundabouts:

Kearney Lake Road & Highway 102 SB Ramps

- Kearney Lake Road – East Leg: single-lane entry
- Highway 102 SB Off-Ramp: single-lane entry with non-segregated right turn by-pass
- Kearney Lake Road – West Leg: single-lane entry with non-segregated right turn by-pass

Kearney Lake Road & Highway 102 NB Ramps

- Kearney Lake Road – East Leg: single-lane entry with non-segregated right turn by-pass
- Kearney Lake Road – West Leg: two-lane entry (one approach lane under the bridge)
- Highway 102 NB Off-Ramp: single lane entry

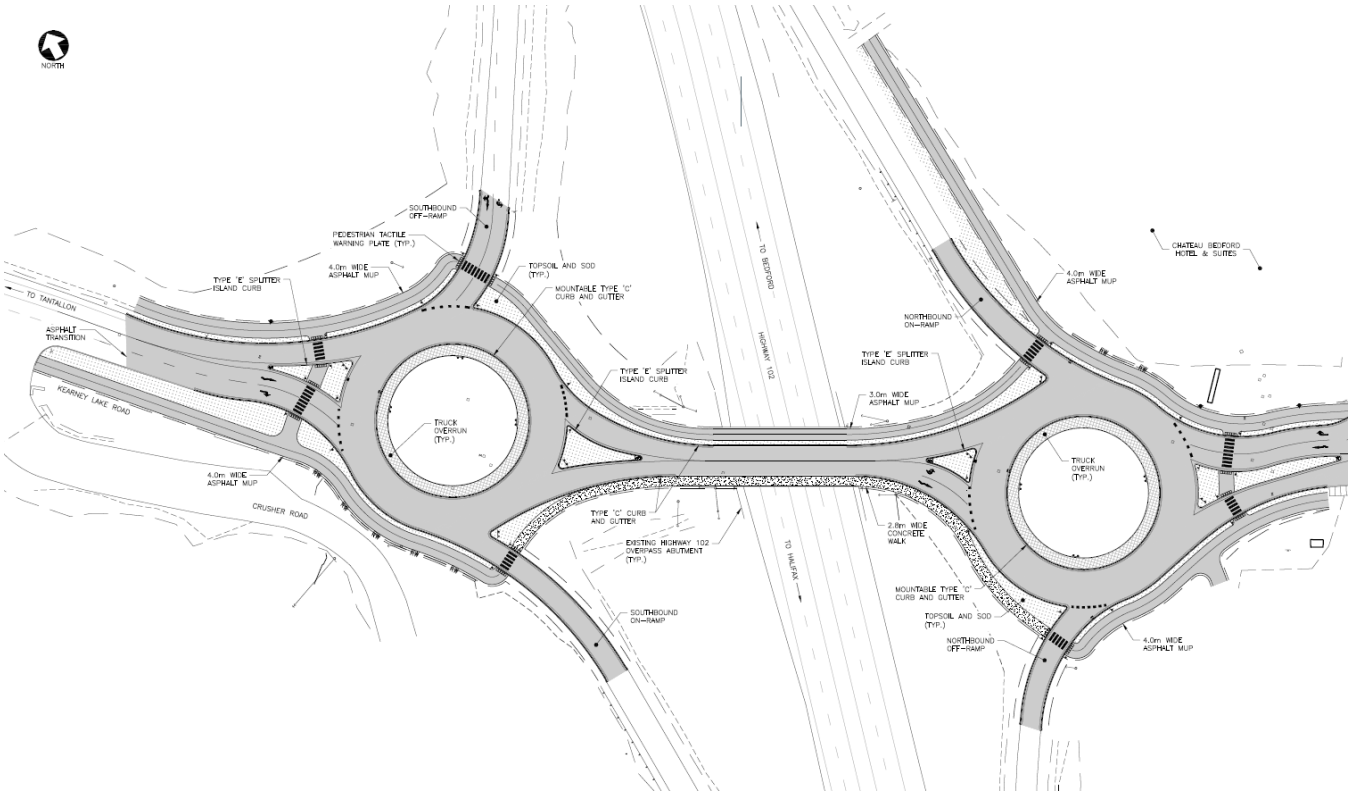


Figure 13 - Preliminary layout of near-term design

Recommended Long-Term Design

The planned future widening of Highway 102, and the associated realignment and replacement of the Kearney Lake Road bridge will trigger a reconfiguration of this interchange in the future. As stated above, based on expected vehicle volume growth, it is estimated that the near-term design can accommodate traffic volumes to the year 2036.

The preliminary layout for the long-term design is shown in the figure below, a full-size drawing can be found in Appendix D. The long-term design includes the following vehicle lane configurations at the roundabouts:

Kearney Lake Road & Highway 102 SB Ramps

- Kearney Lake Road – East Leg: add a second entry lane and approach lane (two-lane entry with two approach lanes under the bridge)
- Highway 102 SB Off-Ramp: convert the non-segregated right-turn bypass into a second entry lane (two-lane entry)
- Kearney Lake Road – West Leg: convert the non-segregated right-turn bypass into a second entry lane (two-lane entry)

Kearney Lake Road & Highway 102 NB Ramps

- Kearney Lake Road – East Leg: no modifications to this approach (single-lane entry with non-segregated right turn by-pass)
- Kearney Lake Road – West Leg: add a second approach lane under the bridge (two-lane entry with two approach lanes under the bridge)
- Highway 102 NB Off-Ramp: add a right turn by-pass (single lane entry with right turn by-pass)

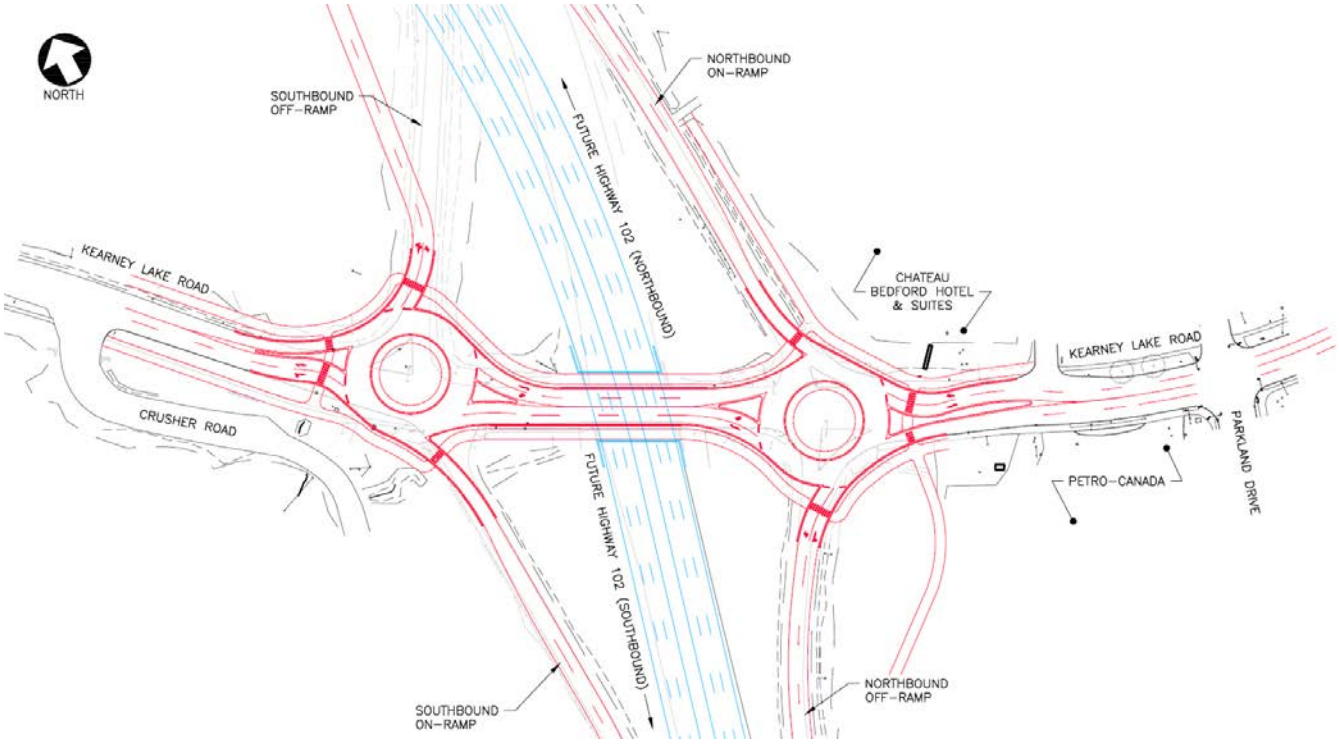


Figure 14 - Preliminary layout of long-term design

New Bridge Cross Section

The planned replacement of the Kearney Lake Road bridge creates an opportunity to widen the underpass to allow for the long-term design. Multi-use pathways on both sides are recommended in the long-term design, with a more desirable buffer of 1.5 metres to the roadway. Four vehicle lanes are provided as well: two eastbound lanes and two westbound lanes. The proposed long-term underpass cross section is shown below and includes a clear width under the bridge of 26 metres.

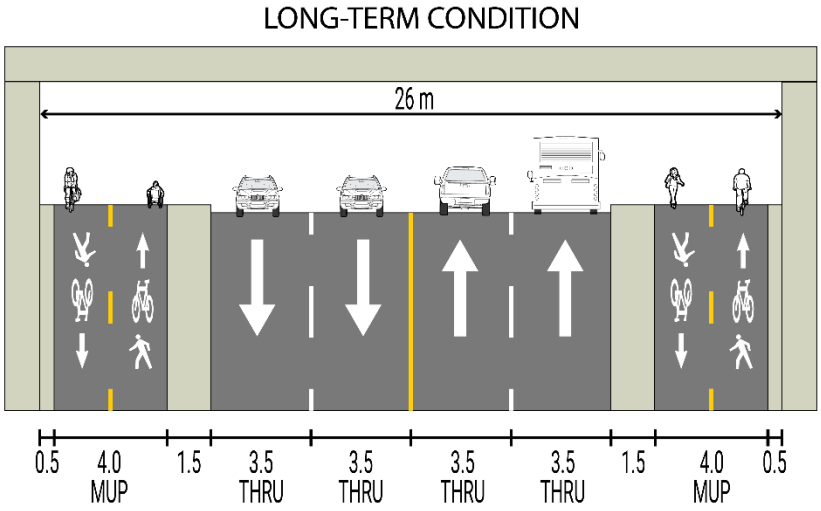


Figure 15 – Recommended long-term underpass cross section

Model Analysis

Traffic Volume Projections

Traffic volume projections for the Kearney Lake Road and Highway 102 interchange developed in the Bedford West Sub Area 10 traffic impact study were used to evaluate the proposed near-term design and identify when the interchange will need to be upgraded to the long-term design. The traffic volume projections include:

- **Full Build Out of Development (2031)**: background traffic growth at 1.2% per year[3] and the full build out of the Bedford West Sub Area 10 development
- **Five-Year Timeframe after Development (2036):** background traffic growth five years after the full build out of the development

For the long-term design, NSTAT required that the roundabouts accommodate traffic volumes up to 2041 to include a full ten-years of background traffic growth after the full out of the Bedford West Sub Area 10 development. Therefore, an additional scenario was developed to include an additional five years of growth using the same background growth rate of 1.2% per year:

- **Ten-Year Timeframe after Development (2041)**: background traffic growth ten years after the full build out of the development

The projected morning and afternoon peak hour traffic volumes at the interchange are illustrated diagrammatically in Appendix B.

Traffic Operations Analysis

The Junction 9 ARCADY software was used to evaluate the roundabout configurations at the Kearney Lake Road interchange. ARCADY uses an empirical model based on the application of statistical regression of a large data set of observed roundabout operations in the United Kingdom. The performance of an intersection can be evaluated using a number of measures of effectiveness (MOEs), including level of service (LOS), delay, volume-to-capacity ratio (v/c) and vehicle queuing.

Level of service is a qualitative measure used to describe the level of performance of an intersection in terms of traffic movement. Level of service is a measure of driver discomfort, frustration and increased travel time. The quality of traffic movement is divided into six levels ranging from A to F, where level of service A represents the best quality of traffic where the driver has the freedom to drive with free flow speed and level of service F represents the worst quality of traffic where the level of congestion is considered unacceptable to most drivers. The level of service criteria for intersections are stated in terms of average control delay per vehicle in the table below.

[3] The background traffic growth rate of 1.2% per year used in the Bedford West Sub Area 10 Traffic Impact Study was derived from traffic volumes on Kearney Lake Road from 2001 to 2012 in the Bedford West Master Plan Transportation Study Update (2014). The background growth rate was applied to volumes on Kearney Lake Road and the Highway 102 ramps.

The volume-to-capacity (v/c) ratio is a measure of how the peak hour traffic volume on an approach to an intersection compares to the theoretical maximum volume that could be accommodated on that intersection approach. As the v/c ratio approaches 1.0, the movement has reduced ability to accommodate any additional volume of traffic.

The 95th percentile queue (95th% queue) is the estimated length in metres of a queue of vehicles stopped on an intersection approach which is only exceeded five percent of the time. Since a stopped vehicle occupies approximately seven metres of queue length, a 95th% queue of 14 metres indicates that less than five times of out 100 the queue may exceed two vehicles on the approach. The 95th% queue is typically used to determine if sufficient vehicle storage is available to maintain efficient traffic flow.

Table 3 - Level of Service Criteria

Level of Service	Description	Signalized Control Delay	Unsignalized Control Delay
A	No congestion; most vehicles do not stop. (Excellent)	≤ 10 sec/veh	≤ 10 sec/veh
B	Very light congestion; some vehicles stop. (Very Good)	10-20 sec/veh	10-15 sec/veh
C	Light congestion; most vehicles stop. (Good)	20-35 sec/veh	15-25 sec/veh
D	Noticeable congestion; vehicles must sometimes wait through more than one red light. No long-standing queues. (Satisfactory)	35-55 sec/veh	25-35 sec/veh
E	Congestion; vehicles must often wait through more than one red light. Long-standing queues are formed. (Unsatisfactory)	55-80 sec/veh	35-50 sec/veh
F	Severe congestion; demand exceeds the capacity of the intersection. (Unacceptable)	≥ 80 sec/veh	≥ 50 sec/veh

Near-Term Design (Existing Bridge)

The detailed Junctions 9 ARCADY reports detailing the results of the analysis can be found in Appendix E. The MOE results including delay, level of service, volume-to-capacity ratio and 95th percentile queue lengths[4] for the near-term design configuration in 2031 at the full build out of the Bedford West Sub Area 10 development and in 2036 five years after the full build out of the development are summarized in the tables below.

