4 Evaluation of Alternative Solutions

The conclusions set out in Section 2 of this report demonstrate the need to extend rapid transit from Baseline Station to Barrhaven Town Centre and provide for rail grade-separation at the Woodroffe Avenue, Southwest Transitway and Fallowfield Road crossings of the VIA Rail line. This section summarizes the development and evaluation of alternative solutions to best meet the established needs of the project. While the City of Ottawa's TMP (2013) identifies extending LRT to Barrhaven as the preferred ultimate solution for this rapid transit corridor, the City of Ottawa, as part of pre-planning work for major transit infrastructure projects, reconfirms the preferred solution as a general practice regardless of the EA process followed.

4.1 Planning and Design Objectives for the Project

As presented in the 2013 TMP, "*Ottawa's Transportation system [in 2031] will enhance our quality of life by supporting social, environmental, and economic sustainability in an accountable and responsive manner*." This vision for transportation in the City is supported by several elements and coinciding principles. This EA uses these elements to provide a basis for developing planning and design objectives for the Project and the subsequent evaluation of alternative solutions based on these objectives. Elements identified in the TMP and the ensuing six (6) objectives as developed for this EA are presented in Table 4-1.

Table 4-1 Planning and Design Objectives for the Project

Element	Planning and Design Objectives for the Project
Reduce automobile dependence	1. Improve travel time, reliability, efficiency of rapid transit
Meet mobility needs	2. Improve universal accessibility and connectivity of the active transportation networks
Integrate transportation and land use	3. Provide for safety, efficiency, resiliency (a system that can tolerate unexpected events by implementation of pocket tracks, cross-overs, elevator redundancy, parallel pathway etc.) and mobility on the area transportation network
Protect public health and safety	4. Eliminate the risk of a near-miss or collision between roadway and pathway users and trains
Enhance the economy	5. Improve connectivity with the VIA Rail Fallowfield Station
Deliver cost-effective services; protect public health and safety and protect the environment	6. Regard for social, natural, physical and economic environmental aspects, and life-cycle cost

4.2 Description of Alternative Solutions

There are three distinct components of the project that require a review and confirmation of alternative solutions. These include the:

1. Extension of LRT from Baseline Station to Barrhaven Town Centre;
2. Grade-separation of Woodroffe Avenue and the Southwest Transitway from the VIA Rail line; and,
3. Grade-separation of Fallowfield Road from the VIA Rail line.

A range of alternative solutions were developed for the LRT extension and the rail grade-separations and subsequently evaluated for their suitability to address the above-noted planning and design objectives. The range of alternative solutions for the Woodroffe Avenue/Southwest Transitway and Fallowfield Road rail grade-separations are the same, however, the evaluation for each component was completed separately. The alternative solutions are described in Table 4-2 and Table 4-3.

Table 4-2 Description of Alternative Solutions - LRT Extension

Alternative Solution		Description
1	Do Nothing	Used as a baseline for comparison, includes regular on-going maintenance of the corridor in its present BRT configuration. Does not include modifications or enhancements to the pedestrian and cycling environment.
2	Implement Transportation Demand Management measures	Transportation Demand Management includes measures aimed at influencing demand to reduce the need or delay timing of infrastructure projects by making more efficient use of existing capacity. Measures such as high-occupancy vehicle lanes (which would require re-designation and roadway modifications), carpooling and encouraging telework/working from home are included as part of this solution. This solution would not include enhancements to the pedestrian and cycling environment.
3	Improve pedestrian and cycling infrastructure	Under this scenario, significant investment would be made in pedestrian and cycling infrastructure to reduce the need for additional road and transit investments. This solution could involve potential widening to enhance corridor pedestrian and cycling facilities only.
4	Improve roadway infrastructure	This solution would involve reconstruction and widening of arterial roadways and other potential measures on the existing road network within the Study Area to address future capacity requirements if rapid transit service is not improved. This would include roadways already identified for future widening in the City's TMP as well as other widenings not currently being considered. Transit would continue to operate in existing dedicated bus lanes. Enhancements to the pedestrian and cycling environment would also be included in this solution.
5	Complete the SW Transitway as BRT	Under this scenario, the transitway would be completed as a fully exclusive and grade-separated BRT facility between Baseline Station and Barrhaven Town Centre, as currently envisaged in the 2013 TMP (2031 RTTP Network Concept). This would involve building new BRT infrastructure, primarily between Baseline Station and the Nepean Sportsplex to replace the existing on-street dedicated bus lanes with an exclusive and grade-separated transitway. Enhancements to the pedestrian and cycling environment would also be included in this solution.
6	Convert and complete the SW Transitway as LRT	Under this scenario, the completion of the transitway as a BRT facility would not take place and would instead be implemented as a fully segregated grade-separated electrically powered LRT facility from Baseline Station to Barrhaven Town Centre, as envisaged in the 2013 TMP (Ultimate RTTP Network). Enhancements to the pedestrian and cycling infrastructure would also be considered as part of this solution.

Table 4-3 Description of Alternative Solutions -Rail Grade-Separation

Alternative Solution		Description
1	Do Nothing	Used as a baseline for comparison, includes regular on-going maintenance of the corridor in its present configuration. Does not include modifications or enhancements to the pedestrian and cycling environment.
2	Close the road/transitway at the VIA Rail crossing location	The existing roads and transitway would be closed at the VIA Rail line crossing until such time they could be grade-separated. Existing roads, transitway traffic, pedestrian and cycling facilities would be redirected to an existing and alternative grade-separated crossing.
3	Improve the existing at-grade road/SW Transitway crossing	The existing roads and transitway crossing of the VIA Rail line would remain but with infrastructure improvements reflective of current best practices. This could include changing the angle to which the roads and transitway cross the VIA Rail line, upgrades to the railway gates, signalization, flashing lights, pavement markings amongst others. This solution would include enhancements to pedestrian and cycling facilities isolated to the crossing area.
4	Realignment of roads/SW Transitway that avoids crossing the VIA Rail line	A realignment of Woodroffe Avenue, Fallowfield Road and the transitway could be constructed that avoids crossing of the VIA Rail line in this area. The original alignments would be closed off and connection across the VIA Rail line would no longer be possible so as to remove at-grade rail crossings. Pedestrian and cycling enhancements would be part of this solution.
5	Grade-separation	A grade-separation of roads and transitway including pedestrian and cycling facilities would be implemented.

4.3 Evaluation of Alternative Solutions

The full range of alternative solutions were subjected to an evaluation process that compared the outcome of each solution to the planning and design objectives listed in **Section 4.1**. The results are presented individually in the following tables for

each of: the LRT extension (**Table 4-4**), grade-separation of Woodroffe Avenue and the Southwest Transitway (**Table 4-5**) and of Fallowfield Road (**Table 4-6**) from the VIA Rail line.

Table 4-4 Evaluation of Alternative Solutions Results - LRT Extension

Alternative Solution		Description	Preferred Solution
1	Do Nothing	Does not deliver a multi-modal system as this solution maintains the status quo. As rapid transit service would continue to operate in dedicated lanes within the Woodroffe Avenue corridor with no changes, there would be no opportunity to improve travel time, reliability, or efficiency. With no changes being implemented, this solution does not provide the opportunity to result in a modal shift. There would be no opportunity to improve universal accessibility or connectivity for the active transportation network. This solution does not provide resiliency and mobility on the area transportation network. There would be no opportunity to improve connectivity with the VIA Rail Fallowfield Station. There would be no impact to the physical or natural environment as additional Right-of-Way would not be required, however, there would be little to no opportunity to improve these environments either. No capital cost involved.	Not Recommended ✗
2	Implement Transportation Demand Management measures	Does not deliver a cost-effective multi-modal system. This solution may improve the area transportation network slightly. However, this solution implemented on its own does not meet transit ridership projections or required capacity, therefore, would limit the opportunity to improve travel time, reliability, or efficiency to meet future needs. As such, this solution does not provide the opportunity to result in a modal shift. This solution does not provide the opportunity to improve connectivity with the VIA Rail Fallowfield Station. This solution may include only re-designation of the existing road surface, therefore there would be little opportunity to improve universal accessibility and connectivity of the active transportation network. No additional Right-of-Way would be acquired. This solution does not provide resiliency and mobility on the area transportation network. There would be little to no impact to the physical or natural environment as no additional Right-of-Way would be required, however, there would be little to no opportunity to improve these environments either.	Not Recommended ✗
3	Improve pedestrian and cycling infrastructure	Does not deliver a cost-effective multi-modal system as this solution maintains existing travel lanes and implemented on its own does not meet transit ridership projections or required capacity. This solution would not address long-term needs as it would result in little to no improvements to transit operations and therefore there would be no opportunity to improve travel time, reliability, efficiency or provide resiliency. This solution does not address long distance travel demand for many people in a practical fashion but offers significant opportunity to address local trips within the Study Area, safety, including access to rapid transit stations and VIA Rail Fallowfield Station for only the active modes. This solution provides the opportunity to improve universal accessibility and connectivity of the active transportation network and may result in a modal shift only for pedestrians and cyclists. During winter months, use of pedestrian and cycling facilities may be impacted while snow removal activities are underway. Close to stations and main networks are typically cleared first leaving local routes more difficult to navigate until cleared. To accommodate this solution within the existing Right-of-Way there would be impacts to the natural environment and would offer limited opportunity for new landscaping unless additional Right-of-Way is acquired.	Not Recommended ✗
4	Improve roadway infrastructure	Does not deliver a cost-effective multi-modal system. This solution would identify some road widenings in/near the Study Area; but is not consistent with the direction of the TMP which seeks to encourage increased transit use, particularly for trips to/from downtown Ottawa. It also does not address future transit needs and objectives within the Study Area. This solution does not support the objective to improve transit travel time, reliability, or efficiency. The solution provides the opportunity to improve the universal accessibility, safety, and connectivity of the active transportation network. Ultimately this solution would not result in a modal-shift as it enhances the road network which does not support a reduction in automobile dependence. This solution does not provide the opportunity to improve connectivity with the VIA Rail Fallowfield Station for transit. Considerable additional Right-of-Way would be required which will impact the natural environment. However, there would be opportunity to improve corridor landscaping with the additional space.	Not Recommended ✗