The results of the analysis suggest that in 2031, after the full build out of the Bedford West Sub Area 10 development, under the proposed near term design configuration, both roundabouts will operate at acceptable levels of service with 95th percentile queue lengths of less than 80 metres on the Highway 102 ramps and queues of less than 60 metres between the two roundabouts (under the overpass).

The results of the analysis suggest that in 2036, five years after the full build out of the Bedford West Sub Area 10 development, both roundabouts will continue to operate at acceptable levels of service under the proposed near term design configuration. However, 95th percentile queue lengths on the Highway 102 SB ramp will reach approximately 132 metres during the afternoon peak hour. NSTAT does not permit highway off-ramp queues to extend within 100 metres of the painted off-ramp gore, on the Highway 102 SB ramp there will be a distance of approximately 235 metres from the yield line to the painted off-ramp gore indicating that the 2036 queues on the ramp will within less than 5 metres of reaching the maximum limit. In addition, 95th percentile queue lengths will reach approximately 104 metres between the two roundabouts during the morning peak hour, where there is approximately 110 metres of storage available.

The modelling predicts that both roundabouts will operate at acceptable levels of service under the near-term design until 2036 (5 years after the full build out of the development), at which point the modeling indicates that the roundabouts will need to be upgraded to their long-term design configuration.

[4] 95th percentile queue length value represents the maximum 95th percentile queue length of all movements on the approach

Table 4 – Near-Term Design Full Build Out of Bedford West Sub Area 10 Development 2031 Traffic Operations

Near Term Design (2031) Full Build Out of Development	Weekday AM Peak Hour				Weekday PM Peak Hour			
Intersection	Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	v/c	95th% Queue (m)
Kearney Lake Road & Highway 102 SB Ramps	**8.9**	**A**			**9.5**	**A**		
Kearney Lake Road (East Leg)	4.0	A	0.27	8.4	6.0	A	0.52	10.5
Highway 102 SB Off-Ramp	9.2	A	0.64	16.8	14.3	B	0.73	79.1
Kearney Lake Road (West Leg)	10.6	B	0.61	21.7	6.7	A	0.36	18.9
Kearney Lake Road & Highway 102 NB Ramps	**6.3**	**A**			**6.2**	**A**		
Kearney Lake Road (East Leg)	2.5	A	0.35	18.2	4.9	A	0.66	24.5
Kearney Lake Road (West Leg)	8.7	A	0.74	55.3	5.6	A	0.60	14.0
Highway 102 NB Off-Ramp	7.5	A	0.26	10.5	11.4	B	0.59	26.6

Table 5 – Near-Term Design Five-Year Timeframe after Development 2036 Traffic Operations

Near Term Design (2036) Five-Year Timeframe after Development	Weekday AM Peak Hour				Weekday PM Peak Hour			
Intersection	Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	v/c	95th% Queue (m)
Kearney Lake Road & Highway 102 SB Ramps	**10.4**	**B**			**11.6**	**B**		
Kearney Lake Road (East Leg)	4.1	A	0.29	11.2	6.5	A	0.55	10.5
Highway 102 SB Off-Ramp	10.6	B	0.68	40.6	18.9	C	0.79	131.6
Kearney Lake Road (West Leg)	12.8	B	0.66	42.0	7.3	A	0.40	21.0
Kearney Lake Road & Highway 102 NB Ramps	**7.5**	**A**			**7.2**	**A**		
Kearney Lake Road (East Leg)	2.6	A	0.37	19.6	5.7	A	0.70	33.6
Kearney Lake Road (West Leg)	10.6	B	0.79	103.6	6.2	A	0.64	19.6
Highway 102 NB Off-Ramp	8.3	A	0.30	11.2	14.0	B	0.65	39.9

Long-Term Design (New Bridge)

The detailed Junctions 9 ARCADY reports detailing the results of the analysis can be found in Appendix E. The MOE results including delay, level of service, volume-to-capacity ratio and 95th percentile queue lengths[5] for the long-term design configuration in 2036 five years after the full build out of the development and in 2041 ten years after the full build out of the development are summarized in the tables below.

The results of the analysis predict that under the proposed long-term design configuration, both roundabouts will operate at acceptable levels of service with 95th percentile queue lengths of less than 50 metres on the Highway 102 ramps.

Table 6 – Long-Term Design Five-Year Timeframe after Development 2036 Traffic Operations

Long-Term Design (2036) Five-Year Timeframe after Development	Weekday AM Peak Hour				Weekday PM Peak Hour			
Intersection	Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	v/c	95th% Queue (m)
Kearney Lake Road & Highway 102 SB Ramps	**4.1**	**A**			**4.6**	**A**		
Kearney Lake Road (East Leg)	1.8	A	0.15	3.5	2.2	A	0.29	9.8
Highway 102 SB Off-Ramp	5.5	A	0.54	10.5	7.9	A	0.63	14.0
Kearney Lake Road (West Leg)	3.8	A	0.47	14.7	2.9	A	0.29	9.8
Kearney Lake Road & Highway 102 NB Ramps	**3.2**	**A**			**4.8**	**A**		
Kearney Lake Road (East Leg)	2.6	A	0.37	19.6	5.7	A	0.70	33.6
Kearney Lake Road (West Leg)	3.4	A	0.54	11.2	2.8	A	0.44	13.3
Highway 102 NB Off-Ramp	5.0	A	0.20	7.0	6.4	A	0.46	21.0

[5] 95th percentile queue length value represents the maximum 95th percentile queue length of all movements on the approach

Table 7 – Long-Term Design Ten-Year Timeframe after Development 2041 Traffic Operations

Long-Term Design (2041) Ten-Year Timeframe after Development	Weekday AM Peak Hour				Weekday PM Peak Hour			
Intersection	Delay (s/veh)	LOS	v/c	95th% Queue (m)	Delay (s/veh)	LOS	v/c	95th% Queue (m)
Kearney Lake Road & Highway 102 SB Ramps	**4.5**	**A**			**5.3**	**A**		
Kearney Lake Road (East Leg)	1.8	A	0.16	3.5	2.2	A	0.31	12.6
Highway 102 SB Off-Ramp	6.1	A	0.58	11.2	9.4	A	0.68	32.9
Kearney Lake Road (West Leg)	4.2	A	0.51	10.5	3.1	A	0.32	13.3
Kearney Lake Road & Highway 102 NB Ramps	**3.4**	**A**			**5.5**	**A**		
Kearney Lake Road (East Leg)	2.7	A	0.40	18.9	6.8	A	0.75	43.4
Kearney Lake Road (West Leg)	3.6	A	0.58	14.0	2.9	A	0.47	10.5
Highway 102 NB Off-Ramp	5.4	A	0.23	9.1	7.2	A	0.51	20.3

Summary

Improvements are required at the Highway 102 and Kearney Lake Road interchange to accommodate background traffic growth and the full build out of the Bedford West Sub Area 10 development. The NSTAT has determined that roundabouts are the best option to accommodate long term needs at the intersection based on vehicle capacity requirements and costs. Lane configurations have been established by the province to accommodate projected 2041 traffic volumes.

Improvements at the interchange will have a significant impact on Halifax Regional Municipality (HRM) infrastructure and the Kearney Lake Road corridor. The design of the Kearney Lake Road interchange provides the opportunity to consider the short term and long term needs for alternative modes of transportation at the interchange and HRM's mobility goals for the Kearney Lake Road corridor.

The most significant constraint to the design of Kearney Lake Road interchange is the existing bridge structure and associated Kearney Lake Road underpass. In the near-term, it is likely the NSTAT will seek to maintain the existing bridge structure which will limit the cross section that can be accommodated through the interchange. In the long-term, when the bridge is replaced, a wider cross section may be possible.

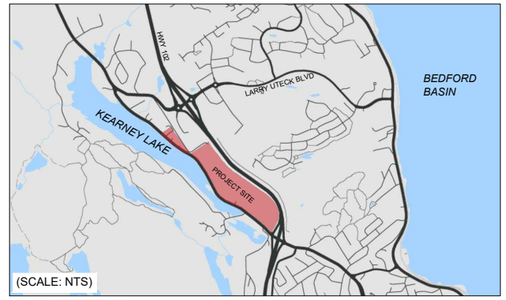
The memo reviews options for both the near-term design (existing bridge) and long-term design (new bridge) and propose recommendations for the design of the Kearney Lake Road and Highway 102 interchange and associated connections for walking, cycling, transit, and driving. There are multiple constraints and multimodal considerations and as such, a balanced approach is required.

While there are many design needs to be accommodated, it is clear that the proposed higher-density development necessitates a closer look at how the new residents of Bedford West Sub Area 10, as well as existing residents in the area, will get around. The planned BRT Purple Line presents an opportunity for these residents to leave their cars at home and commute using transit, while the "potential transit-oriented community" at Kearney Lake Road and Parkland will lead to more amenities in the area. Both of these changes will create a strong "desire line" for people to cross through the interchange on foot and by bicycle, and it is therefore critical that the interchange design provide a comfortable and convenient active transportation solution.

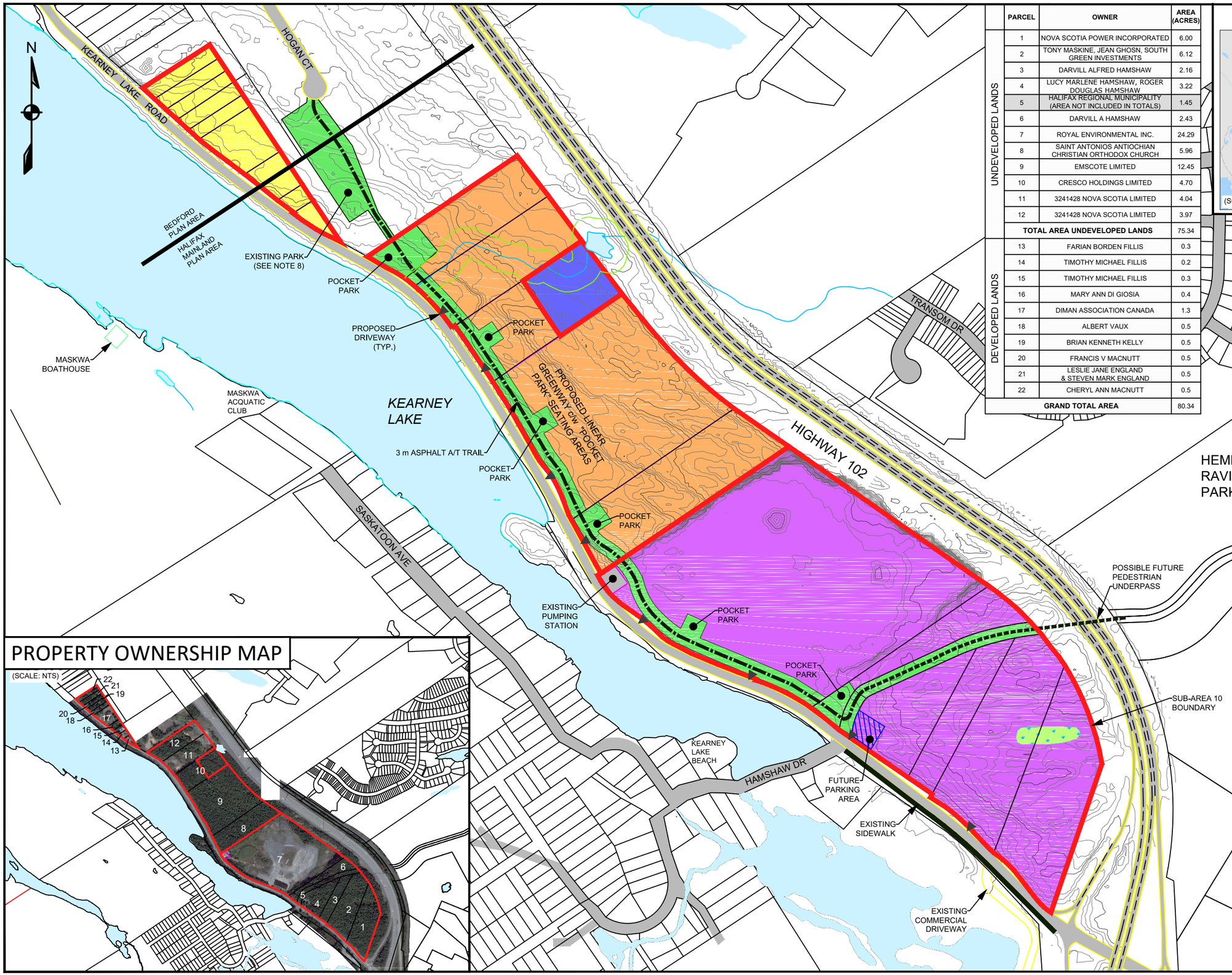
Appendix A - Site Plan

	PARCEL	OWNER	AREA (ACRES)
UNDEVELOPED LANDS	1	NOVA SCOTIA POWER INCORPORATED	6.00
	2	TONY MASKINE, JEAN GHOSN, SOUTH GREEN INVESTMENTS	6.12
	3	DARVILL ALFRED HAMSHAW	2.16
	4	LUCY MARLENE HAMSHAW, ROGER DOUGLAS HAMSHAW	3.22
	5	HALIFAX REGIONAL MUNICIPALITY (AREA NOT INCLUDED IN TOTALS)	1.45
	6	DARVILL A HAMSHAW	2.43
	7	ROYAL ENVIRONMENTAL INC.	24.29
	8	SAINT ANTONIOS ANTIOCHIAN CHRISTIAN ORTHODOX CHURCH	5.96
	9	EMSCOTE LIMITED	12.45
	10	CRESCO HOLDINGS LIMITED	4.70
	11	3241428 NOVA SCOTIA LIMITED	4.04
	12	3241428 NOVA SCOTIA LIMITED	3.97
	TOTAL AREA UNDEVELOPED LANDS		75.34
DEVELOPED LANDS	13	FARIAN BORDEN FILLIS	0.3
	14	TIMOTHY MICHAEL FILLIS	0.2
	15	TIMOTHY MICHAEL FILLIS	0.3
	16	MARY ANN DI GIOSIA	0.4
	17	DIMAN ASSOCIATION CANADA	1.3
	18	ALBERT VAUX	0.5
	19	BRIAN KENNETH KELLY	0.5
	20	FRANCIS V MACNUTT	0.5
	21	LESLIE JANE ENGLAND & STEVEN MARK ENGLAND	0.5
	22	CHERYL ANN MACNUTT	0.5
GRAND TOTAL AREA			80.34

KEY PLAN



PRELIMINARY



PROPERTY OWNERSHIP MAP

Metres
100 0 100 200
1:5000

LEGEND - PROPOSED LAND USE

- MIXED-USE ZONE
- RMT ZONE
- R1 ZONE
- INSTITUTIONAL ZONE
- PARK AND PATH ZONE
- WETLAND AREA
- PROPOSED AT TRAIL
- EXISTING SIDEWALK
- FUTURE A/T TRAIL
- WATERCOURSE BUFFER
- PROPOSED DRIVEWAY
- ZONE BOUNDARY

NOTES

1. LANDS ARE WITHIN HALIFAX MAINLAND PLAN AREA AND BEDFORD PLAN AREA.
2. WETLANDS AND WATERCOURSES SHOWN BASED ON PROVINCIAL MAPPING
3. LAND OWNERS OF PARCELS 2 AND 7-12 ARE CURRENTLY PARTICIPATING IN THE PLANNING PROCESS.
4. EXACT LOCATIONS OF DRIVEWAYS TO BE DETERMINED DURING DETAILED SITE DESIGN AND ARE SUBJECT TO CHANGE. STOPPING SIGHT DISTANCE TO BE ASSESSED AT ALL ACCESS POINTS.
5. ACTIVE TRANSPORTATION TRAIL DOES NOT PREVENT VEHICLE CROSSINGS. TRAIL LOCATION IS FLEXIBLE AND SUBJECT TO CHANGE.
6. CONTOURS BASED ON HRM LIDAR MAPPING. CONTOUR INTERVAL = 2m. PROPERTY LINES BASED ON PROVINCIAL MAPPING.
7. ALL BUILDING LOCATIONS ARE APPROXIMATE.
8. EXISTING PARK AND HOGAN CT LAYOUT BASED ON SDMM PLAN NO. 14-1640-0; REVISED ON APRIL 10TH, 2015.

Clayton The Community Builder

DESIGN POINT ENGINEERING & SURVEYING

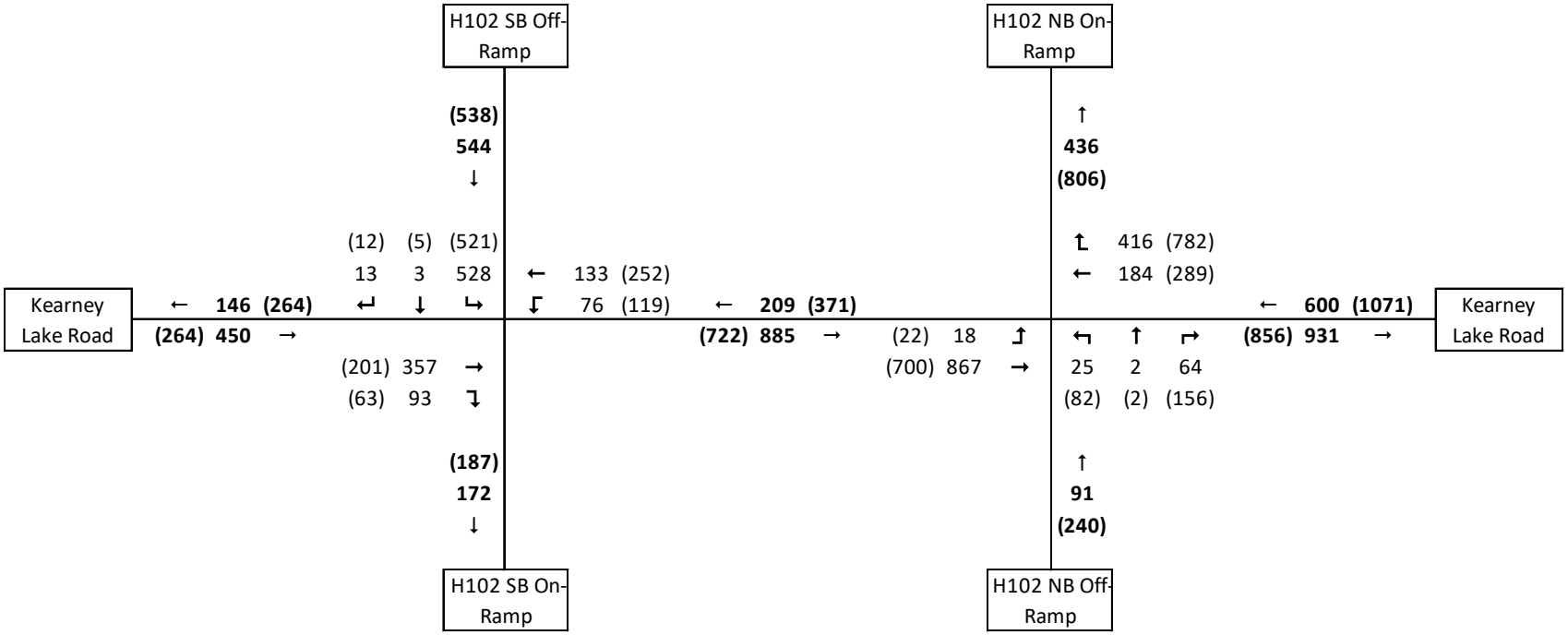
BEDFORD WEST SUB AREA 10 GENERALIZED FUTURE LAND-USE PLAN

HALIFAX, NOVA SCOTIA

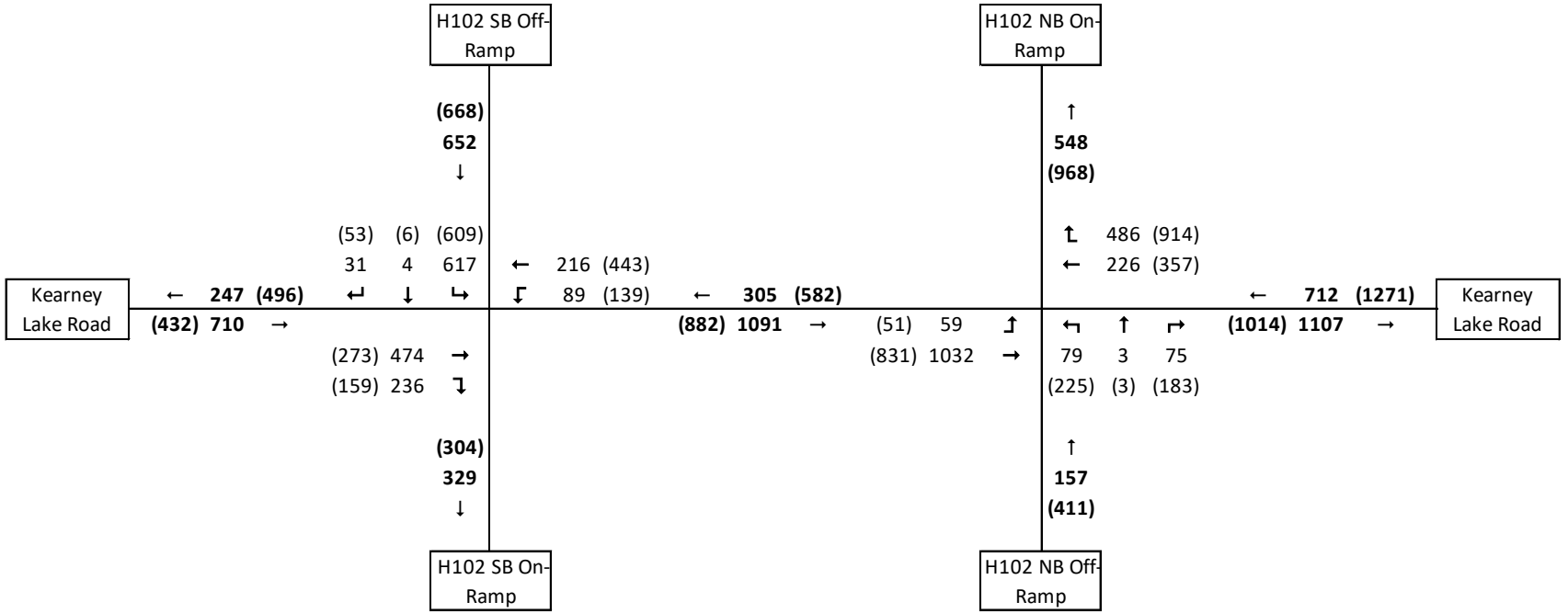
PROJECT NO.15-004	23-MAR-2018
DRAWING SCALE 1:5000	

Appendix B – Traffic Volume Projections

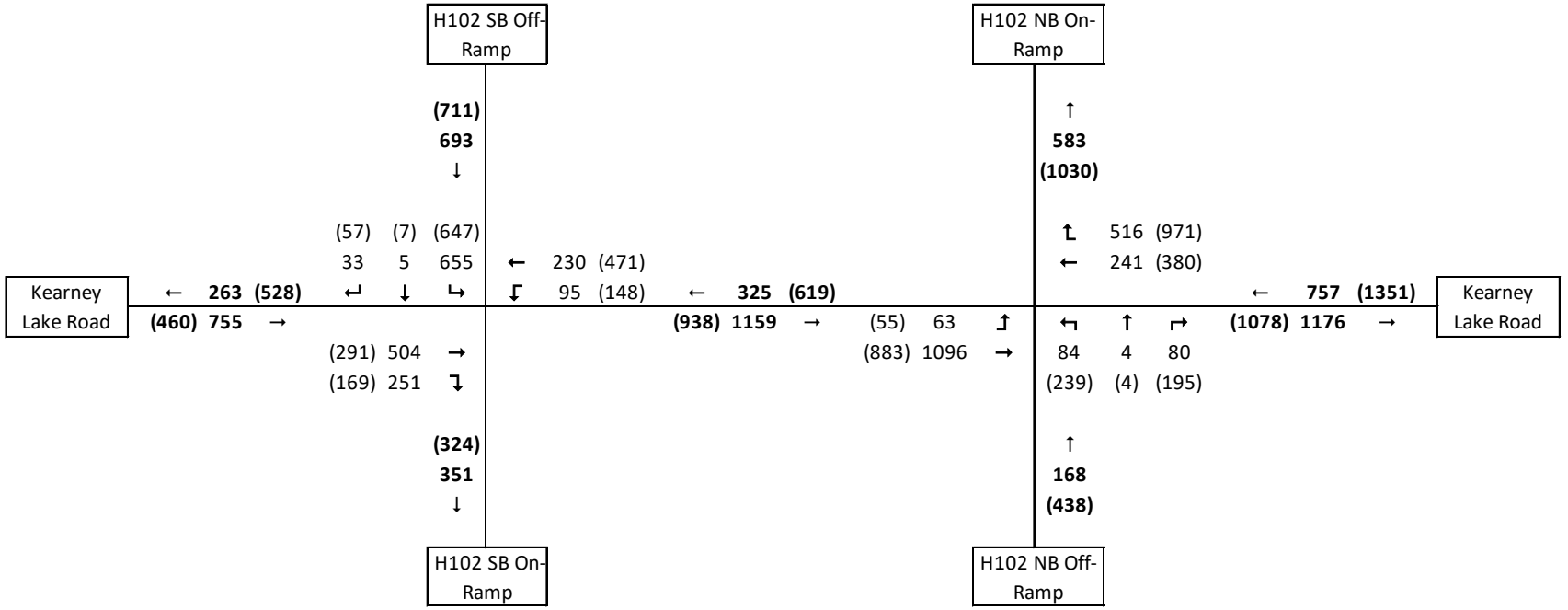
Kearney Lake Road/Highway 102 Interchange - 2018 AM(PM) Traffic Volumes



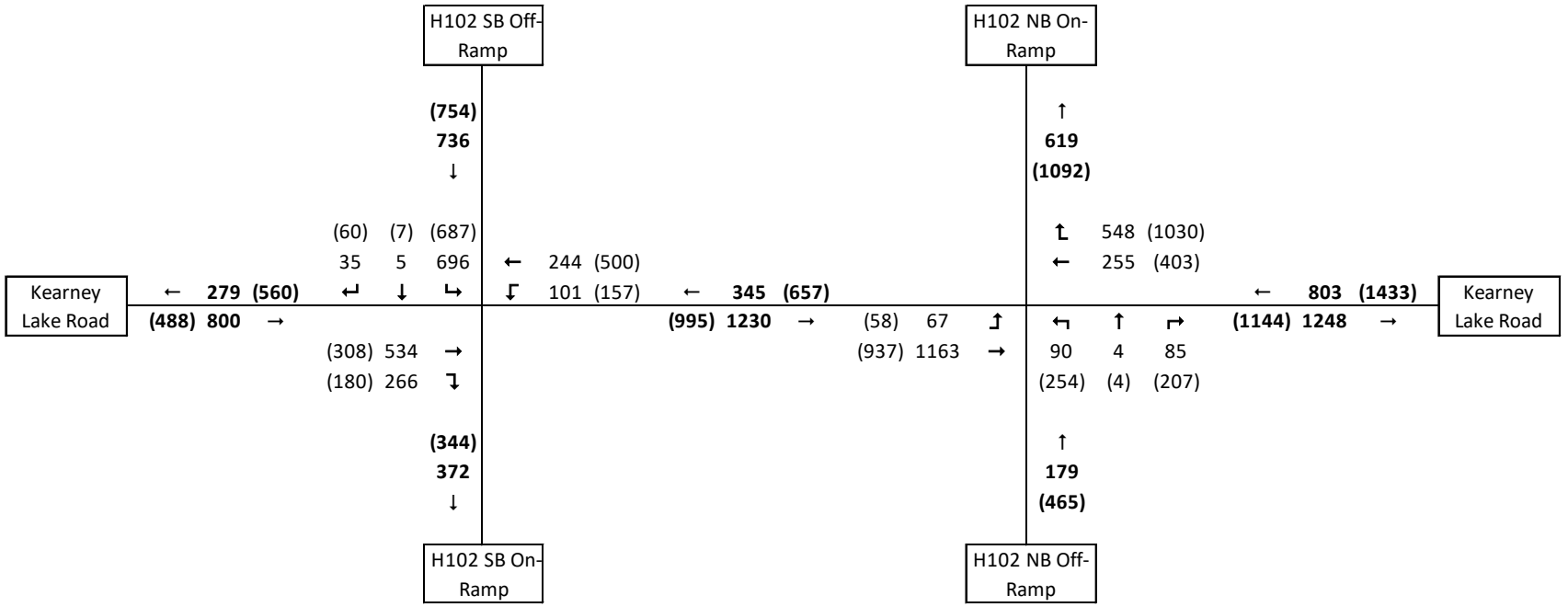
Kearney Lake Road/Highway 102 Interchange - Background Growth + Development 2031 AM(PM) Traffic Volumes