Alternative Solution		Description	Preferred Solution
5	Complete SW Transitway as BRT	Does not deliver a cost-effective solution given the cost involved. If a BRT facility is pursued it would likely need to remain as a BRT facility for a substantial period to justify the capital investment required and reduce opportunity cost/throwaway costs associated with future conversion to LRT. This period is likely to be decades given the investment required to construct a grade-separated transitway from Baseline Station to West Hunt Club Road. The removal of dedicated on-street transit on Woodroffe Avenue would provide the opportunity to redevelop the corridor and enhance existing facilities. This solution supports the 2031 RTTP Network identified in the City's TMP, which envisions completion of the Southwest Transitway as an exclusive BRT facility prior to long-term conversion to LRT technology as identified in the TMP Ultimate RTTP Network. This solution would improve travel time, reliability, and efficiency of rapid transit to some degree. However, it would still require riders travelling beyond Baseline Station to transfer to LRT, which may discourage future ridership growth or a modal shift. This solution meets transit ridership projections or required capacity. This solution provides a limited opportunity to improve universal accessibility and connectivity of the active transportation network (reconstructing existing stations and facilities would not be practical) as it could not be constructed the entire length of the corridor. A dedicated BRT facility would improve connectivity with the VIA Rail Fallowfield Station. Considerable additional Right-of-Way would be required which will impact the natural environment. However, there would be opportunity to improve corridor landscaping with the additional space.	Not Recommended ✗
6	Convert and complete SW Transitway as LRT	This solution supports the Ultimate RTTP Network identified in the City's TMP but changes the implementation phasing of the City's RTTP network, which currently identifies completion of the SW Transitway as a BRT facility prior to eventual conversion to LRT technology. This solution provides a cost-effective multi-modal system. This solution meets transit ridership projections or required capacity. By developing as LRT, it avoids potential throw-away costs of constructing an interim BRT facility first. Based on the Project Need and Opportunities identified (Section 2) and the City's long-term plan for rapid transit, this solution best addresses the planning objectives with respect to improving travel time, reliability, safety, and efficiency of rapid transit. The solution provides a dedicated and consistent connection (via LRT) not only to the VIA Rail Fallowfield Station but the entire LRT network. It also increases transit capacity, improves reliability and user experience, and addresses issues around conversion from BRT to LRT technology. This solution provides the best opportunity for enhancing the active transportation network by improving universal accessibility and connectivity. TOD policies and other City planning polices support making connections and implementing higher order active transportation facilities in the Study Area associated with LRT throughout the entire corridor. Additional Right-of-Way would result in impacts to the natural environment. However, this solution provides the opportunity to define spaces for new corridor landscaping.	Recommended Preferred Solution ✓

Table 4-5 Evaluation of Alternative Solutions Results – Rail Grade-Separation: Woodroffe Avenue and Southwest Transitway

Alternative Solution		Description	Preferred Solution
1	Do Nothing	This solution does not eliminate the risk of a near-miss or collision between all users and trains. This solution does not address the Project Need and Opportunities established for the Study Area. There would be no capital cost involved to implement this solution. It does not provide the opportunity to improve universal accessibility, safety, and connectivity of the active transportation network. This solution does not provide resiliency and mobility on the area transportation network. There would be no opportunity to improve connectivity with the VIA Rail Fallowfield Station. There would be no impact to the physical or natural environment as additional Right-of-Way would not be required, however, there would be little to no opportunity to improve these environments either.	Not Recommended ✗
2	Close the road/transitway at the VIA Rail crossing location	This solution eliminates the risk of a near-miss or collision between all users and trains. This solution also eliminates the need for rail-crossing infrastructure maintenance and inspection as it removes the crossing altogether. However, this solution performs poorly in consideration of the planning objectives, as it removes accessibility across the tracks, removes connectivity for all modes and does not contribute towards enhancing the natural or social environments. All modes would be forced to re-route out of their way which would	Not Recommended ✗

Alternative Solution		Description	Preferred Solution
		severely affect travel time, reliability, or efficiency. Pedestrian and cycling facilities would be redirected to an existing and alternative grade-separated crossing. Transit would be rerouted long distances to connect to Fallowfield Station adding travel time, decreasing resiliency, and preventing connectivity. Further, this solution does not address the Project Need and Opportunities established for the Study Area.	
3	Improve the existing at-grade road/transitway crossing	This solution partially addresses the project objectives but does not fully eliminate the risk of a near-miss or collision between all users and trains. Upgrading the rail infrastructure equipment or improving the angle of crossing partially improves the safety and leads to a better-quality environment for users and better accessibility. Improving travel times and efficiency for all modes will ultimately be limited by the frequency of train crossings. This solution may have impacts to the natural environment depending on the improvement(s) implemented. This solution does not address the Project Need and Opportunities established for the Study Area.	Not Recommended ✗
4	Realignment of Woodroffe Avenue and the Southwest Transitway that avoids crossing the VIA Rail line	This solution would eliminate the risk of a near-miss or collision between all users and trains. However, this solution performs poorly in consideration of the planning objectives, as it would remove accessibility and connectivity across the tracks for all modes on the networks where the roads would be closed to prevent the rail crossing. The closure of the existing roads to remove crossing of the rail line would force all modes to re-route to the realignment to make connections which would not improve travel time, reliability, or efficiency. This solution does not contribute towards enhancing the natural or social environments or address the Project Need and Opportunities established for the Study Area. This solution would require substantial land acquisition. The land impacts would be almost entirely Greenbelt lands that are actively farmed. As such, this solution results in social, natural, and economic environmental impacts and is not consistent with established planning policy.	Not Recommended ✗
5	Grade-separation	This solution eliminates the risk of a near-miss or collision between roadway and pathway users and trains. This solution also eliminates the need for rail-crossing infrastructure maintenance and inspection as it removes the crossing altogether. This solution provides the best opportunity to provide efficiency, resiliency, and mobility on the area transportation network. All modes would result in improved travel time, reliability, and efficiency as there would be no crossing where waits are experienced to let trains pass. Connectivity with the VIA Rail Fallowfield Station would be direct. This solution is consistent with addressing the Project Need and Opportunities. This solution results in impacts to the natural environment. However, there would be opportunity to improve corridor landscaping with implementation.	Recommended Preferred Solution ✓

Table 4-6 Evaluation of Alternative Solutions Results – Rail Grade-Separation: Fallowfield Road

Alternative Solution		Description	Preferred Solution
1	Do Nothing	This solution does not eliminate the risk of a near-miss or collision between all users and trains. This solution does not address the Project Need and Opportunities established for the Study Area. There would be no capital cost involved to implement this solution. It does not provide the opportunity to improve universal accessibility, safety, and connectivity of the active transportation network. This solution does not provide resiliency and mobility on the area transportation network. There would be no opportunity to improve connectivity with the VIA Rail Fallowfield Station. There would be no impact to the physical or natural environment as additional Right-of-Way would not be required. However, there would be little to no opportunity to improve these environments either.	Not Recommended ✗
2	Close the road at the VIA Rail crossing location	This solution eliminates the risk of a near-miss or collision between all users and trains. This solution also eliminates the need for rail-crossing infrastructure maintenance and inspection as it removes the crossing altogether. However, this solution performs poorly in consideration of the planning objectives, as it removes accessibility across the tracks, removes connectivity for all modes and does not contribute towards enhancing the natural or social environments. All modes would be forced to re-route out of their way which would severely affect travel time, reliability, or efficiency. Pedestrian and cycling facilities would be redirected to an existing and alternative grade-separated crossing. Transit would be rerouted long distances to connect to Fallowfield Station adding travel time, decreasing resiliency,	Not Recommended ✗

Alternative Solution		Description	Preferred Solution
		and preventing connectivity. Further, this solution does not address the Project Need and Opportunities established for the Study Area.	
3	Improve the existing at-grade road crossing	This solution partially addresses the project objectives but does not fully eliminate the risk of a near-miss or collision between all users and trains. Upgrading the rail infrastructure equipment or improving the angle of crossing partially improves the safety and leads to a better-quality environment for users and better accessibility. Improving travel times and efficiency for all modes will ultimately be limited by the frequency of train crossings. This solution may have impacts to the natural environment depending on the improvement(s) implemented. This solution does not address the Project Need and Opportunities established for the Study Area.	Not Recommended ✗
4	Realignment of Fallowfield Road that avoids crossing the VIA Rail line	This solution would eliminate the risk of a near-miss or collision between all users and trains. However, this solution performs poorly in consideration of the planning objectives, as it would remove accessibility and connectivity across the tracks for all modes on the networks where the roads would be closed to prevent the rail crossing. The closure of the existing roads to remove crossing of the rail line would force all modes to re-route to the realignment to make connections which would not improve travel time, reliability, or efficiency. This solution does not contribute towards enhancing the natural or social environments or address the Project Need and Opportunities established for the Study Area. This solution would require substantial land acquisition. The land impacts would be almost entirely Greenbelt lands that are actively farmed. As such, this solution results in social, natural, and economic environmental impacts and is not consistent with established planning policy.	Not Recommended ✗
5	Grade-separation	This solution eliminates the risk of a near-miss or collision between roadway and pathway users and trains. This solution also eliminates the need for rail-crossing infrastructure maintenance and inspection as it removes the crossing altogether. This solution provides the best opportunity to provide efficiency, resiliency, and mobility on the area transportation network. All modes would result in improved travel time, reliability, and efficiency as there would be no crossing where waits are experienced to let trains pass. Connectivity with the VIA Rail Fallowfield Station would be direct. This solution is consistent with addressing the Project Need and Opportunities. This solution results in impacts to the natural environment. However, there would be opportunity to improve corridor landscaping with implementation.	Recommended Preferred Solution ✓

4.4 Preliminary Preferred Solution

Based on the preceding evaluation the Preliminary Preferred Solution is to extend rapid transit from Baseline Station to Barrhaven Town Centre using LRT (including converting the Southwest Transitway from BRT to an LRT facility) and grade-separate the Southwest Transitway/Barrhaven LRT, Woodroffe Avenue and Fallowfield Road from the VIA Rail line.

4.5 Stakeholder Consultation

4.5.1 FIRST ROUND OF CONSULTATION GROUP MEETINGS

The first round of Study Consultation group meetings (Agency, Business and Public) were held on November 27 and 28, 2018. The Study Team, including members from the City of Ottawa and the consultant team, were available to discuss the study and answer questions in a round table forum. Consultation group members were identified and invited to participate via email correspondence. At these meetings, participants were presented information including: confirmation of project need and opportunities, an overview of existing conditions, evaluation of alternative solutions criteria, methodology and results, and the preliminary preferred solutions.

The first POH was held on October 30, 2019 and is discussed in Section 6.3.2. Information presented included the needs and opportunities, existing conditions, evaluation of alternative solutions and preliminary preferred solutions. Feedback received from stakeholders in these consultation meetings included the following:

- General support for the preliminary preferred solution to extend LRT from Baseline Station to Barrhaven Town Centre;
- General support for the preliminary preferred solution for grade-separating the Southwest Transitway/Barrhaven LRT, Woodroffe Avenue and Fallowfield Road from the VIA Rail line;
- Redevelopment plans for Barrhaven Town Centre;
- Consideration for staging/phasing plans to improve the area transportation network sooner; and,
- Consideration for extending the southerly limit of the study to serve to quickly growing communities south of the Jock River.

For a full account of discussion from these consultation group meetings and the first POH, refer to **Appendix A**.

4.6 Preferred Solution

The Study Team also took into consideration additional feedback received including opportunities to implement phasing options to improve the area transportation network sooner. The potential southerly extension beyond Barrhaven Town Centre was not included as part of this study but further considered by the City.

Based on the comments received the preferred solution was confirmed as an extension of rapid transit from Baseline Station to Barrhaven Town Centre as LRT (including converting the Southwest Transitway from BRT to an LRT facility) and grade-separating the Southwest Transitway/Barrhaven LRT, Woodroffe Avenue and Fallowfield Road from the VIA Rail line.

5 Update to Existing Environmental Conditions

Following the establishment of existing conditions for the Study Area and a preferred solution, more detailed analyses were conducted to further inform and develop the subsequent evaluation criteria and evaluation of alternative designs discussed in **Section 6**. These updated studies were completed during 2019-2020.

Additional analysis of existing conditions as it pertains to the modification to the Preferred Design is described in **Section 6.7** and **Annex 18 of Appendix B**.

5.1 Natural Environment Focused Field Studies

An extensive natural environment focused field study program was undertaken. The complete report can be found in **Appendix B.** Natural environment field surveys were conducted as part of this update to existing conditions and included:

- Ecological Land Classification (ELC);
- Significant Wildlife Habitat (SWH) assessment;
  - Amphibian breeding surveys;
  - Breeding bird surveys;
  - Bat maternity colony habitat assessment;
- Significant Woodlands assessment;
- Canadian Wetland Classification;
- Aquatic features assessment; and,
- Species at Risk (SAR) habitat suitability analysis.

Conduct of these surveys was limited to areas where consent to enter public/private lands was obtained during the appropriate timing window for each field survey.

5.1.1 ECOLOGICAL LAND CLASSIFICATION

Twenty-five natural vegetation communities were documented within the Study Area following the established methodology as per the *ELC system for southern Ontario* (Lee et. al., 1998) with updates from the 2008 catalogue. No ELC vegetation communities were found to be provincially at risk or of conservation concern as per the Natural Heritage Information Centre (NHIC). A total of 93 vascular plant species were recorded and most plants inventoried are common to widespread throughout Ontario. Vegetation SAR observed included the City of Ottawa's compensation plantings of Butternut (*Juglans cinerea*) specimens (listed as Endangered both federally and provincially) within the existing Transitway corridor, north and south of Berrigan Drive, and in the Black Rapids Creek corridor (not considered compensation plantings). Detailed ELC mapping is found in **Appendix B.**

5.1.2 SIGNIFICANT WILDLIFE HABITAT

There are four categories of SWH: seasonal concentration areas, migration corridors, rare or specialized habitats and Species of Conservation Concern. Species and their habitats that are already protected as Endangered or Threatened under the ESA are not considered in the assessment of SWH.

Three candidate SWH features and three confirmed SWH features were identified within the Study Area (**Table 5-1**). There are no candidate or confirmed migration corridors for the Study Area. Candidate SWH refers to those natural features that are potentially significant based on the presence of suitable habitat in the criteria outlined in MNRF's SWH guidance document (2015).

All candidate and confirmed SWH features were identified based on ELC, wildlife habitat assessments, and targeted surveys.