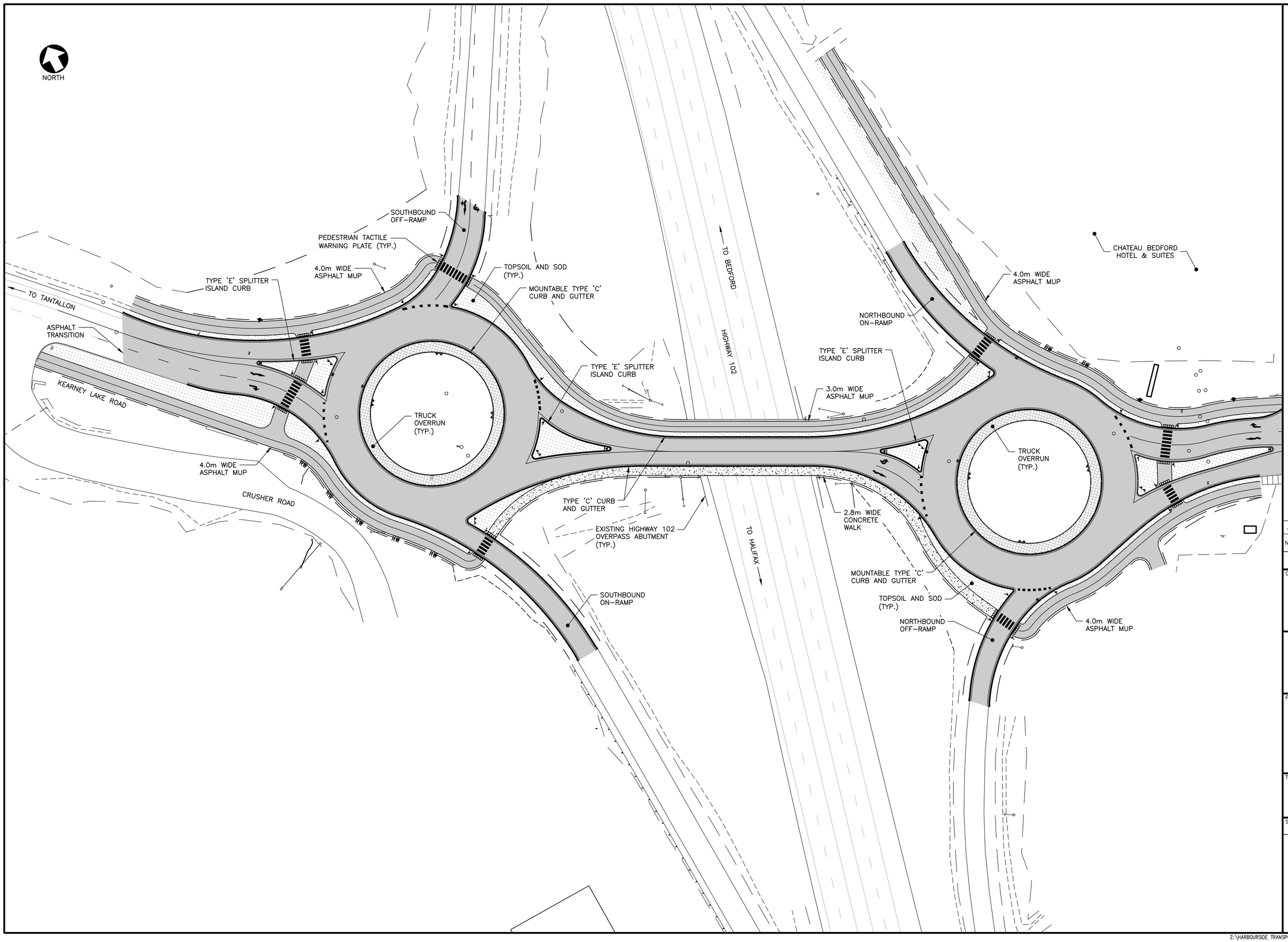
Kearney Lake Road/Highway 102 Interchange - Five-Year Timeframe after Development 2036 AM(PM) Traffic Volumes



Kearney Lake Road/Highway 102 Interchange - Ten-Year Timeframe after Development 2041 AM(PM) Traffic Volumes



Appendix C – Near-Term Design Preliminary Layout



LEGEND

EXISTING

- CURB AND GUTTER
- EDGE OF ASPHALT
- SIDEWALK
- EDGE OF GRAVEL
- TOP OF SLOPE
- BOTTOM OF SLOPE
- UTILITY POLE
- LIGHT STANDARD
- MANHOLE
- CATCH BASIN
- HYDRANT
- VALVE
- SIGN
- CULVERT
- TRAFFIC SIGNAL
- TREE
- OVERHEAD WIRE

PROPOSED

- CURB AND GUTTER
- EDGE OF ASPHALT
- MULTI USE PATHWAY (MUP)
- EDGE OF GRAVEL
- TOP OF SLOPE
- BOTTOM OF SLOPE
- MANHOLE
- CATCH BASIN
- HYDRANT
- VALVE
- SIGN
- CULVERT
- TACTILE WARNING PLATE
- RW — RETAINING WALL

PRELIMINARY
Not For Construction

No.	DESCRIPTION	Date (mm/dd/yy)	By
A	ISSUED FOR REVIEW	05/31/21	MSM

ISSUE or REVISION

Client

Clayton
The Community Builder

HARBOURSIDE
Transportation Consultants

Project

KEARNEY LAKE ROAD / HIGHWAY 102 INTERCHANGE HALIFAX, NOVA SCOTIA

ROUNDABOUT PRE-DESIGN

Title

KEARNEY LAKE ROAD
PROPOSED LAYOUT

Scale: 1:500	Date: MARCH 2021
	Drawn: K.D.M. / Designed: M.S.M.
	Checked: F.A. / Approved: M.S.
	Contract No.: 202081
	Drawing No.: **CSK-1**

Z:\HARBOURSIDE TRANSPORTATION CONSULTANTS\PROJECTS\202081 KLR ROUNDABOUTS\CAD\PRELIM DESIGN DRAWINGS\202081_C1-REV2.DWG, May 31, 2021, 3:30 PM

Appendix D – Long-Term Design Preliminary Layout

NORTH

SOUTHBOUND OFF–RAMP

NORTHBOUND ON–RAMP

FUTURE HIGHWAY 102 (NORTHBOUND)

KEARNEY LAKE ROAD

CHATEAU BEDFORD HOTEL & SUITES

KEARNEY LAKE ROAD

CRUSHER ROAD

PARKLAND DRIVE

PETRO–CANADA

FUTURE HIGHWAY 102 (SOUTHBOUND)

SOUTHBOUND ON–RAMP

NORTHBOUND OFF–RAMP

Scale	Date	Drawn	Designed	Checked	Approved	Contract
1:1250	DECEMBER 2020	K.D.M.	M.S.M.	F.A.	M.S.	202081

HARBOURSIDE
Transportation Consultants

KEARNEY LAKE ROAD ROUNDABOUT PRE–DESIGN HALIFAX, NOVA SCOTIA

ULTIMATE LAYOUT

SKETCH No.

CSK - 02

Appendix E – Junctions 9 ARCADY Report

Junctions 9

ARCADY 9 - Roundabout Module

Version: 9.5.1.7462

For sales and distribution information, program advice and maintenance, contact TRL:
+44 (0)1344 379777 software@trl.co.uk www.trlsoftware.co.uk

Filename: KLR & Hwy 102 Linked - Advanced Mode One-Hour Demand Profile - Rev.j9
Path: C:\Users\fallaire\Desktop\Design Memo - Rev 2 (Jan 2021)\Arcady
Report generation date: 2021-03-19 1:54:26 PM

Summary of intersection performance

	AM							PM						
	Queue (PCE)	95% Queue (PCE)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Queue (PCE)	95% Queue (PCE)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS
Near-Term Design - 2031														
1 - KLR & Hwy 102 SB - 1 - Kearney Lake Road (East)	0.4	1.2	3.98	0.27	A	8.85	A	1.1	1.5	6.01	0.52	A	9.48	A
1 - KLR & Hwy 102 SB - 2 - Highway 102 SB Off-Ramp	1.8	2.4	9.17	0.64	A			2.7	11.3	14.29	0.73	B		
1 - KLR & Hwy 102 SB - 3 - Kearney Lake Road (West)	1.6	3.1	10.64	0.61	B			0.6	2.7	6.72	0.36	A		
2 - KLR & Hwy 102 NB - 1 - Kearney Lake Road (East)	0.5	2.6	2.48	0.35	A	6.34	A	1.9	3.5	4.91	0.66	A	6.19	A
2 - KLR & Hwy 102 NB - 3 - Kearney Lake Road (West)	2.9	7.9	8.71	0.74	A			1.5	2.0	5.60	0.60	A		
2 - KLR & Hwy 102 NB - 4 - Highway 102 NB Off-Ramp	0.4	1.5	7.45	0.26	A			1.4	3.8	11.41	0.59	B		
Near-Term Design - 2036														
1 - KLR & Hwy 102 SB - 1 - Kearney Lake Road (East)	0.4	1.6	4.08	0.29	A	10.35	B	1.2	1.5	6.45	0.55	A	11.62	B
1 - KLR & Hwy 102 SB - 2 - Highway 102 SB Off-Ramp	2.1	5.8	10.61	0.68	B			3.7	18.8	18.89	0.79	C		
1 - KLR & Hwy 102 SB - 3 - Kearney Lake Road (West)	2.0	6.0	12.80	0.66	B			0.7	3.0	7.34	0.40	A		
2 - KLR & Hwy 102 NB - 1 - Kearney Lake Road (East)	0.6	2.8	2.58	0.37	A	7.50	A	2.4	4.8	5.70	0.70	A	7.21	A
2 - KLR & Hwy 102 NB - 3 - Kearney Lake Road (West)	3.7	14.8	10.60	0.79	B			1.8	2.8	6.19	0.64	A		
2 - KLR & Hwy 102 NB - 4 - Highway 102 NB Off-Ramp	0.4	1.6	8.28	0.30	A			1.9	5.7	14.03	0.65	B		

	AM							PM						
	Queue (PCE)	95% Queue (PCE)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS	Queue (PCE)	95% Queue (PCE)	Delay (s)	V/C Ratio	LOS	Intersection Delay (s)	Intersection LOS
Long-Term Design - 2036														
1 - KLR & Hwy 102 SB - 1 - Kearney Lake Road (East)	0.2	0.5	1.81	0.15	A	4.11	A	0.4	1.4	2.17	0.29	A	4.64	A
1 - KLR & Hwy 102 SB - 2 - Highway 102 SB Off-Ramp	1.2	1.5	5.51	0.54	A			1.7	2.0	7.92	0.63	A		
1 - KLR & Hwy 102 SB - 3 - Kearney Lake Road (West)	0.9	2.1	3.81	0.47	A			0.4	1.4	2.91	0.29	A		
2 - KLR & Hwy 102 NB - 1 - Kearney Lake Road (East)	0.6	2.8	2.58	0.37	A	3.21	A	2.4	4.8	5.70	0.70	A	4.80	A
2 - KLR & Hwy 102 NB - 3 - Kearney Lake Road (West)	1.2	1.6	3.38	0.54	A			0.8	1.9	2.75	0.44	A		
2 - KLR & Hwy 102 NB - 4 - Highway 102 NB Off-Ramp	0.3	1.0	4.97	0.20	A			0.9	3.0	6.41	0.46	A		
Long-Term Design - 2041														
1 - KLR & Hwy 102 SB - 1 - Kearney Lake Road (East)	0.2	0.5	1.83	0.16	A	4.49	A	0.5	1.8	2.22	0.31	A	5.28	A
1 - KLR & Hwy 102 SB - 2 - Highway 102 SB Off-Ramp	1.4	1.6	6.07	0.58	A			2.2	4.7	9.36	0.68	A		
1 - KLR & Hwy 102 SB - 3 - Kearney Lake Road (West)	1.0	1.5	4.18	0.51	A			0.5	1.9	3.08	0.32	A		
2 - KLR & Hwy 102 NB - 1 - Kearney Lake Road (East)	0.7	2.7	2.69	0.40	A	3.44	A	3.0	6.2	6.82	0.75	A	5.53	A
2 - KLR & Hwy 102 NB - 3 - Kearney Lake Road (West)	1.4	2.0	3.64	0.58	A			0.9	1.5	2.89	0.47	A		
2 - KLR & Hwy 102 NB - 4 - Highway 102 NB Off-Ramp	0.3	1.3	5.38	0.23	A			1.0	2.9	7.24	0.51	A		

There are warnings associated with one or more model runs - see the 'Data Errors and Warnings' tables for each Analysis or Demand Set.

Values shown are the highest values encountered over all time segments. Delay is the maximum value of average delay per arriving vehicle. Intersection LOS and Intersection Delay are demand-weighted averages.

File summary

File Description

Title	Kearney Lake Road Interchange
Location	Bedford, NS
Date	2020-12-16
Version	1
Client	Clayton Developments
Jobnumber	202081

Units

Distance units	Speed units	Traffic units input	Traffic units results	Flow units	Average delay units	Total delay units	Rate of delay units
m	kph	Veh	PCE	perHour	s	-Min	perMin

Analysis Options

Vehicle length (m)	Calculate Queue Percentiles	Calculate detailed queueing delay	Calculate residual capacity	V/C Ratio Threshold	Average Delay threshold (s)	Queue threshold (PCE)
7.00	✓			0.85	35.00	14.00

Demand Set Summary

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D1	2031	AM	ONE HOUR	08:00	09:30	15	✓
D2	2031	PM	ONE HOUR	16:00	17:30	15	✓
D3	2036	AM	ONE HOUR	08:00	09:30	15	✓
D4	2036	PM	ONE HOUR	16:00	17:30	15	✓
D5	2041	AM	ONE HOUR	08:00	09:30	15	✓
D6	2041	PM	ONE HOUR	16:00	17:30	15	✓

Near-Term Design - 2031, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Queue variations	Analysis Options	Queue percentiles may be unreliable if the mean queue in any time segment is very low or very high.