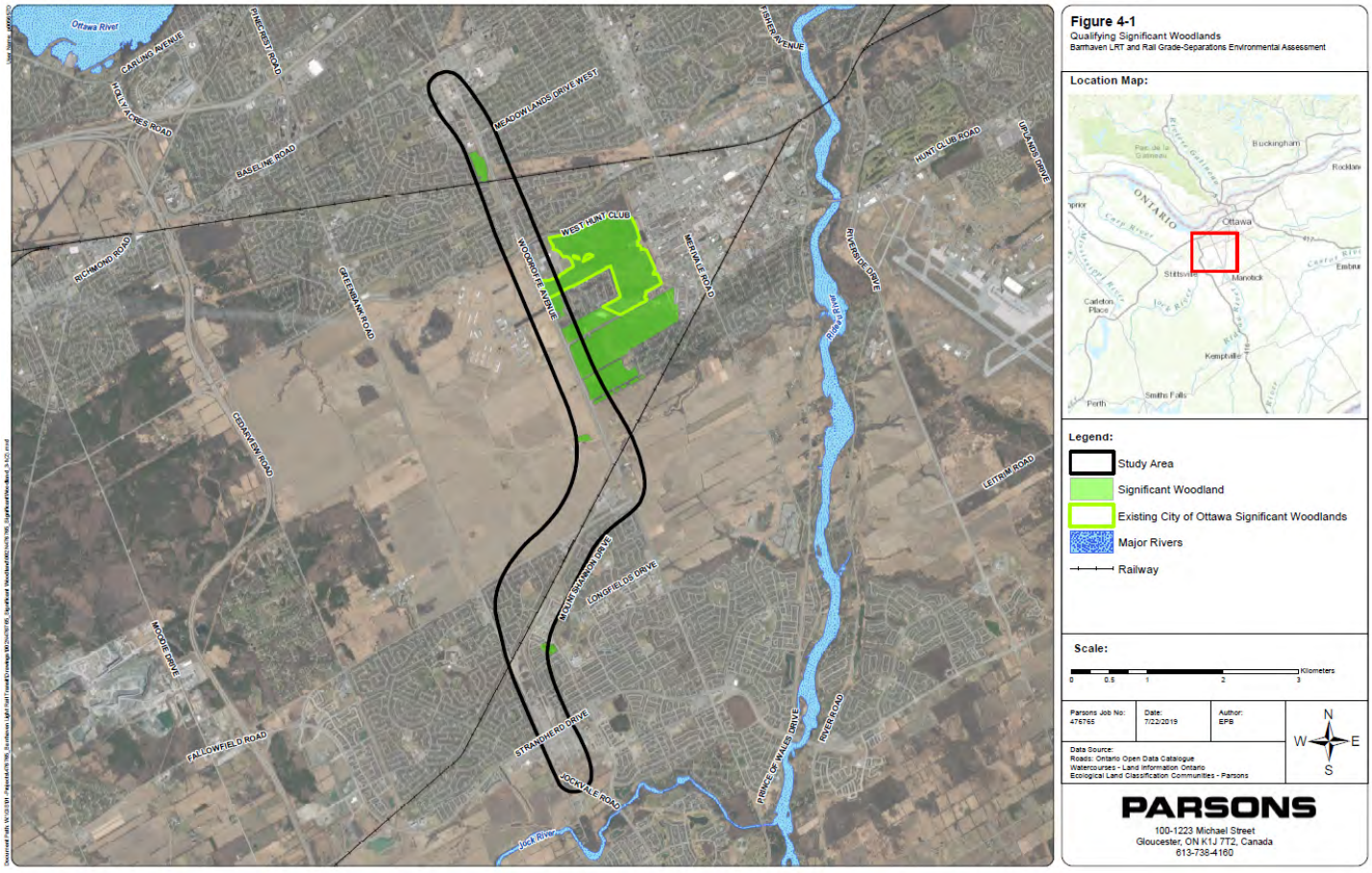
Table 5-1 Summary of Candidate and Confirmed SWH for the Study Area

SWH Category	Wildlife Habitat	Determination
Seasonal Concentration Areas	Waterfowl stopover and staging areas (terrestrial)	Candidate
	Bat Maternity Colonies	Candidate
Rare Habitats	Sand Barren	Confirmed; natural feature SBOB1
Specialized Habitats	Woodland raptor nesting habitat	Confirmed; a breeding pair of Cooper's Hawk observed in the forest communities of Pinhey Forest
	Amphibian breeding habitat (wetlands)	Candidate
Habitats for Species of Conservation Concern	Special Concern and Rare Wildlife Species	Confirmed; breeding pairs of Eastern Wood-pewee were observed within the forest communities comprising Pinhey Forest

5.1.3 SIGNIFICANT WOODLANDS

An assessment was conducted to determine if there were additional qualifying areas within the Study Area that meet the criteria for significant woodlands. Existing and qualifying significant woodland areas were identified as illustrated in **Figure 5-1**.

Figure 5-1 Significant Woodland Assessment Results



5.1.4 SPECIES AT RISK

Following additional field surveys including targeted surveys, the following is applicable to the Study Area:

- Four Threatened/Endangered species under the ESA and/or SARA were confirmed present within the Study Area, these include: Butternut, Barn Swallow*, Bobolink and Eastern Meadowlark.

- One species, Eastern Wood-pewee, listed as special concern species under the ESA and SARA was confirmed present within the Study Area.
- Seven Threatened/Endangered species under the ESA and/or SARA have a high potential to occur within the Study Area, these include: Bank Swallow, Chimney Swift, Common Nighthawk, Wood Thrush, Little Brown Myotis, Northern Myotis and Tricolored Bat.
- Seven species listed as Special Concern under the ESA and/or SARA have potential to occur within the Study Area, these include: Monarch, Yellow-banded Bumble Bee, Snapping Turtle, Eastern Milksnake, Evening Grosbeak, Grasshopper Sparrow and Northern Brook Lamprey.

* Species downlisted prior to finalizing EPR. Special Concern under provincial ESA as of January 25, 2023

5.1.5 CANADIAN WETLAND CLASSIFICATION

Classification keys outlined in the Canadian Wetland Classification System were used to determine wetlands within the Study Area (NWWG 1997). Wetlands are classified based on three levels: class, form, and type.

In total, five wetlands were identified within the Study Area according to the ELC system. These vegetation units have been further evaluated based on federal wetland guidelines. Wetland classification, description and locations of the evaluated wetlands identified based on their associated ELC code are provided (Table 5-2). The wetland communities observed within the Study Area are common throughout Ontario and have been heavily influenced by adjacent land uses such as active agriculture, transportation corridors, or pine plantations.

Table 5-2 Canadian Wetland Classification for the Study Area

ELC Vegetation Type	Wetland Class	Wetland Form	Wetland Type
SWDM3-2 Silver Maple Mineral Deciduous Swamp	Mineral Swamp1	Discharge Seepage Swamp3	Hardwood Treed6
SWDM4 Mineral Deciduous Swamp (Black Rapids Creek)	Mineral Swamp1	Riverine Swamp4	Hardwood Treed6
SWTM5 Mineral Deciduous Thicket Swamp (Black Rapids Creek, shown as MAMM1/SWTM5)	Mineral Swamp1	Riverine Swamp4	Mixed Shrub7
MAMM1 Graminoid Mineral Meadow Marsh (Black Rapids Creek, shown as MAMM1/SWTM5)	Mineral Marsh2	Riparian Stream Marsh5	Graminoid (Grass and Tall Rush)8
MAMM1-12 Common Reed Graminoid Mineral Meadow Marsh	Mineral Marsh2	Riparian Stream Marsh5	Graminoid (Reed – dominated by reed species (Phragmites spp.)

[1] periodically standing surface water and gently moving, nutrient-rich groundwater, with vegetation dominated by woody plants > 1 m high.

[2] wetland ecosystem characterized by minimal or no peat accumulation (although thin layers of muck and a mix of mineral and organic muck may be present), periodic or persistent standing water or slow-moving surface water which is circumneutral to alkaline and generally nutrient-rich, and vegetation dominated by graminoids, shrubs, forbs, or emergent plants.

[3] topographically flat and develop around and along the outflow of groundwater seepage. There are no distinct springs on the surface.

[4] occur along the banks of rivers and permanent/intermittent streams. Water table maintained by the level of water in the adjacent stream. Situated adjacent to streams and subject to flooding.

[5] situated on channels, streams, or rivers, on watercourses with continuous or intermittent flow.

[6] dominated by broadleaf species in the canopy layer. Most common species are maple species (*Acer spp.*), black ash (*Fraxinus nigra*), American elm (*Ulmus americana*), birch species (*Betula spp.*), and balsam poplar (*Populus balsamifera*).

[7] tall shrubs (> 1.5 m), medium shrubs (0.5 to 1.5 m), and low shrubs (0.1 to 0.5 m).

[8] dominated by low, tall, or mixed grass species and cattail species.

5.2 Geotechnical Investigation

To assist with the evaluation of alternative designs a focused geotechnical program was undertaken, which included drilling two boreholes at strategic points, along with analysis of extensive historical borehole data to provide more detail regarding the subsurface existing conditions and potential constraints. The investigation was completed November 19 and 27, 2018. The full report can be found in **Appendix B**. The results confirm the soil and groundwater challenges identified during previous planning studies in the vicinity of the proposed rail grade-separations for Woodroffe Avenue, Southwest Transitway and Fallowfield Road. The results from these investigations also identify that the same subsurface challenges that exist in the vicinity of the rail grade-separations exist in the north section of the Study Area between Baseline Station and West Hunt Club Road. The subsurface conditions in the southern section of the Study Area were also investigated between Fallowfield Road and Barrhaven Town Centre.

5.2.1 NORTH SECTION - LRT ALTERNATIVES

The north section of the Study Area is underlain by compressible silty clay (up to about 13m thick), over sand, silt, glacial till and bedrock. An extensive deposit of sand underlies the silty clay, increasing in thickness as the thickness of the silty clay decreases to the south.

The silty clay deposit, where present, has limited capacity to support additional loading without undergoing potentially significant compression, which could in turn lead to settlement of overlying structures. If excessive foundation settlements are to be avoided, the net change in stress on the underlying silty clay must be limited so that the stress level in the silty clay would not approach or exceed the deposit's precondition pressure (i.e., its 'yield' stress). The additional potential stress on the silty clay could result from a combination of new foundations loads, the weight of any material used for filling around the structures and any potential future groundwater level lowering.

5.2.1.1 Elevated Alternatives

Based on the anticipated subsurface conditions encountered between Baseline Station and Knoxdale Road, it is expected that elevated/overpass structures (including Tallwood Station), if considered along this segment of the LRT alignment, would likely need to be supported on deep foundations supported on the underlying glacial till or bedrock, in order to minimize the additional stress on the silty clay due to the foundation loads or filling. Based on the previous boreholes advanced along this section of the alignment, the depth to the bedrock surface is expected to be in the range of about 12 to 17m, generally decreasing towards south. The use of embankments is not recommended as they would require preloading and generally more technically complicated construction methods. No hydrogeological constraints are anticipated associated with the elevated/overpass structure alternative.

5.2.1.2 Below-Grade Alternatives

Conceptually, construction of the LRT within an open trench or tunnel (either cut and cover or underground tunnelling) is feasible from a geotechnical standpoint but the ground conditions present would result in significant risks, mainly related to control of groundwater.

Hydrogeological Considerations

Following on the November 2018 geotechnical investigations, a hydrogeological desktop analysis was carried out for the below-grade alternatives to assess the potential inflows and impacts. Assuming open excavations would extend to about 1m below the underside of the rail structure (tunnel or trench bottom), this would be between 5 to 7m below the measured groundwater level. Groundwater inflows from the sandy deposits will be very high and have significant construction impacts with respect to the excavation and structure. Based on the results of the previous hydrogeological investigations, and depending on the final LRT grades, temporary and permanent groundwater lowering in this area could lead to an unacceptable risk of settlement for those structures, facilities and utilities founded on shallow foundations. The predicted drawdown radius of influence could extend to approximately 250m located in or near the vicinity of the excavation due to the presence of thick compressible silty clay. The settlement impacts will not necessarily be limited to the areas immediately adjacent to the trench or tunnel.

The steady-state dewatering rate would need to be maintained for the life of the structure, assuming it would remain drained. Alternatively, the structure could be made entirely waterproof such that the groundwater levels could return to their current levels following construction. This would, however, significantly complicate the construction of any underground structure and potentially long-term maintenance (because of the need to maintain extensive waterproofing, liners, seals, etc.).

Open Cut Trench or Tunnel Considerations

The clay settlement mechanism described above is currently well understood in the geotechnical engineering community in the Ottawa area. Historically, however, it was not always understood and there have been instances where dewatering has resulted in significant settlements of structures.

In the case of the LRT tunnel/trench, the groundwater levels would need to be lowered permanently, as well as during construction, in order to maintain a dry facility. Typically, where that is required but the risks of dewatering are very high (as in this case) the approach is to carry out the excavation within a watertight shoring system and to design the permanent structure to be watertight, such that permanent pumping of groundwater is not required. This typically requires extremely robust shoring systems, such as interlocking secant pile walls or slurry walls that extend at least a few metres below the bedrock surface to completely cut off water inflows. Construction of a watertight base slab, tied into the watertight shoring on either side is also required.

Construction of watertight shoring and permanent structures is difficult, very costly and is not always successful. There are a number of construction challenges that must be overcome. The secant pile or slurry walls must be constructed in such a manner that the individual piles or slurry wall panels are completely interlocked (i.e., joined without gaps, or 'windows') over the full depth of installation. This can be difficult to achieve in practice but has been done successfully on many projects. However, the projects where complete sealing of the shoring has been achieved typically involve relatively limited lengths of shoring or construction areas (such as a building footprint), and typically require significant amounts of localized repairing as excavation proceeds). In the case of the Barrhaven LRT tunnel/trench, the watertight shoring walls and base slab would need to be constructed on both sides and base of a more than 2km long cut. Achieving the required shoring integrity over that length would be a significant challenge. Where the shoring installation does result in gaps or leakage, the corrective measures are difficult, costly, time-consuming and may not be entirely successful. Those measures typically involve grouting to seal the gaps (which can be very difficult to successfully complete), jet grouting, ground freezing (as a temporary solution), or the installation of recharge systems (which may be required to operate for the life of the facility).

It should also be noted that even small leaks in the permanent structure, especially if there are a number of them, can result in groundwater lowering that may take place over a number of years, resulting in third party claims many years after construction.

Tunnelling (TBM) Considerations

As an alternative to cut and cover construction, a tunnel or twin tunnels could be constructed using tunneling or trenchless methods along the entire alignment from Baseline Station to West Hunt Club Road. The total length of the alignment is about 2.3 km and a Tunnel Boring Machine (TBM) drive (or drives for twin tunnels) of this length may be economically feasible, although still costly, in comparison to the challenges noted above for open cut construction and the potential disruption associated with open cut construction.

TBM tunnelling is not without risk in the ground conditions present along this alignment. The ground conditions change from till to sands and clays along the alignment. These 'mixed face' conditions can be challenging from a tunnelling perspective since it is difficult to appropriately condition the tunnel spoils (excavated material) for muck removal and tunnel advancement as the composition of the soil changes. This can lead to clogging that significantly slows the rate of advancement (resulting increased cost or schedule delays), or, of more concern if support cannot be maintained in the running sands, over excavation and loss of ground can lead to sinkholes that result in damage to structures and utilities and threats to public safety.

In addition, although the risks of settlement of structures founded on compressible clay would likely be minimal for construction of the tunnel, the construction of the stations would still require watertight shoring, as described above for the open cut trench or tunnel. Permanently watertight structures would also be required for the stations and the resulting risks associated with groundwater control as described above for the open cut option, although of lesser magnitude, would still

apply for those excavations and the completed structures. Any leakage over time in the tunnel lining (due to construction issues of degradation of the gaskets or liner) could result in groundwater lowering over the long term that could lead to settlement and damage of structures or utilities along the alignment.

5.2.2 RAIL GRADE-SEPARATIONS

The subsurface conditions between West Hunt Club Road and Slack Road generally consist of sandy deposits but the total thickness of the deposits is not known. South of Slack Road, the sandy deposits tend to thin out and compressible silty clay is present with the thickness of the deposit increasing towards the south. Near the VIA Rail crossing, the LRT alignment is generally underlain by compressible silty clay, over very loose to loose silty and sandy soils, above glacial till and bedrock. The surface of bedrock was encountered in the range of 9 to 10m depth at the rail crossing.

It is not considered feasible to support an overpass in this location on shallow foundations given the limited capacity of the compressible silty clay. An overpass structure will therefore have to be founded on deep foundations. There are no significant geotechnical concerns with supporting bridge structures on deep foundations (such as driven steel H-piles end bearing on rock or drilled cast-in-place caissons end bearing on, or socketed in, the bedrock), recognizing that some of the piles could have difficulty penetrating to the bedrock surface and could 'hang up' on cobbles and boulders within the glacial till which overlies the bedrock, if driven steel H-piles are considered.

The significant issue with respect to excavations is groundwater control. Excavations below the groundwater level, which penetrate the overburden soils and are near/in the bedrock surface will experience significant groundwater inflow. Based on a previous pumping test carried out at the Fallowfield Road crossing, the water table in the very permeable bedrock will need to be lowered significantly to complete construction. In addition, based on the results of the previous investigations, the excavations may encounter basal heave and/or soil boiling when the base of excavation is within about 3 or 4m of the bedrock.

Water drawdown in the bedrock would also potentially cause consolidation of the overlying soil due to water depletion in the silty clay and very loose and loose silt material, resulting in settlement of adjacent structures supported on and within the overburden in the area. The magnitude of the consolidation settlement as a result of groundwater lowering is difficult to predict but it is likely greater than what structures can typically tolerate (i.e., greater than 25mm), which would be in addition to any settlement previously experienced by the structures.

Depressurizing the groundwater in the bedrock could prevent basal heave / soil boiling. This option would require continuous pumping of groundwater inflows from the bedrock to recharge wells even after the construction period. In the long-term, however, unless the water table in the bedrock is returned to pre-construction levels, pumping in the bedrock could lower the water in the bedrock regionally resulting in settlements of structures supported on and within the overburden in the area. Furthermore, any excavation that reaches or penetrates bedrock would require placement of low hydraulic conductivity material such as concrete and/or weathered clay to prevent hydraulic connection between the structure base materials and the bedrock.

Based on the above, an overpass bridge structure is considered to be the preferred grade-separation alternative from a geotechnical and hydrogeological perspective.

5.2.3 SOUTH SECTION - BRT TO LRT CONVERSION

The subsurface conditions moving southwards generally consist of silty clay and glacial till. The thickness of silty clay tends to decrease towards Barrhaven Town Centre and is limited or absent between Highbury Park Drive and Jockvale Road. Shallow bedrock was encountered between Highbury Park Drive and Berrigan Drive. The bedrock consists of sandstone underlain by dolostone or limestone.

Near Berrigan Drive, in view of the shallow bedrock conditions (within about 1m depth), a bridge structure, if considered, could be founded on spread footings supported directly on the bedrock. Since the embankments will essentially be supported on bedrock, settlement of the approach embankments will only occur due to compression of the embankment fill itself; settlement of the subgrade should be negligible.