Analysis Set Details

ID	Name	Include in report	Use specific Demand Set(s)	Specific Demand Set(s)	Network flow scaling factor (%)	Network capacity scaling factor (%)
A1	Near-Term Design	✓	✓	D1,D2,D3,D4	100.000	100.000

Intersection Network

Intersections

Intersection	Name	Intersection type	Use circulating lanes	Leg order	Intersection Delay (s)	Intersection LOS
1	KLR & Hwy 102 SB	Standard Roundabout		1, 2, 3, 4	8.85	A
2	KLR & Hwy 102 NB	Standard Roundabout		1, 2, 3, 4	6.34	A

Intersection Network Options

Driving side	Lighting
Right	Normal/unknown

Legs

Legs

Intersection	Leg	Name	Description
1 - KLR & Hwy 102 SB	1	Kearney Lake Road (East)	
	2	Highway 102 SB Off-Ramp	
	3	Kearney Lake Road (West)	
	4	Highway 102 SB On-Ramp	
2 - KLR & Hwy 102 NB	1	Kearney Lake Road (East)	
	2	Highway 102 NB On-Ramp	
	3	Kearney Lake Road (West)	
	4	Highway 102 NB Off-Ramp	

Roundabout Geometry

Intersection	Leg	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	3.50	4.25	10.0	30.0	60.0	30.0	
	2 - Highway 102 SB Off-Ramp	3.50	4.25	10.0	30.0	60.0	30.0	
	3 - Kearney Lake Road (West)	3.50	4.25	10.0	30.0	60.0	30.0	
	4 - Highway 102 SB On-Ramp							✓
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)	7.00	8.00	10.0	30.0	60.0	30.0	
	2 - Highway 102 NB On-Ramp							✓
	3 - Kearney Lake Road (West)	3.50	8.00	10.0	30.0	60.0	30.0	
	4 - Highway 102 NB Off-Ramp	3.50	4.25	10.0	30.0	60.0	30.0	

Bypass

Intersection	Leg	Leg has bypass	Bypass utilisation (%)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)		
	2 - Highway 102 SB Off-Ramp	✓	100
	3 - Kearney Lake Road (West)	✓	100
	4 - Highway 102 SB On-Ramp		
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)		
	2 - Highway 102 NB On-Ramp		
	3 - Kearney Lake Road (West)		
	4 - Highway 102 NB Off-Ramp		

Slope / Intercept / Capacity

Roundabout Slope and Intercept used in model

Intersection	Leg	Final slope	Final intercept (PCE/hr)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	0.486	1264
	2 - Highway 102 SB Off-Ramp	0.486	1264
	3 - Kearney Lake Road (West)	0.486	1264
	4 - Highway 102 SB On-Ramp		
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)	0.681	2389
	2 - Highway 102 NB On-Ramp		
	3 - Kearney Lake Road (West)	0.552	1646
	4 - Highway 102 NB Off-Ramp	0.486	1264

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D1	2031	AM	ONE HOUR	08:00	09:30	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCE Factor for a Truck (PCE)
✓	✓	Truck Percentages	2.00

Linked Leg Data

Intersection	Leg	Feeding Intersection	Feeding Leg	Link Type	Flow source	Uniform flow (Veh/hr)	Flow multiplier (%)	Internal storage space (PCE)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	2	3	Queue limited	Exit flow only	0	100.00	15.00
2 - KLR & Hwy 102 NB	3 - Kearney Lake Road (West)	1	1	Queue limited	Exit flow only	0	100.00	15.00

Demand overview (Traffic)

Intersection	Leg	Linked leg	Profile type	Use O-D data	Average Demand (Veh/hr)	Scaling Factor (%)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	✓				
	2 - Highway 102 SB Off-Ramp		ONE HOUR	✓	652	100.000
	3 - Kearney Lake Road (West)		ONE HOUR	✓	710	100.000
	4 - Highway 102 SB On-Ramp					
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)		ONE HOUR	✓	712	100.000
	2 - Highway 102 NB On-Ramp					
	3 - Kearney Lake Road (West)	✓				
	4 - Highway 102 NB Off-Ramp		ONE HOUR	✓	157	100.000

Origin-Destination Data

1 - KLR & Hwy 102 SB

Demand (Veh/hr)

		To			
		1 - Kearney Lake Road (East)	2 - Highway 102 SB Off-Ramp	3 - Kearney Lake Road (West)	4 - Highway 102 SB On-Ramp
From	1 - Kearney Lake Road (East)	0	0	216	88
	2 - Highway 102 SB Off-Ramp	617	0	31	4
	3 - Kearney Lake Road (West)	474	0	0	236
	4 - Highway 102 SB On-Ramp	Exit-only	Exit-only	Exit-only	Exit-only

2 - KLR & Hwy 102 NB

Demand (Veh/hr)

		To			
		1 - Kearney Lake Road (East)	2 - Highway 102 NB On-Ramp	3 - Kearney Lake Road (West)	4 - Highway 102 NB Off-Ramp
From	1 - Kearney Lake Road (East)	0	486	226	0
	2 - Highway 102 NB On-Ramp	Exit-only	Exit-only	Exit-only	Exit-only
	3 - Kearney Lake Road (West)	1032	59	0	0
	4 - Highway 102 NB Off-Ramp	75	3	79	0

Vehicle Mix

1 - KLR & Hwy 102 SB

Truck Percentages

		To			
		1 - Kearney Lake Road (East)	2 - Highway 102 SB Off-Ramp	3 - Kearney Lake Road (West)	4 - Highway 102 SB On-Ramp
From	1 - Kearney Lake Road (East)	2	2	2	2
	2 - Highway 102 SB Off-Ramp	2	2	2	2
	3 - Kearney Lake Road (West)	2	2	2	2
	4 - Highway 102 SB On-Ramp	Exit-only	Exit-only	Exit-only	Exit-only

2 - KLR & Hwy 102 NB

Truck Percentages

		To			
		1 - Kearney Lake Road (East)	2 - Highway 102 NB On-Ramp	3 - Kearney Lake Road (West)	4 - Highway 102 NB Off-Ramp
From	1 - Kearney Lake Road (East)	2	2	2	2
	2 - Highway 102 NB On-Ramp	Exit-only	Exit-only	Exit-only	Exit-only
	3 - Kearney Lake Road (West)	2	2	2	2
	4 - Highway 102 NB Off-Ramp	2	2	2	2

Results

Results Summary for whole modelled period

Intersection	Leg	Max V/C Ratio	Max Delay (s)	Max Queue (PCE)	Max 95th percentile Queue (PCE)	Max LOS	Average Demand (PCE/hr)	Total Intersection Arrivals (PCE)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	0.27	3.98	0.4	1.2	A	285	428
	2 - Highway 102 SB Off-Ramp	0.64	9.17	1.8	2.4	A	610	872
	3 - Kearney Lake Road (West)	0.61	10.64	1.6	3.1	B	665	665
	4 - Highway 102 SB On-Ramp							
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)	0.35	2.48	0.5	2.6	A	666	1000
	2 - Highway 102 NB On-Ramp							
	3 - Kearney Lake Road (West)	0.74	8.71	2.9	7.9	A	1020	1530
	4 - Highway 102 NB Off-Ramp	0.26	7.45	0.4	1.5	A	147	220

Near-Term Design - 2031, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Queue variations	Analysis Options	Queue percentiles may be unreliable if the mean queue in any time segment is very low or very high.

Analysis Set Details

ID	Name	Include in report	Use specific Demand Set(s)	Specific Demand Set(s)	Network flow scaling factor (%)	Network capacity scaling factor (%)
A1	Near-Term Design	✓	✓	D1,D2,D3,D4	100.000	100.000

Intersection Network

Intersections

Intersection	Name	Intersection type	Use circulating lanes	Leg order	Intersection Delay (s)	Intersection LOS
1	KLR & Hwy 102 SB	Standard Roundabout		1, 2, 3, 4	9.48	A
2	KLR & Hwy 102 NB	Standard Roundabout		1, 2, 3, 4	6.19	A

Intersection Network Options

Driving side	Lighting
Right	Normal/unknown

Legs

Legs

Intersection	Leg	Name	Description
1 - KLR & Hwy 102 SB	1	Kearney Lake Road (East)	
	2	Highway 102 SB Off-Ramp	
	3	Kearney Lake Road (West)	
	4	Highway 102 SB On-Ramp	
2 - KLR & Hwy 102 NB	1	Kearney Lake Road (East)	
	2	Highway 102 NB On-Ramp	
	3	Kearney Lake Road (West)	
	4	Highway 102 NB Off-Ramp	

Roundabout Geometry

Intersection	Leg	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	3.50	4.25	10.0	30.0	60.0	30.0	
	2 - Highway 102 SB Off-Ramp	3.50	4.25	10.0	30.0	60.0	30.0	
	3 - Kearney Lake Road (West)	3.50	4.25	10.0	30.0	60.0	30.0	
	4 - Highway 102 SB On-Ramp							✓
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)	7.00	8.00	10.0	30.0	60.0	30.0	
	2 - Highway 102 NB On-Ramp							✓
	3 - Kearney Lake Road (West)	3.50	8.00	10.0	30.0	60.0	30.0	
	4 - Highway 102 NB Off-Ramp	3.50	4.25	10.0	30.0	60.0	30.0	

Bypass

Intersection	Leg	Leg has bypass	Bypass utilisation (%)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)		
	2 - Highway 102 SB Off-Ramp	✓	100
	3 - Kearney Lake Road (West)	✓	100
	4 - Highway 102 SB On-Ramp		
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)		
	2 - Highway 102 NB On-Ramp		
	3 - Kearney Lake Road (West)		
	4 - Highway 102 NB Off-Ramp		

Slope / Intercept / Capacity

Roundabout Slope and Intercept used in model

Intersection	Leg	Final slope	Final intercept (PCE/hr)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	0.486	1264
	2 - Highway 102 SB Off-Ramp	0.486	1264
	3 - Kearney Lake Road (West)	0.486	1264
	4 - Highway 102 SB On-Ramp		
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)	0.681	2389
	2 - Highway 102 NB On-Ramp		
	3 - Kearney Lake Road (West)	0.552	1646
	4 - Highway 102 NB Off-Ramp	0.486	1264

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D2	2031	PM	ONE HOUR	16:00	17:30	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCE Factor for a Truck (PCE)
✓	✓	Truck Percentages	2.00

Linked Leg Data

Intersection	Leg	Feeding Intersection	Feeding Leg	Link Type	Flow source	Uniform flow (Veh/hr)	Flow multiplier (%)	Internal storage space (PCE)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	2	3	Queue limited	Exit flow only	0	100.00	15.00
2 - KLR & Hwy 102 NB	3 - Kearney Lake Road (West)	1	1	Queue limited	Exit flow only	0	100.00	15.00

Demand overview (Traffic)

Intersection	Leg	Linked leg	Profile type	Use O-D data	Average Demand (Veh/hr)	Scaling Factor (%)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	✓				
	2 - Highway 102 SB Off-Ramp		ONE HOUR	✓	668	100.000
	3 - Kearney Lake Road (West)		ONE HOUR	✓	432	100.000
	4 - Highway 102 SB On-Ramp					
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)		ONE HOUR	✓	1271	100.000
	2 - Highway 102 NB On-Ramp					
	3 - Kearney Lake Road (West)	✓				
	4 - Highway 102 NB Off-Ramp		ONE HOUR	✓	411	100.000

Origin-Destination Data

1 - KLR & Hwy 102 SB

Demand (Veh/hr)

		To			
		1 - Kearney Lake Road (East)	2 - Highway 102 SB Off-Ramp	3 - Kearney Lake Road (West)	4 - Highway 102 SB On-Ramp
From	1 - Kearney Lake Road (East)	0	0	443	139
	2 - Highway 102 SB Off-Ramp	609	0	53	6
	3 - Kearney Lake Road (West)	273	0	0	159
	4 - Highway 102 SB On-Ramp	Exit-only	Exit-only	Exit-only	Exit-only

2 - KLR & Hwy 102 NB

Demand (Veh/hr)

		To			
		1 - Kearney Lake Road (East)	2 - Highway 102 NB On-Ramp	3 - Kearney Lake Road (West)	4 - Highway 102 NB Off-Ramp
From	1 - Kearney Lake Road (East)	0	914	357	0
	2 - Highway 102 NB On-Ramp	Exit-only	Exit-only	Exit-only	Exit-only
	3 - Kearney Lake Road (West)	831	51	0	0
	4 - Highway 102 NB Off-Ramp	183	3	225	0

Vehicle Mix

1 - KLR & Hwy 102 SB

Truck Percentages

		To			
		1 - Kearney Lake Road (East)	2 - Highway 102 SB Off-Ramp	3 - Kearney Lake Road (West)	4 - Highway 102 SB On-Ramp
From	1 - Kearney Lake Road (East)	2	2	2	2
	2 - Highway 102 SB Off-Ramp	2	2	2	2
	3 - Kearney Lake Road (West)	2	2	2	2
	4 - Highway 102 SB On-Ramp	Exit-only	Exit-only	Exit-only	Exit-only

2 - KLR & Hwy 102 NB

Truck Percentages

		To			
		1 - Kearney Lake Road (East)	2 - Highway 102 NB On-Ramp	3 - Kearney Lake Road (West)	4 - Highway 102 NB Off-Ramp
From	1 - Kearney Lake Road (East)	2	2	2	2
	2 - Highway 102 NB On-Ramp	Exit-only	Exit-only	Exit-only	Exit-only
	3 - Kearney Lake Road (West)	2	2	2	2
	4 - Highway 102 NB Off-Ramp	2	2	2	2

Results

Results Summary for whole modelled period

Intersection	Leg	Max V/C Ratio	Max Delay (s)	Max Queue (PCE)	Max 95th percentile Queue (PCE)	Max LOS	Average Demand (PCE/hr)	Total Intersection Arrivals (PCE)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	0.52	6.01	1.1	1.5	A	544	817
	2 - Highway 102 SB Off-Ramp	0.73	14.29	2.7	11.3	B	625	863
	3 - Kearney Lake Road (West)	0.36	6.72	0.6	2.7	A	404	383
	4 - Highway 102 SB On-Ramp							
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)	0.66	4.91	1.9	3.5	A	1190	1784
	2 - Highway 102 NB On-Ramp							
	3 - Kearney Lake Road (West)	0.60	5.60	1.5	2.0	A	825	1237
	4 - Highway 102 NB Off-Ramp	0.59	11.41	1.4	3.8	B	385	577

Near-Term Design - 2036, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Queue variations	Analysis Options	Queue percentiles may be unreliable if the mean queue in any time segment is very low or very high.