South of Berrigan Drive, the bedrock surface is at deeper depths. Although technically feasible, it would not be practical to support the foundations of the new station on bedrock. The new station could instead be founded on shallow foundations placed directly on glacial till.

Shoring will likely be required due to the space constraints within the Barrhaven Town Centre. The type of shoring will depend on the proximity to existing structures and may require the use of relatively inflexible shoring (e.g., secant piles).

Some groundwater inflow into the excavations should be expected. However, if the floor of excavations will approach or extend into the bedrock surface, inflow from the bedrock would be significant. Some form of active dewatering will be required (such as pumping from a series of wells drilled into the bedrock) and the groundwater level will need to be lowered in advance of excavation; otherwise, the rate of groundwater inflow to the excavation would be excessive.

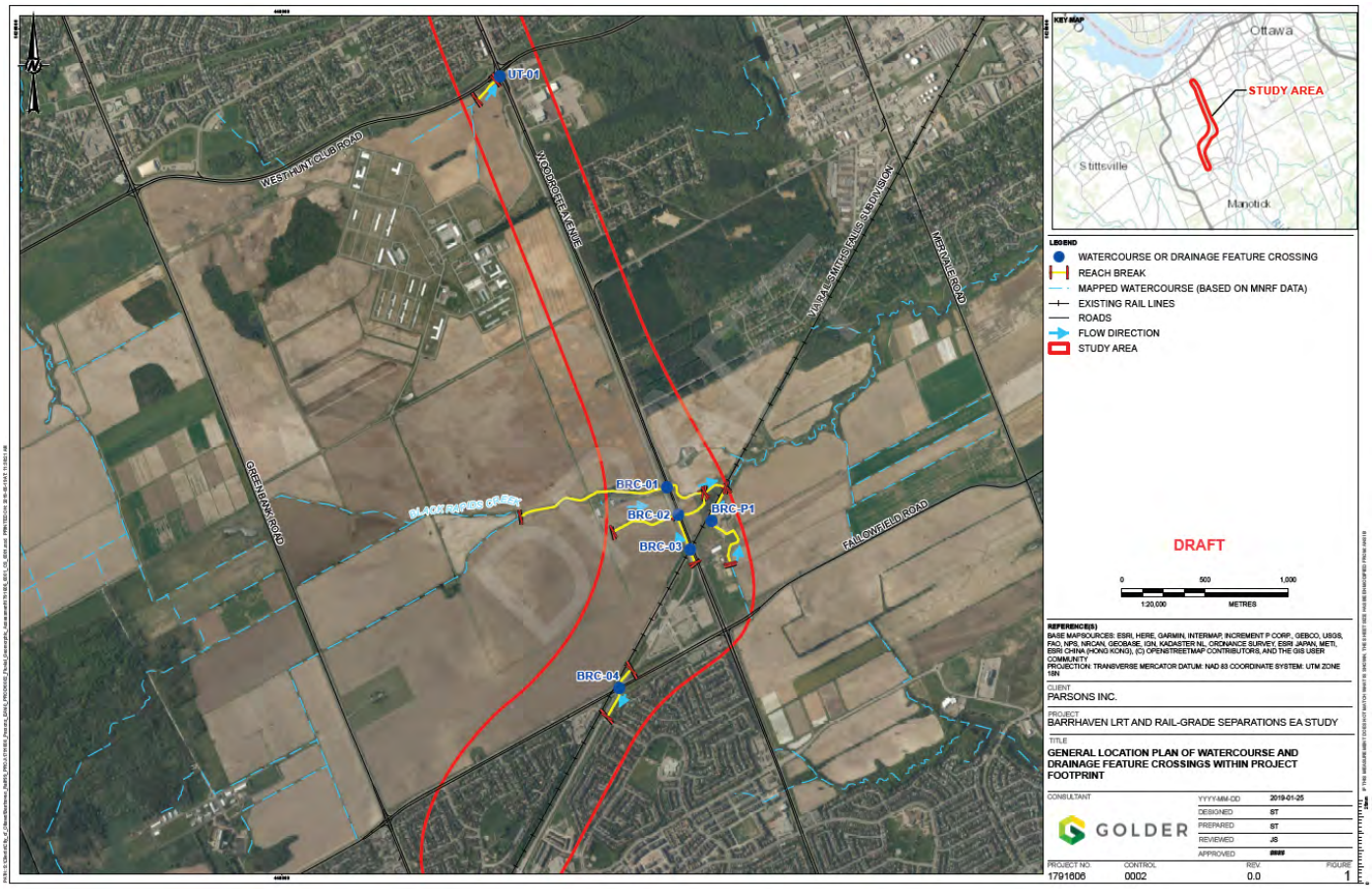
Short-term groundwater level lowering can be expected in the area around the new bridge and/or station due to the groundwater control requirement during construction. Longer-term groundwater level lowering may also be expected if a drainage system beneath and around the below-grade stations and running track is required. The silty clay soils in this area are potentially sensitive to changes in the ground water level. The potential for impacts on surrounding structures and utilities will therefore need to be evaluated.

It is expected that some groundwater lowering has already occurred due to drainage system of the existing underpass structures, which is likely at a similar level to the planned drainage system. The additional drawdown resulting from construction will therefore likely be fairly modest. Further, silty clay is not present on the southern section of the alignment. Where present, due to the low hydraulic conductivity of the silty clay (and the underlying glacial till), the drawdown is expected to be fairly localized to the area of construction. It is therefore expected that the potential groundwater level lowering would not cause excessive settlement of existing structures; however, this would need to be confirmed during subsequent geotechnical investigations during preliminary and detailed design.

5.3 Fluvial Geomorphic Assessment

A fluvial geomorphic assessment was conducted on relevant watercourse crossings in the Study Area to determine the extent of the 100-year erosion limit for each channel and thereby inform the functional design of upgraded crossing structures (**Figure 5-2**). Fieldwork to support this work was conducted on December 12, 2018 and January 11, 2019. The reaches of BRC-01 (Black Rapids Creek), BRC-02 (tributary to Black Rapids Creek) and BRC-P1 (tributary to Black Rapids Creek) are generally characterized by straightened/realigned channel patterns (altered before 1965 to accommodate agriculture or other land use practices) and have shown limited evidence of natural planform adjustment over the duration of the historical air photograph record. These reaches were shown to include no particular channel characteristics that would merit specific crossing structure sizes from the perspective of fluvial geomorphology. It is expected that the minimum span recommendations for the study reaches of BRC-03 (engineered ditch that conveys flows north-south located between the Southwest Transitway and Woodroffe Avenue), BRC-04 (engineered ditch that conveys flows to/from a stormwater management facility) and UTC-01 (tributary to Nepean Creek) will be based on hydraulics alone (i.e., conveyance of the design flood).

Figure 5-2 Location of Watercourse Crossings within the Study Area



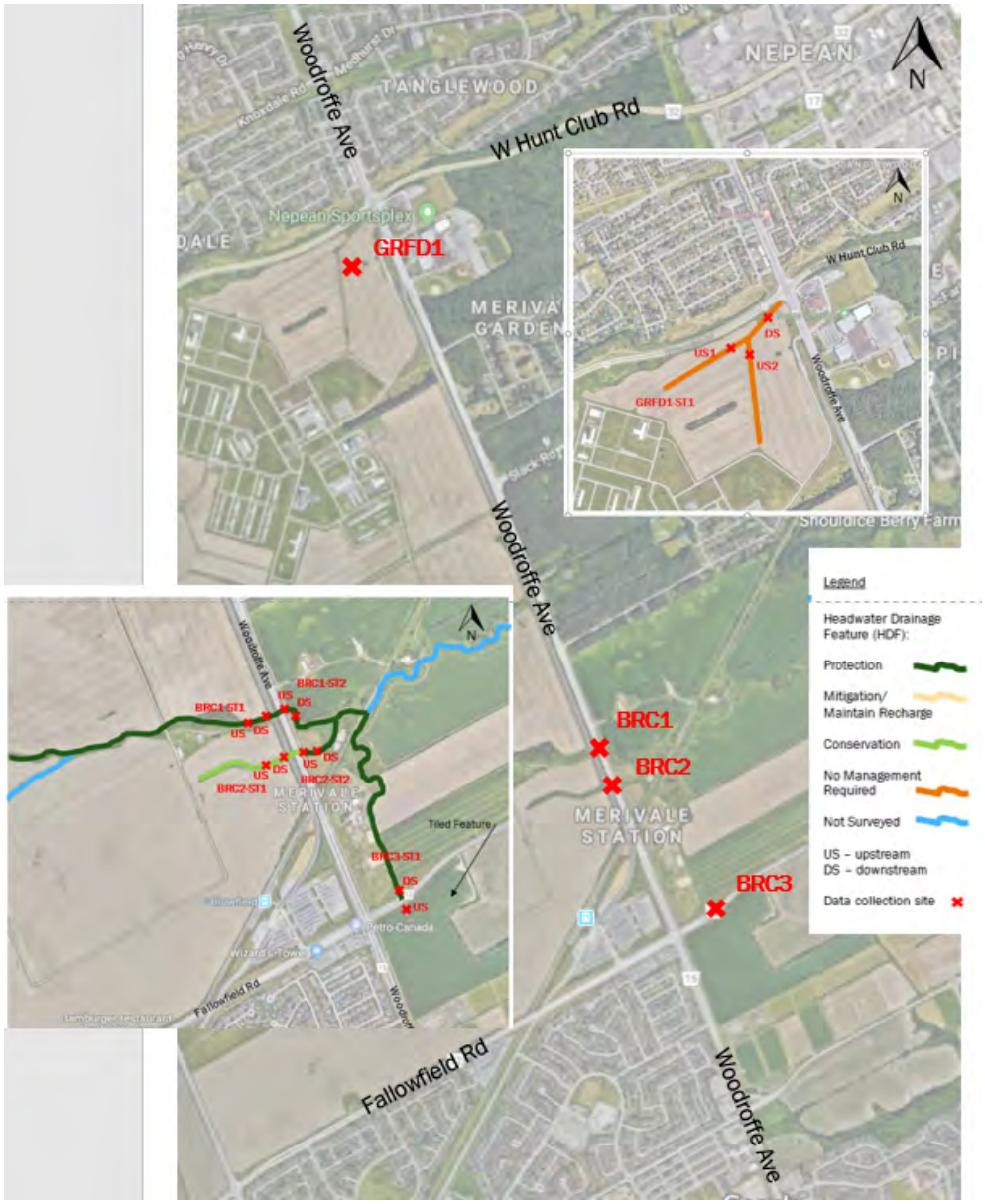
5.4 Headwater Drainage Assessment

A headwater drainage assessment was conducted for the Study Area where four sites were observed (**Figure 5-3**). Fieldwork to support this work was conducted July 10, 2018 and April 17, 2019, the complete assessment can be found in **Appendix B**. Based on the management recommendations (TRCA, 2014), it was determined that BRC1-ST1, BRC1-ST2, BRC2-ST2, and BRC3-ST1 will require protection. This involves ensuring that the reach remains open and that the hydroperiod is maintained and is directly connected downstream. Relocation of any kind is not permitted and groundwater or wetlands must be maintained.

Conservation was recommended for BRC2-ST1. This involves maintaining or replacing the existing surrounding features, including on-site and external flows and vegetation within the riparian zone corridor. Natural design techniques to maintain or enhance the reach are to be used.

No management is required for both the GRFD1-ST1 site, due to the lack of flow, natural vegetation and connection downstream.

Figure 5-3 Headwater Drainage Feature Assessment Locations and Management Recommendation



6 Evaluation of Alternative Designs

This section of the EPR presents the development and evaluation of alternative designs for the Barrhaven LRT and rail grade-separations, based on the preferred solutions for the undertaking identified in **Section 4**. It describes the process undertaken to develop the criteria used to evaluate the alternatives in consideration of the existing conditions within the Study Area (**Section 3**), documents the major features, issues and opportunities along the corridor, considers the additional detailed work undertaken to understand the existing conditions (**Section 5**) to inform the evaluation and presents preliminary preferred designs for the undertaking. There are four (4) distinct aspects of the study that require an evaluation of alternative designs. These include evaluating:

1. The extension of LRT from Baseline Station to the Nepean Sportsplex;
2. The grade-separation of Woodroffe Avenue and the Southwest Transitway/Barrhaven LRT from the VIA Rail line;
3. The grade-separation of Fallowfield Road from the VIA Rail line; and,
4. The locations for a Train Storage and Servicing Facility (TSSF).

Given that the existing Southwest Transitway is a dedicated rapid transit facility south of the Nepean Sportsplex to Barrhaven Town Centre, the recommendation is to convert this facility to support LRT within its existing corridor.

6.1 Evaluation Criteria and Methodology

An evaluation method provides the rationale or reasons for decisions which assist in decision making. As such, evaluation methods are designed as decision-making tools. Using a formal evaluation method has these advantages:

- It provides a better basis for decision-making that may not otherwise exist;
- It provides reasons for decisions that on examination can be traced, explained, and defended; and,
- It provides a means to demonstrate how the many aspects of the environment have been considered, in a holistic and multi-disciplinary manner.

Several evaluation methods are available for EA studies. An Evaluation Matrix was selected as the methodology for this study as it provides a means of objectivity evaluating alternatives against criteria that can be tailored to the varying Study Area contexts. The evaluation methodology included the following tasks:

Task 1: Criteria Development

Task 2: Identifying Alternative Designs (and locations for the TSSF)

Task 3: Identifying Differentiating Criteria

Task 4: Performing a criteria-based Evaluation of Alternative Designs (and locations for the TSSF)

Task 5: Synthesizing the findings and recommending a Preliminary Preferred Design

The context-sensitive criteria that were developed for this study are presented in **Table 6-1,** with the evaluation scale shown in **Table 6-2**. The criteria are grouped into five (5) broad categories covering all aspects of the environment as defined in the EA Act including:

I. Transportation System Sustainability;
II. Ecological and Physical Sustainability;
III. NCC Greenbelt Sustainability;
IV. Land Use and Community Sustainability; and,
V. Economic Sustainability.

For evaluation of each alternative, all listed criteria were considered, however, only those criteria particularly relevant and differentiating were selected to assist with each of the four evaluations of alternative designs.

Table 6-1 Evaluation Criteria and Indicators

Criteria		Indicators
I. Transportation System Sustainability		
1	TRANSIT NETWORK	a) Provides optimal LRT geometry (horizontal and vertical) to meet design requirements b) Maximizes opportunity for convenient and accessible LRT Stations c) Supports enjoyable transit user experience, including ride comfort, riders' views, and integrated station opportunities d) Maximizes opportunity to provide convenient and accessible connections to existing and future local and rapid transit via LRT e) *Maximizes the tie-in compatibility and maintains access to Fallowfield Station f) *Minimizes impacts to transit operations
2	ACTIVE TRANSPORTATION	a) Provides the opportunity to connect to pedestrian and cycling facilities within the Study Area b) Provides a direct and efficient north-south pedestrian and cycling travel route through the Study Area
3	MAJOR ROAD NETWORK	a) Provides opportunities to optimize functionality of the existing and future road network b) Provides/Supports Complete Streets design objective c) *Minimizes impacts to arterial roads function as a truck route
4	RAIL NETWORK*	a) Minimizes or avoids impacts to existing and planned rail networks b) Maximizes safe operation of the rail network
5	TRANSPORTATION NETWORK**	a) Provides opportunity to maintain or optimize functionality of existing and planned networks for all modes
6	FACILITY OPERATIONS**	a) Maximizes LRT operation reliability b) Maximizes the opportunity to connect to utilities and infrastructure c) Maximizes the opportunity to provide a safe and secure access to the facility from the surrounding road network d) Maximizes ability to provide secure access to the facility
II. Ecological and Physical Sustainability		
7	NATURAL HERITAGE FEATURES	a) Minimizes or avoids impacts on designated features of the City's natural heritage system or other identified natural areas b) Minimizes stormwater management complexity and maintenance c) Minimizes impact on surface water features including shoreline vegetation zones, or loss of or degradation of existing aquatic habitat d) Minimizes or controls the spread of invasive plant species e) Minimizes or reduces the amount of natural habitat loss, maximizes protection of urban trees f) Minimizes the disruption to ecosystem connectivity and natural habitats g) Maximizes the opportunity to reduce/avoid wildlife collisions
8	PHYSICAL ENVIRONMENT	a) Minimizes risk to human health on areas of known contaminated soils and/or groundwater b) Minimizes risks associated with groundwater and/or sensitive soils c) Maximizes the opportunity to adopt enhanced stormwater management techniques to reduce impacts on water quality and quantity
9	CLIMATE CHANGE MITIGATION	a) Minimizes the impact from the project on contributing to climate change
10	CLIMATE CHANGE ADAPTATION	a) Minimizes the impact of extreme weather events on the infrastructure b) Maximizes the safety and comfort of corridor users exposed to the environment
III. NCC Greenbelt Sustainability		
11	AGRICULTURAL RESOURCES	a) Minimizes impact to designated prime agricultural lands b) Minimizes impacts on existing farm infrastructure including buildings and tile drainage systems c) Maximizes opportunity to maintain farmhouse access and farming access roads
12	GREENBELT ENVIRONMENT	a) Minimizes impacts to designated NCC Greenbelt lands b) Maximizes opportunity to improve views and vistas within the Study Area
IV. Land Use and Community Sustainability		
13	COMMUNITY PLANNING AND DESIGN	a) Supports the orderly arrangement and organization of land uses/diminishes fragmentation of land uses b) Minimizes impacts to existing land uses including existing buildings and residences c) Minimizes or avoids disruption to essential municipal services (utilities, potable water, and sanitary services)