Analysis Set Details

ID	Name	Include in report	Use specific Demand Set(s)	Specific Demand Set(s)	Network flow scaling factor (%)	Network capacity scaling factor (%)
A1	Near-Term Design	✓	✓	D1,D2,D3,D4	100.000	100.000

Intersection Network

Intersections

Intersection	Name	Intersection type	Use circulating lanes	Leg order	Intersection Delay (s)	Intersection LOS
1	KLR & Hwy 102 SB	Standard Roundabout		1, 2, 3, 4	10.35	B
2	KLR & Hwy 102 NB	Standard Roundabout		1, 2, 3, 4	7.50	A

Intersection Network Options

Driving side	Lighting
Right	Normal/unknown

Legs

Legs

Intersection	Leg	Name	Description
1 - KLR & Hwy 102 SB	1	Kearney Lake Road (East)	
	2	Highway 102 SB Off-Ramp	
	3	Kearney Lake Road (West)	
	4	Highway 102 SB On-Ramp	
2 - KLR & Hwy 102 NB	1	Kearney Lake Road (East)	
	2	Highway 102 NB On-Ramp	
	3	Kearney Lake Road (West)	
	4	Highway 102 NB Off-Ramp	

Roundabout Geometry

Intersection	Leg	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	3.50	4.25	10.0	30.0	60.0	30.0	
	2 - Highway 102 SB Off-Ramp	3.50	4.25	10.0	30.0	60.0	30.0	
	3 - Kearney Lake Road (West)	3.50	4.25	10.0	30.0	60.0	30.0	
	4 - Highway 102 SB On-Ramp							✓
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)	7.00	8.00	10.0	30.0	60.0	30.0	
	2 - Highway 102 NB On-Ramp							✓
	3 - Kearney Lake Road (West)	3.50	8.00	10.0	30.0	60.0	30.0	
	4 - Highway 102 NB Off-Ramp	3.50	4.25	10.0	30.0	60.0	30.0	

Bypass

Intersection	Leg	Leg has bypass	Bypass utilisation (%)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)		
	2 - Highway 102 SB Off-Ramp	✓	100
	3 - Kearney Lake Road (West)	✓	100
	4 - Highway 102 SB On-Ramp		
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)		
	2 - Highway 102 NB On-Ramp		
	3 - Kearney Lake Road (West)		
	4 - Highway 102 NB Off-Ramp		

Slope / Intercept / Capacity

Roundabout Slope and Intercept used in model

Intersection	Leg	Final slope	Final intercept (PCE/hr)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	0.486	1264
	2 - Highway 102 SB Off-Ramp	0.486	1264
	3 - Kearney Lake Road (West)	0.486	1264
	4 - Highway 102 SB On-Ramp		
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)	0.681	2389
	2 - Highway 102 NB On-Ramp		
	3 - Kearney Lake Road (West)	0.552	1646
	4 - Highway 102 NB Off-Ramp	0.486	1264

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D3	2036	AM	ONE HOUR	08:00	09:30	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCE Factor for a Truck (PCE)
✓	✓	Truck Percentages	2.00

Linked Leg Data

Intersection	Leg	Feeding Intersection	Feeding Leg	Link Type	Flow source	Uniform flow (Veh/hr)	Flow multiplier (%)	Internal storage space (PCE)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	2	3	Queue limited	Exit flow only	0	100.00	15.00
2 - KLR & Hwy 102 NB	3 - Kearney Lake Road (West)	1	1	Queue limited	Exit flow only	0	100.00	15.00

Demand overview (Traffic)

Intersection	Leg	Linked leg	Profile type	Use O-D data	Average Demand (Veh/hr)	Scaling Factor (%)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	✓				
	2 - Highway 102 SB Off-Ramp		ONE HOUR	✓	693	100.000
	3 - Kearney Lake Road (West)		ONE HOUR	✓	755	100.000
	4 - Highway 102 SB On-Ramp					
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)		ONE HOUR	✓	757	100.000
	2 - Highway 102 NB On-Ramp					
	3 - Kearney Lake Road (West)	✓				
	4 - Highway 102 NB Off-Ramp		ONE HOUR	✓	168	100.000

Origin-Destination Data

Demand (Veh/hr)

1 - KLR & Hwy 102 SB

		To			
		1 - Kearney Lake Road (East)	2 - Highway 102 SB Off-Ramp	3 - Kearney Lake Road (West)	4 - Highway 102 SB On-Ramp
From	1 - Kearney Lake Road (East)	0	0	230	95
	2 - Highway 102 SB Off-Ramp	655	0	33	5
	3 - Kearney Lake Road (West)	504	0	0	251
	4 - Highway 102 SB On-Ramp	Exit-only	Exit-only	Exit-only	Exit-only

Demand (Veh/hr)

2 - KLR & Hwy 102 NB

		To			
		1 - Kearney Lake Road (East)	2 - Highway 102 NB On-Ramp	3 - Kearney Lake Road (West)	4 - Highway 102 NB Off-Ramp
From	1 - Kearney Lake Road (East)	0	516	241	0
	2 - Highway 102 NB On-Ramp	Exit-only	Exit-only	Exit-only	Exit-only
	3 - Kearney Lake Road (West)	1096	63	0	0
	4 - Highway 102 NB Off-Ramp	80	4	84	0

Vehicle Mix

Truck Percentages

1 - KLR & Hwy 102 SB

		To			
		1 - Kearney Lake Road (East)	2 - Highway 102 SB Off-Ramp	3 - Kearney Lake Road (West)	4 - Highway 102 SB On-Ramp
From	1 - Kearney Lake Road (East)	2	2	2	2
	2 - Highway 102 SB Off-Ramp	2	2	2	2
	3 - Kearney Lake Road (West)	2	2	2	2
	4 - Highway 102 SB On-Ramp	Exit-only	Exit-only	Exit-only	Exit-only

Truck Percentages

2 - KLR & Hwy 102 NB

		To			
		1 - Kearney Lake Road (East)	2 - Highway 102 NB On-Ramp	3 - Kearney Lake Road (West)	4 - Highway 102 NB Off-Ramp
From	1 - Kearney Lake Road (East)	2	2	2	2
	2 - Highway 102 NB On-Ramp	Exit-only	Exit-only	Exit-only	Exit-only
	3 - Kearney Lake Road (West)	2	2	2	2
	4 - Highway 102 NB Off-Ramp	2	2	2	2

Results

Results Summary for whole modelled period

Intersection	Leg	Max V/C Ratio	Max Delay (s)	Max Queue (PCE)	Max 95th percentile Queue (PCE)	Max LOS	Average Demand (PCE/hr)	Total Intersection Arrivals (PCE)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	0.29	4.08	0.4	1.6	A	304	456
	2 - Highway 102 SB Off-Ramp	0.68	10.61	2.1	5.8	B	649	927
	3 - Kearney Lake Road (West)	0.66	12.80	2.0	6.0	B	707	708
	4 - Highway 102 SB On-Ramp							
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)	0.37	2.58	0.6	2.8	A	709	1063
	2 - Highway 102 NB On-Ramp							
	3 - Kearney Lake Road (West)	0.79	10.60	3.7	14.8	B	1084	1626
	4 - Highway 102 NB Off-Ramp	0.30	8.28	0.4	1.6	A	157	236

Near-Term Design - 2036, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Queue variations	Analysis Options	Queue percentiles may be unreliable if the mean queue in any time segment is very low or very high.

Analysis Set Details

ID	Name	Include in report	Use specific Demand Set(s)	Specific Demand Set(s)	Network flow scaling factor (%)	Network capacity scaling factor (%)
A1	Near-Term Design	✓	✓	D1,D2,D3,D4	100.000	100.000

Intersection Network

Intersections

Intersection	Name	Intersection type	Use circulating lanes	Leg order	Intersection Delay (s)	Intersection LOS
1	KLR & Hwy 102 SB	Standard Roundabout		1, 2, 3, 4	11.62	B
2	KLR & Hwy 102 NB	Standard Roundabout		1, 2, 3, 4	7.21	A

Intersection Network Options

Driving side	Lighting
Right	Normal/unknown

Legs

Legs

Intersection	Leg	Name	Description
1 - KLR & Hwy 102 SB	1	Kearney Lake Road (East)	
	2	Highway 102 SB Off-Ramp	
	3	Kearney Lake Road (West)	
	4	Highway 102 SB On-Ramp	
2 - KLR & Hwy 102 NB	1	Kearney Lake Road (East)	
	2	Highway 102 NB On-Ramp	
	3	Kearney Lake Road (West)	
	4	Highway 102 NB Off-Ramp	

Roundabout Geometry

Intersection	Leg	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	3.50	4.25	10.0	30.0	60.0	30.0	
	2 - Highway 102 SB Off-Ramp	3.50	4.25	10.0	30.0	60.0	30.0	
	3 - Kearney Lake Road (West)	3.50	4.25	10.0	30.0	60.0	30.0	
	4 - Highway 102 SB On-Ramp							✓
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)	7.00	8.00	10.0	30.0	60.0	30.0	
	2 - Highway 102 NB On-Ramp							✓
	3 - Kearney Lake Road (West)	3.50	8.00	10.0	30.0	60.0	30.0	
	4 - Highway 102 NB Off-Ramp	3.50	4.25	10.0	30.0	60.0	30.0	

Bypass

Intersection	Leg	Leg has bypass	Bypass utilisation (%)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)		
	2 - Highway 102 SB Off-Ramp	✓	100
	3 - Kearney Lake Road (West)	✓	100
	4 - Highway 102 SB On-Ramp		
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)		
	2 - Highway 102 NB On-Ramp		
	3 - Kearney Lake Road (West)		
	4 - Highway 102 NB Off-Ramp		

Slope / Intercept / Capacity

Roundabout Slope and Intercept used in model

Intersection	Leg	Final slope	Final intercept (PCE/hr)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	0.486	1264
	2 - Highway 102 SB Off-Ramp	0.486	1264
	3 - Kearney Lake Road (West)	0.486	1264
	4 - Highway 102 SB On-Ramp		
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)	0.681	2389
	2 - Highway 102 NB On-Ramp		
	3 - Kearney Lake Road (West)	0.552	1646
	4 - Highway 102 NB Off-Ramp	0.486	1264

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D4	2036	PM	ONE HOUR	16:00	17:30	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCE Factor for a Truck (PCE)
✓	✓	Truck Percentages	2.00

Linked Leg Data

Intersection	Leg	Feeding Intersection	Feeding Leg	Link Type	Flow source	Uniform flow (Veh/hr)	Flow multiplier (%)	Internal storage space (PCE)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	2	3	Queue limited	Exit flow only	0	100.00	15.00
2 - KLR & Hwy 102 NB	3 - Kearney Lake Road (West)	1	1	Queue limited	Exit flow only	0	100.00	15.00

Demand overview (Traffic)

Intersection	Leg	Linked leg	Profile type	Use O-D data	Average Demand (Veh/hr)	Scaling Factor (%)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	✓				
	2 - Highway 102 SB Off-Ramp		ONE HOUR	✓	711	100.000
	3 - Kearney Lake Road (West)		ONE HOUR	✓	460	100.000
	4 - Highway 102 SB On-Ramp					
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)		ONE HOUR	✓	1351	100.000
	2 - Highway 102 NB On-Ramp					
	3 - Kearney Lake Road (West)	✓				
	4 - Highway 102 NB Off-Ramp		ONE HOUR	✓	438	100.000

Origin-Destination Data

Demand (Veh/hr)

1 - KLR & Hwy 102 SB

		To			
		1 - Kearney Lake Road (East)	2 - Highway 102 SB Off-Ramp	3 - Kearney Lake Road (West)	4 - Highway 102 SB On-Ramp
From	1 - Kearney Lake Road (East)	0	0	471	148
	2 - Highway 102 SB Off-Ramp	647	0	57	7
	3 - Kearney Lake Road (West)	291	0	0	169
	4 - Highway 102 SB On-Ramp	Exit-only	Exit-only	Exit-only	Exit-only

Demand (Veh/hr)

2 - KLR & Hwy 102 NB

		To			
		1 - Kearney Lake Road (East)	2 - Highway 102 NB On-Ramp	3 - Kearney Lake Road (West)	4 - Highway 102 NB Off-Ramp
From	1 - Kearney Lake Road (East)	0	971	380	0
	2 - Highway 102 NB On-Ramp	Exit-only	Exit-only	Exit-only	Exit-only
	3 - Kearney Lake Road (West)	883	55	0	0
	4 - Highway 102 NB Off-Ramp	195	4	239	0

Vehicle Mix

Truck Percentages

1 - KLR & Hwy 102 SB

		To			
		1 - Kearney Lake Road (East)	2 - Highway 102 SB Off-Ramp	3 - Kearney Lake Road (West)	4 - Highway 102 SB On-Ramp
From	1 - Kearney Lake Road (East)	2	2	2	2
	2 - Highway 102 SB Off-Ramp	2	2	2	2
	3 - Kearney Lake Road (West)	2	2	2	2
	4 - Highway 102 SB On-Ramp	Exit-only	Exit-only	Exit-only	Exit-only

Truck Percentages

2 - KLR & Hwy 102 NB

		To			
		1 - Kearney Lake Road (East)	2 - Highway 102 NB On-Ramp	3 - Kearney Lake Road (West)	4 - Highway 102 NB Off-Ramp
From	1 - Kearney Lake Road (East)	2	2	2	2
	2 - Highway 102 NB On-Ramp	Exit-only	Exit-only	Exit-only	Exit-only
	3 - Kearney Lake Road (West)	2	2	2	2
	4 - Highway 102 NB Off-Ramp	2	2	2	2

Results

Results Summary for whole modelled period

Intersection	Leg	Max V/C Ratio	Max Delay (s)	Max Queue (PCE)	Max 95th percentile Queue (PCE)	Max LOS	Average Demand (PCE/hr)	Total Intersection Arrivals (PCE)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	0.55	6.45	1.2	1.5	A	579	868
	2 - Highway 102 SB Off-Ramp	0.79	18.89	3.7	18.8	C	665	918
	3 - Kearney Lake Road (West)	0.40	7.34	0.7	3.0	A	431	409
	4 - Highway 102 SB On-Ramp							
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)	0.70	5.70	2.4	4.8	A	1264	1897
	2 - Highway 102 NB On-Ramp							
	3 - Kearney Lake Road (West)	0.64	6.19	1.8	2.8	A	877	1316
	4 - Highway 102 NB Off-Ramp	0.65	14.03	1.9	5.7	B	410	615

Long-Term Design - 2036, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Queue variations	Analysis Options	Queue percentiles may be unreliable if the mean queue in any time segment is very low or very high.

Analysis Set Details

ID	Name	Include in report	Use specific Demand Set(s)	Specific Demand Set(s)	Network flow scaling factor (%)	Network capacity scaling factor (%)
A2	Long-Term Design	✓	✓	D3,D4,D5,D6	100.000	100.000

Intersection Network

Intersections

Intersection	Name	Intersection type	Use circulating lanes	Leg order	Intersection Delay (s)	Intersection LOS
1	KLR & Hwy 102 SB	Standard Roundabout		1, 2, 3, 4	4.11	A
2	KLR & Hwy 102 NB	Standard Roundabout		1, 2, 3, 4	3.21	A

Intersection Network Options

Driving side	Lighting
Right	Normal/unknown

Legs

Legs

Intersection	Leg	Name	Description
1 - KLR & Hwy 102 SB	1	Kearney Lake Road (East)	
	2	Highway 102 SB Off-Ramp	
	3	Kearney Lake Road (West)	
	4	Highway 102 SB On-Ramp	
2 - KLR & Hwy 102 NB	1	Kearney Lake Road (East)	
	2	Highway 102 NB On-Ramp	
	3	Kearney Lake Road (West)	
	4	Highway 102 NB Off-Ramp	

Roundabout Geometry

Intersection	Leg	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	7.00	8.00	10.0	30.0	60.0	30.0	
	2 - Highway 102 SB Off-Ramp	3.50	8.00	10.0	30.0	60.0	30.0	
	3 - Kearney Lake Road (West)	7.00	8.00	10.0	30.0	60.0	30.0	
	4 - Highway 102 SB On-Ramp							✓
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)	7.00	8.00	10.0	30.0	60.0	30.0	
	2 - Highway 102 NB On-Ramp							✓
	3 - Kearney Lake Road (West)	7.00	8.00	10.0	30.0	60.0	30.0	
	4 - Highway 102 NB Off-Ramp	3.50	8.00	10.0	30.0	60.0	30.0	

Slope / Intercept / Capacity

Roundabout Slope and Intercept used in model

Intersection	Leg	Final slope	Final intercept (PCE/hr)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	0.681	2389
	2 - Highway 102 SB Off-Ramp	0.552	1646
	3 - Kearney Lake Road (West)	0.681	2389
	4 - Highway 102 SB On-Ramp		
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)	0.681	2389
	2 - Highway 102 NB On-Ramp		
	3 - Kearney Lake Road (West)	0.681	2389
	4 - Highway 102 NB Off-Ramp	0.552	1646

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D3	2036	AM	ONE HOUR	08:00	09:30	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCE Factor for a Truck (PCE)
✓	✓	Truck Percentages	2.00

Linked Leg Data

Intersection	Leg	Feeding Intersection	Feeding Leg	Link Type	Flow source	Uniform flow (Veh/hr)	Flow multiplier (%)	Internal storage space (PCE)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	2	3	Queue limited	Exit flow only	0	100.00	15.00
2 - KLR & Hwy 102 NB	3 - Kearney Lake Road (West)	1	1	Queue limited	Exit flow only	0	100.00	15.00

Demand overview (Traffic)

Intersection	Leg	Linked leg	Profile type	Use O-D data	Average Demand (Veh/hr)	Scaling Factor (%)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	✓				
	2 - Highway 102 SB Off-Ramp		ONE HOUR	✓	693	100.000
	3 - Kearney Lake Road (West)		ONE HOUR	✓	755	100.000
	4 - Highway 102 SB On-Ramp					
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)		ONE HOUR	✓	757	100.000
	2 - Highway 102 NB On-Ramp					
	3 - Kearney Lake Road (West)	✓				
	4 - Highway 102 NB Off-Ramp		ONE HOUR	✓	168	100.000

Origin-Destination Data

Demand (Veh/hr)

1 - KLR & Hwy 102 SB

		To			
		1 - Kearney Lake Road (East)	2 - Highway 102 SB Off-Ramp	3 - Kearney Lake Road (West)	4 - Highway 102 SB On-Ramp
From	1 - Kearney Lake Road (East)	0	0	230	95
	2 - Highway 102 SB Off-Ramp	655	0	33	5
	3 - Kearney Lake Road (West)	504	0	0	251
	4 - Highway 102 SB On-Ramp	Exit-only	Exit-only	Exit-only	Exit-only

Demand (Veh/hr)

2 - KLR & Hwy 102 NB

		To			
		1 - Kearney Lake Road (East)	2 - Highway 102 NB On-Ramp	3 - Kearney Lake Road (West)	4 - Highway 102 NB Off-Ramp
From	1 - Kearney Lake Road (East)	0	516	241	0
	2 - Highway 102 NB On-Ramp	Exit-only	Exit-only	Exit-only	Exit-only
	3 - Kearney Lake Road (West)	1096	63	0	0
	4 - Highway 102 NB Off-Ramp	80	4	84	0

Vehicle Mix

Truck Percentages

1 - KLR & Hwy 102 SB

		To			
		1 - Kearney Lake Road (East)	2 - Highway 102 SB Off-Ramp	3 - Kearney Lake Road (West)	4 - Highway 102 SB On-Ramp
From	1 - Kearney Lake Road (East)	2	2	2	2
	2 - Highway 102 SB Off-Ramp	2	2	2	2
	3 - Kearney Lake Road (West)	2	2	2	2
	4 - Highway 102 SB On-Ramp	Exit-only	Exit-only	Exit-only	Exit-only

Truck Percentages

2 - KLR & Hwy 102 NB

		To			
		1 - Kearney Lake Road (East)	2 - Highway 102 NB On-Ramp	3 - Kearney Lake Road (West)	4 - Highway 102 NB Off-Ramp
From	1 - Kearney Lake Road (East)	2	2	2	2
	2 - Highway 102 NB On-Ramp	Exit-only	Exit-only	Exit-only	Exit-only
	3 - Kearney Lake Road (West)	2	2	2	2
	4 - Highway 102 NB Off-Ramp	2	2	2	2

Results

Results Summary for whole modelled period

Intersection	Leg	Max V/C Ratio	Max Delay (s)	Max Queue (PCE)	Max 95th percentile Queue (PCE)	Max LOS	Average Demand (PCE/hr)	Total Intersection Arrivals (PCE)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	0.15	1.81	0.2	0.5	A	304	456
	2 - Highway 102 SB Off-Ramp	0.54	5.51	1.2	1.5	A	649	973
	3 - Kearney Lake Road (West)	0.47	3.81	0.9	2.1	A	707	1060
	4 - Highway 102 SB On-Ramp							
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)	0.37	2.58	0.6	2.8	A	709	1063
	2 - Highway 102 NB On-Ramp							
	3 - Kearney Lake Road (West)	0.54	3.38	1.2	1.6	A	1084	1626
	4 - Highway 102 NB Off-Ramp	0.20	4.97	0.3	1.0	A	157	236

Long-Term Design - 2036, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Queue variations	Analysis Options	Queue percentiles may be unreliable if the mean queue in any time segment is very low or very high.

Analysis Set Details

ID	Name	Include in report	Use specific Demand Set(s)	Specific Demand Set(s)	Network flow scaling factor (%)	Network capacity scaling factor (%)
A2	Long-Term Design	✓	✓	D3,D4,D5,D6	100.000	100.000

Intersection Network

Intersections

Intersection	Name	Intersection type	Use circulating lanes	Leg order	Intersection Delay (s)	Intersection LOS
1	KLR & Hwy 102 SB	Standard Roundabout		1, 2, 3, 4	4.64	A
2	KLR & Hwy 102 NB	Standard Roundabout		1, 2, 3, 4	4.80	A

Intersection Network Options

Driving side	Lighting
Right	Normal/unknown

Legs

Legs

Intersection	Leg	Name	Description
1 - KLR & Hwy 102 SB	1	Kearney Lake Road (East)	
	2	Highway 102 SB Off-Ramp	
	3	Kearney Lake Road (West)	
	4	Highway 102 SB On-Ramp	
2 - KLR & Hwy 102 NB	1	Kearney Lake Road (East)	
	2	Highway 102 NB On-Ramp	
	3	Kearney Lake Road (West)	
	4	Highway 102 NB Off-Ramp	

Roundabout Geometry

Intersection	Leg	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	7.00	8.00	10.0	30.0	60.0	30.0	
	2 - Highway 102 SB Off-Ramp	3.50	8.00	10.0	30.0	60.0	30.0	
	3 - Kearney Lake Road (West)	7.00	8.00	10.0	30.0	60.0	30.0	
	4 - Highway 102 SB On-Ramp							✓
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)	7.00	8.00	10.0	30.0	60.0	30.0	
	2 - Highway 102 NB On-Ramp							✓
	3 - Kearney Lake Road (West)	7.00	8.00	10.0	30.0	60.0	30.0	
	4 - Highway 102 NB Off-Ramp	3.50	8.00	10.0	30.0	60.0	30.0	

Slope / Intercept / Capacity

Roundabout Slope and Intercept used in model

Intersection	Leg	Final slope	Final intercept (PCE/hr)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	0.681	2389
	2 - Highway 102 SB Off-Ramp	0.552	1646
	3 - Kearney Lake Road (West)	0.681	2389
	4 - Highway 102 SB On-Ramp		
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)	0.681	2389
	2 - Highway 102 NB On-Ramp		
	3 - Kearney Lake Road (West)	0.681	2389
	4 - Highway 102 NB Off-Ramp	0.552	1646

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D4	2036	PM	ONE HOUR	16:00	17:30	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCE Factor for a Truck (PCE)
✓	✓	Truck Percentages	2.00

Linked Leg Data

Intersection	Leg	Feeding Intersection	Feeding Leg	Link Type	Flow source	Uniform flow (Veh/hr)	Flow multiplier (%)	Internal storage space (PCE)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	2	3	Queue limited	Exit flow only	0	100.00	15.00
2 - KLR & Hwy 102 NB	3 - Kearney Lake Road (West)	1	1	Queue limited	Exit flow only	0	100.00	15.00

Demand overview (Traffic)

Intersection	Leg	Linked leg	Profile type	Use O-D data	Average Demand (Veh/hr)	Scaling Factor (%)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	✓				
	2 - Highway 102 SB Off-Ramp		ONE HOUR	✓	711	100.000
	3 - Kearney Lake Road (West)		ONE HOUR	✓	460	100.000
	4 - Highway 102 SB On-Ramp					
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)		ONE HOUR	✓	1351	100.000
	2 - Highway 102 NB On-Ramp					
	3 - Kearney Lake Road (West)	✓				
	4 - Highway 102 NB Off-Ramp		ONE HOUR	✓	438	100.000

Origin-Destination Data

1 - KLR & Hwy 102 SB

Demand (Veh/hr)

		To			
		1 - Kearney Lake Road (East)	2 - Highway 102 SB Off-Ramp	3 - Kearney Lake Road (West)	4 - Highway 102 SB On-Ramp
From	1 - Kearney Lake Road (East)	0	0	471	148
	2 - Highway 102 SB Off-Ramp	647	0	57	7
	3 - Kearney Lake Road (West)	291	0	0	169
	4 - Highway 102 SB On-Ramp	Exit-only	Exit-only	Exit-only	Exit-only

2 - KLR & Hwy 102 NB

Demand (Veh/hr)

		To			
		1 - Kearney Lake Road (East)	2 - Highway 102 NB On-Ramp	3 - Kearney Lake Road (West)	4 - Highway 102 NB Off-Ramp
From	1 - Kearney Lake Road (East)	0	971	380	0
	2 - Highway 102 NB On-Ramp	Exit-only	Exit-only	Exit-only	Exit-only
	3 - Kearney Lake Road (West)	883	55	0	0
	4 - Highway 102 NB Off-Ramp	195	4	239	0

Vehicle Mix

1 - KLR & Hwy 102 SB

Truck Percentages

		To			
		1 - Kearney Lake Road (East)	2 - Highway 102 SB Off-Ramp	3 - Kearney Lake Road (West)	4 - Highway 102 SB On-Ramp
From	1 - Kearney Lake Road (East)	2	2	2	2
	2 - Highway 102 SB Off-Ramp	2	2	2	2
	3 - Kearney Lake Road (West)	2	2	2	2
	4 - Highway 102 SB On-Ramp	Exit-only	Exit-only	Exit-only	Exit-only

2 - KLR & Hwy 102 NB

Truck Percentages

		To			
		1 - Kearney Lake Road (East)	2 - Highway 102 NB On-Ramp	3 - Kearney Lake Road (West)	4 - Highway 102 NB Off-Ramp
From	1 - Kearney Lake Road (East)	2	2	2	2
	2 - Highway 102 NB On-Ramp	Exit-only	Exit-only	Exit-only	Exit-only
	3 - Kearney Lake Road (West)	2	2	2	2
	4 - Highway 102 NB Off-Ramp	2	2	2	2

Results

Results Summary for whole modelled period

Intersection	Leg	Max V/C Ratio	Max Delay (s)	Max Queue (PCE)	Max 95th percentile Queue (PCE)	Max LOS	Average Demand (PCE/hr)	Total Intersection Arrivals (PCE)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	0.29	2.17	0.4	1.4	A	579	869
	2 - Highway 102 SB Off-Ramp	0.63	7.92	1.7	2.0	A	665	998
	3 - Kearney Lake Road (West)	0.29	2.91	0.4	1.4	A	431	646
	4 - Highway 102 SB On-Ramp							
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)	0.70	5.70	2.4	4.8	A	1264	1897
	2 - Highway 102 NB On-Ramp							
	3 - Kearney Lake Road (West)	0.44	2.75	0.8	1.9	A	877	1316
	4 - Highway 102 NB Off-Ramp	0.46	6.41	0.9	3.0	A	410	615

Long-Term Design - 2041, AM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Queue variations	Analysis Options	Queue percentiles may be unreliable if the mean queue in any time segment is very low or very high.

Analysis Set Details

ID	Name	Include in report	Use specific Demand Set(s)	Specific Demand Set(s)	Network flow scaling factor (%)	Network capacity scaling factor (%)
A2	Long-Term Design	✓	✓	D3,D4,D5,D6	100.000	100.000

Intersection Network

Intersections

Intersection	Name	Intersection type	Use circulating lanes	Leg order	Intersection Delay (s)	Intersection LOS
1	KLR & Hwy 102 SB	Standard Roundabout		1, 2, 3, 4	4.49	A
2	KLR & Hwy 102 NB	Standard Roundabout		1, 2, 3, 4	3.44	A

Intersection Network Options

Driving side	Lighting
Right	Normal/unknown

Legs

Legs

Intersection	Leg	Name	Description
1 - KLR & Hwy 102 SB	1	Kearney Lake Road (East)	
	2	Highway 102 SB Off-Ramp	
	3	Kearney Lake Road (West)	
	4	Highway 102 SB On-Ramp	
2 - KLR & Hwy 102 NB	1	Kearney Lake Road (East)	
	2	Highway 102 NB On-Ramp	
	3	Kearney Lake Road (West)	
	4	Highway 102 NB Off-Ramp	

Roundabout Geometry

Intersection	Leg	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	7.00	8.00	10.0	30.0	60.0	30.0	
	2 - Highway 102 SB Off-Ramp	3.50	8.00	10.0	30.0	60.0	30.0	
	3 - Kearney Lake Road (West)	7.00	8.00	10.0	30.0	60.0	30.0	
	4 - Highway 102 SB On-Ramp							✓
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)	7.00	8.00	10.0	30.0	60.0	30.0	
	2 - Highway 102 NB On-Ramp							✓
	3 - Kearney Lake Road (West)	7.00	8.00	10.0	30.0	60.0	30.0	
	4 - Highway 102 NB Off-Ramp	3.50	8.00	10.0	30.0	60.0	30.0	

Slope / Intercept / Capacity

Roundabout Slope and Intercept used in model

Intersection	Leg	Final slope	Final intercept (PCE/hr)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	0.681	2389
	2 - Highway 102 SB Off-Ramp	0.552	1646
	3 - Kearney Lake Road (West)	0.681	2389
	4 - Highway 102 SB On-Ramp		
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)	0.681	2389
	2 - Highway 102 NB On-Ramp		
	3 - Kearney Lake Road (West)	0.681	2389
	4 - Highway 102 NB Off-Ramp	0.552	1646

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D5	2041	AM	ONE HOUR	08:00	09:30	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCE Factor for a Truck (PCE)
✓	✓	Truck Percentages	2.00

Linked Leg Data

Intersection	Leg	Feeding Intersection	Feeding Leg	Link Type	Flow source	Uniform flow (Veh/hr)	Flow multiplier (%)	Internal storage space (PCE)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	2	3	Queue limited	Exit flow only	0	100.00	15.00
2 - KLR & Hwy 102 NB	3 - Kearney Lake Road (West)	1	1	Queue limited	Exit flow only	0	100.00	15.00

Demand overview (Traffic)

Intersection	Leg	Linked leg	Profile type	Use O-D data	Average Demand (Veh/hr)	Scaling Factor (%)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	✓				
	2 - Highway 102 SB Off-Ramp		ONE HOUR	✓	736	100.000
	3 - Kearney Lake Road (West)		ONE HOUR	✓	800	100.000
	4 - Highway 102 SB On-Ramp					
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)		ONE HOUR	✓	803	100.000
	2 - Highway 102 NB On-Ramp					
	3 - Kearney Lake Road (West)	✓				
	4 - Highway 102 NB Off-Ramp		ONE HOUR	✓	179	100.000

Origin-Destination Data

Demand (Veh/hr)

1 - KLR & Hwy 102 SB

		To			
		1 - Kearney Lake Road (East)	2 - Highway 102 SB Off-Ramp	3 - Kearney Lake Road (West)	4 - Highway 102 SB On-Ramp
From	1 - Kearney Lake Road (East)	0	0	244	101
	2 - Highway 102 SB Off-Ramp	696	0	35	5
	3 - Kearney Lake Road (West)	534	0	0	266
	4 - Highway 102 SB On-Ramp	Exit-only	Exit-only	Exit-only	Exit-only

Demand (Veh/hr)

2 - KLR & Hwy 102 NB

		To			
		1 - Kearney Lake Road (East)	2 - Highway 102 NB On-Ramp	3 - Kearney Lake Road (West)	4 - Highway 102 NB Off-Ramp
From	1 - Kearney Lake Road (East)	0	548	255	0
	2 - Highway 102 NB On-Ramp	Exit-only	Exit-only	Exit-only	Exit-only
	3 - Kearney Lake Road (West)	1163	67	0	0
	4 - Highway 102 NB Off-Ramp	85	4	90	0

Vehicle Mix

Truck Percentages

1 - KLR & Hwy 102 SB

		To			
		1 - Kearney Lake Road (East)	2 - Highway 102 SB Off-Ramp	3 - Kearney Lake Road (West)	4 - Highway 102 SB On-Ramp
From	1 - Kearney Lake Road (East)	2	2	2	2
	2 - Highway 102 SB Off-Ramp	2	2	2	2
	3 - Kearney Lake Road (West)	2	2	2	2
	4 - Highway 102 SB On-Ramp	Exit-only	Exit-only	Exit-only	Exit-only

Truck Percentages

2 - KLR & Hwy 102 NB

		To			
		1 - Kearney Lake Road (East)	2 - Highway 102 NB On-Ramp	3 - Kearney Lake Road (West)	4 - Highway 102 NB Off-Ramp
From	1 - Kearney Lake Road (East)	2	2	2	2
	2 - Highway 102 NB On-Ramp	Exit-only	Exit-only	Exit-only	Exit-only
	3 - Kearney Lake Road (West)	2	2	2	2
	4 - Highway 102 NB Off-Ramp	2	2	2	2

Results

Results Summary for whole modelled period

Intersection	Leg	Max V/C Ratio	Max Delay (s)	Max Queue (PCE)	Max 95th percentile Queue (PCE)	Max LOS	Average Demand (PCE/hr)	Total Intersection Arrivals (PCE)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	0.16	1.83	0.2	0.5	A	323	484
	2 - Highway 102 SB Off-Ramp	0.58	6.07	1.4	1.6	A	689	1033
	3 - Kearney Lake Road (West)	0.51	4.18	1.0	1.5	A	749	1123
	4 - Highway 102 SB On-Ramp							
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)	0.40	2.69	0.7	2.7	A	752	1127
	2 - Highway 102 NB On-Ramp							
	3 - Kearney Lake Road (West)	0.58	3.64	1.4	2.0	A	1151	1726
	4 - Highway 102 NB Off-Ramp	0.23	5.38	0.3	1.3	A	168	251

Long-Term Design - 2041, PM

Data Errors and Warnings

Severity	Area	Item	Description
Warning	Queue variations	Analysis Options	Queue percentiles may be unreliable if the mean queue in any time segment is very low or very high.

Analysis Set Details

ID	Name	Include in report	Use specific Demand Set(s)	Specific Demand Set(s)	Network flow scaling factor (%)	Network capacity scaling factor (%)
A2	Long-Term Design	✓	✓	D3,D4,D5,D6	100.000	100.000

Intersection Network

Intersections

Intersection	Name	Intersection type	Use circulating lanes	Leg order	Intersection Delay (s)	Intersection LOS
1	KLR & Hwy 102 SB	Standard Roundabout		1, 2, 3, 4	5.28	A
2	KLR & Hwy 102 NB	Standard Roundabout		1, 2, 3, 4	5.53	A

Intersection Network Options

Driving side	Lighting
Right	Normal/unknown

Legs

Legs

Intersection	Leg	Name	Description
1 - KLR & Hwy 102 SB	1	Kearney Lake Road (East)	
	2	Highway 102 SB Off-Ramp	
	3	Kearney Lake Road (West)	
	4	Highway 102 SB On-Ramp	
2 - KLR & Hwy 102 NB	1	Kearney Lake Road (East)	
	2	Highway 102 NB On-Ramp	
	3	Kearney Lake Road (West)	
	4	Highway 102 NB Off-Ramp	

Roundabout Geometry

Intersection	Leg	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	7.00	8.00	10.0	30.0	60.0	30.0	
	2 - Highway 102 SB Off-Ramp	3.50	8.00	10.0	30.0	60.0	30.0	
	3 - Kearney Lake Road (West)	7.00	8.00	10.0	30.0	60.0	30.0	
	4 - Highway 102 SB On-Ramp							✓
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)	7.00	8.00	10.0	30.0	60.0	30.0	
	2 - Highway 102 NB On-Ramp							✓
	3 - Kearney Lake Road (West)	7.00	8.00	10.0	30.0	60.0	30.0	
	4 - Highway 102 NB Off-Ramp	3.50	8.00	10.0	30.0	60.0	30.0	

Slope / Intercept / Capacity

Roundabout Slope and Intercept used in model

Intersection	Leg	Final slope	Final intercept (PCE/hr)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	0.681	2389
	2 - Highway 102 SB Off-Ramp	0.552	1646
	3 - Kearney Lake Road (West)	0.681	2389
	4 - Highway 102 SB On-Ramp		
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)	0.681	2389
	2 - Highway 102 NB On-Ramp		
	3 - Kearney Lake Road (West)	0.681	2389
	4 - Highway 102 NB Off-Ramp	0.552	1646

The slope and intercept shown above include any corrections and adjustments.

Traffic Demand

Demand Set Details

ID	Scenario name	Time Period name	Traffic profile type	Start time (HH:mm)	Finish time (HH:mm)	Time segment length (min)	Run automatically
D6	2041	PM	ONE HOUR	16:00	17:30	15	✓

Vehicle mix varies over turn	Vehicle mix varies over entry	Vehicle mix source	PCE Factor for a Truck (PCE)
✓	✓	Truck Percentages	2.00

Linked Leg Data

Intersection	Leg	Feeding Intersection	Feeding Leg	Link Type	Flow source	Uniform flow (Veh/hr)	Flow multiplier (%)	Internal storage space (PCE)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	2	3	Queue limited	Exit flow only	0	100.00	15.00
2 - KLR & Hwy 102 NB	3 - Kearney Lake Road (West)	1	1	Queue limited	Exit flow only	0	100.00	15.00

Demand overview (Traffic)

Intersection	Leg	Linked leg	Profile type	Use O-D data	Average Demand (Veh/hr)	Scaling Factor (%)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	✓				
	2 - Highway 102 SB Off-Ramp		ONE HOUR	✓	754	100.000
	3 - Kearney Lake Road (West)		ONE HOUR	✓	488	100.000
	4 - Highway 102 SB On-Ramp					
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)		ONE HOUR	✓	1433	100.000
	2 - Highway 102 NB On-Ramp					
	3 - Kearney Lake Road (West)	✓				
	4 - Highway 102 NB Off-Ramp		ONE HOUR	✓	465	100.000

Origin-Destination Data

1 - KLR & Hwy 102 SB

Demand (Veh/hr)

		To			
		1 - Kearney Lake Road (East)	2 - Highway 102 SB Off-Ramp	3 - Kearney Lake Road (West)	4 - Highway 102 SB On-Ramp
From	1 - Kearney Lake Road (East)	0	0	500	157
	2 - Highway 102 SB Off-Ramp	687	0	60	7
	3 - Kearney Lake Road (West)	308	0	0	180
	4 - Highway 102 SB On-Ramp	Exit-only	Exit-only	Exit-only	Exit-only

2 - KLR & Hwy 102 NB

Demand (Veh/hr)

		To			
		1 - Kearney Lake Road (East)	2 - Highway 102 NB On-Ramp	3 - Kearney Lake Road (West)	4 - Highway 102 NB Off-Ramp
From	1 - Kearney Lake Road (East)	0	1030	403	0
	2 - Highway 102 NB On-Ramp	Exit-only	Exit-only	Exit-only	Exit-only
	3 - Kearney Lake Road (West)	937	58	0	0
	4 - Highway 102 NB Off-Ramp	207	4	254	0

Vehicle Mix

1 - KLR & Hwy 102 SB

Truck Percentages

		To			
		1 - Kearney Lake Road (East)	2 - Highway 102 SB Off-Ramp	3 - Kearney Lake Road (West)	4 - Highway 102 SB On-Ramp
From	1 - Kearney Lake Road (East)	2	2	2	2
	2 - Highway 102 SB Off-Ramp	2	2	2	2
	3 - Kearney Lake Road (West)	2	2	2	2
	4 - Highway 102 SB On-Ramp	Exit-only	Exit-only	Exit-only	Exit-only

2 - KLR & Hwy 102 NB

Truck Percentages

		To			
		1 - Kearney Lake Road (East)	2 - Highway 102 NB On-Ramp	3 - Kearney Lake Road (West)	4 - Highway 102 NB Off-Ramp
From	1 - Kearney Lake Road (East)	2	2	2	2
	2 - Highway 102 NB On-Ramp	Exit-only	Exit-only	Exit-only	Exit-only
	3 - Kearney Lake Road (West)	2	2	2	2
	4 - Highway 102 NB Off-Ramp	2	2	2	2

Results

Results Summary for whole modelled period

Intersection	Leg	Max V/C Ratio	Max Delay (s)	Max Queue (PCE)	Max 95th percentile Queue (PCE)	Max LOS	Average Demand (PCE/hr)	Total Intersection Arrivals (PCE)
1 - KLR & Hwy 102 SB	1 - Kearney Lake Road (East)	0.31	2.22	0.5	1.8	A	615	922
	2 - Highway 102 SB Off-Ramp	0.68	9.36	2.2	4.7	A	706	1059
	3 - Kearney Lake Road (West)	0.32	3.08	0.5	1.9	A	457	685
	4 - Highway 102 SB On-Ramp							
2 - KLR & Hwy 102 NB	1 - Kearney Lake Road (East)	0.75	6.82	3.0	6.2	A	1341	2012
	2 - Highway 102 NB On-Ramp							
	3 - Kearney Lake Road (West)	0.47	2.89	0.9	1.5	A	931	1396
	4 - Highway 102 NB Off-Ramp	0.51	7.24	1.0	2.9	A	435	653