Criteria		Indicators
		d) Maximizes opportunities to improve community health and well-being through creation or access to recreation areas/facilities e) Maximizes opportunities to improve the public realm f) Maximizes opportunity to provide a safe facility and implement CPTED principles g) Maximizes accessibility design standards h) Minimizes impacts from winter conditions from a safety, snow removal, accessibility and cost perspective
14	CULTURAL HERITAGE RESOURCES	a) Avoids or minimizes impact on existing archaeological resources or areas with potential b) Avoids or minimizes impact on designated or potential built heritage resources c) Avoids or minimizes impact on designated or potential cultural heritage landscapes
15	NOISE AND VIBRATION	a) Maximizes separation between the [LRT/Road] facility (a potential noise and vibration source) and sensitive receivers b) Maximizes opportunities to reduce noise and vibration by utilizing best practices and design for LRT
16	AIR QUALITY	a) Minimizes future air quality impacts at sensitive receivers
V. Economic Sustainability		
17	PHASING AND IMPLEMENTATION	a) Maximizes the ability to phase and incrementally implement the project b) Minimizes the disruption or diversion for all modes (transit and vehicular traffic, sidewalks, cycling facilities, pathways etc.) during construction c) Minimizes overall construction impacts (noise, dust, vibration)
18	LIFE CYCLE COST	a) Minimizes the capital infrastructure cost including minimizing the need to alter or abandon existing infrastructure b) Minimizes construction duration and complexity c) Minimizes infrastructure maintenance and operation cost d) Minimizes property acquisition cost

*indicates criteria specific to rail grade-separation evaluation only
**indicates criteria specific to TSSF evaluation only

6.1.1 EVALUATION SCALE

Each alternative was evaluated against each indicator using the evaluation scale as defined in Table 6-2 with the assumption that best management practices and standard mitigation measures would be applied. The results of the assessment are color coded and indicate a performance level, ranging from "Performs very well" to "Fails." Criteria that are not differentiating were considered but are omitted from the table as shown below.

Table 6-2 Evaluation Scale

Assessment Scale	Definition
Performs Very Well	The alternative is evaluated by subject matter experts to have a highly favorable result in regard to fulfillment of the indicator. The design is expected to result in the achievement of best design practices, benchmarks, regulatory standards, or values expressed by stakeholders and, in policy and guidelines, with the performance often exceeding benchmarks.
Performs Well	The alternative is evaluated by subject matter experts to have a favorable result in regard to fulfillment of the indicator. The design is expected to result in the achievement of best design practices, benchmarks, regulatory standards, or values expressed by the stakeholders and in policy and guidelines.
Performs Adequately	The alternative is evaluated by subject matter experts to have an acceptable result in regard to fulfillment of the indicator. The design is expected to result in the achievement of best design practices, benchmarks, regulatory standards, or values expressed by stakeholders and in policy and guidelines, with the performance just meeting or approaching benchmarks.
Performs Poorly	The alternative is evaluated by subject matter experts to have an undesirable result in regard to fulfillment of the indicator. There is a risk that the design may fall short of best design practices, benchmarks, regulatory standards, or values expressed by stakeholders and in policy and guidelines.

Assessment Scale	Definition
Fails	The alternative is evaluated by subject matter experts to have an unacceptable result in regard to fulfillment of the indicator. The design is expected to fall short of best design practices, benchmarks, regulatory standards, or values expressed by stakeholders and in policy and guidelines with the performance often below benchmarks.
-	Where there is no difference expected between alternatives, this indicator is not included within the evaluation table.

6.2 Focussed Evaluations

6.2.1 EVALUATION OF ALTERNATIVE DESIGNS FOR THE EXTENSION OF LRT FROM BASELINE STATION TO THE NEPEAN SPORTSPLEX

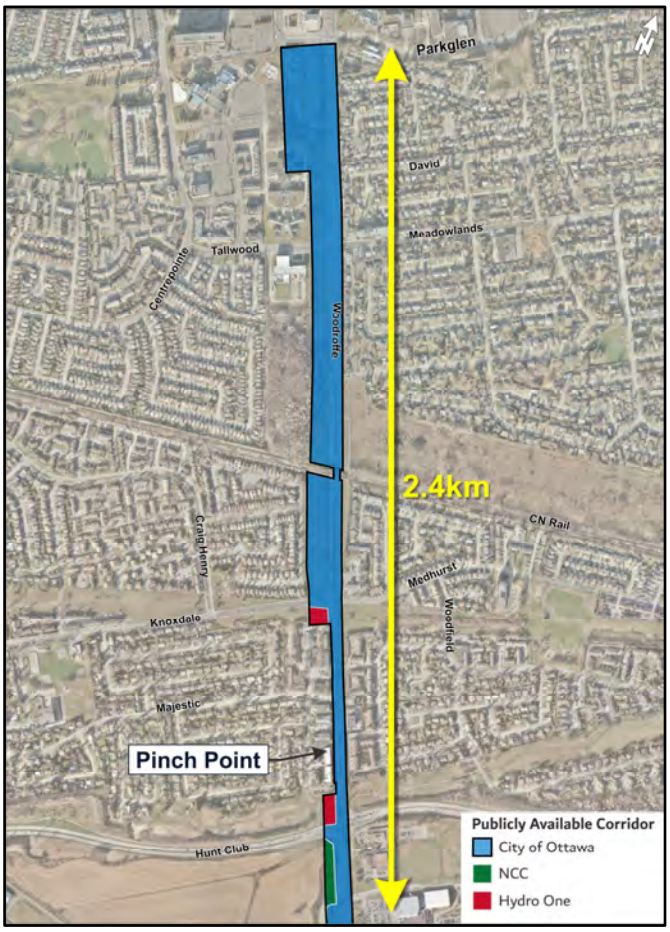
The 1997 Southwest Transitway EA (McCormick Rankin) was reviewed as a starting point in the development of alternative designs for this focussed evaluation. As described in **Section 2.2.1.1** of this report, the Recommended Plan consisted of an exclusive BRT facility described as follows:

1. An open-cut below-grade trench running along the west side of Woodroffe Avenue between Baseline Station and Knoxdale Road, with stations located at Tallwood and Knoxdale.
2. A below-grade tunnel (constructed using cut and cover technique) running under the southbound lanes of Woodroffe Avenue between Knoxdale Road and West Hunt Club Road. South of West Hunt Club Road the rapid transit corridor remains below-grade and transitions back to the west side of Woodroffe Avenue in an open-cut to a station opposite the Nepean Sportsplex. The station incorporates a covered overhead walkway crossing Woodroffe Avenue.
3. South of the Nepean Sportsplex the rapid transit corridor transitions up to an at-grade facility running along the west side of Woodroffe Avenue through the Greenbelt, crossing under the VIA Rail Smiths Falls subdivision to Fallowfield Station and Park and Ride.
4. South of Fallowfield Station the rapid transit corridor runs at-grade, parallel and east of the VIA Rail tracks and then bends south to run parallel to Greenbank Road in the Longfields area connecting to Berrigan Drive (then Wessex Avenue).
5. Implementation/staging of the project identified bus-only lanes along Woodroffe as an interim measure.

The 2006 Southwest Transitway Extension EA Study (TSH, 2006) extended the transitway south from Strandherd Drive to Barrhaven Town Centre within a below-grade trench with a grade-separation under Strandherd Drive. It included new stations at Strandherd, Market Place and the Town Centre.

Currently the Southwest Transitway runs in dedicated bus-lanes along Woodroffe Avenue between Baseline Station and the Nepean Sportsplex. The 1997 Southwest Transitway EA protected a minimum 40m wide Right-of-Way corridor on the west side of Woodroffe Avenue between Baseline Station and Knoxdale Road for the proposed future construction of the Southwest Transitway extension. However, since that EA located the facility within a cut-and-cover facility between Knoxdale Road and the Nepean Sportsplex, no additional Right-of-Way to the west of the roadway was protected in this area. The available Woodroffe Avenue Right-of-Way narrows down to 38m at its narrowest point along this segment of the corridor. This is referred to as the “Pinch Point” throughout the following evaluation and is shown in **Figure 6-1** complete with the previously protected Right-of-Way corridors to the north and south.

Figure 6-1 Location of the Pinch Point in the Study Area



Results of more detailed studies (**Section 5**) identified key challenges in this part of the Study Area including:

- Geotechnical conditions;
- Limited Right-of-Way available at the Pinch Point;
- Adjacent community impacts; and,
- Transportation operations during and post construction.

As previously detailed, this study reconsidered the preferred 1997 Southwest Transitway EA design in light of the conversion to LRT technology, current environmental conditions, and the results from the more detailed studies (geotechnical, natural environment) presented in **Section 5** of this report.

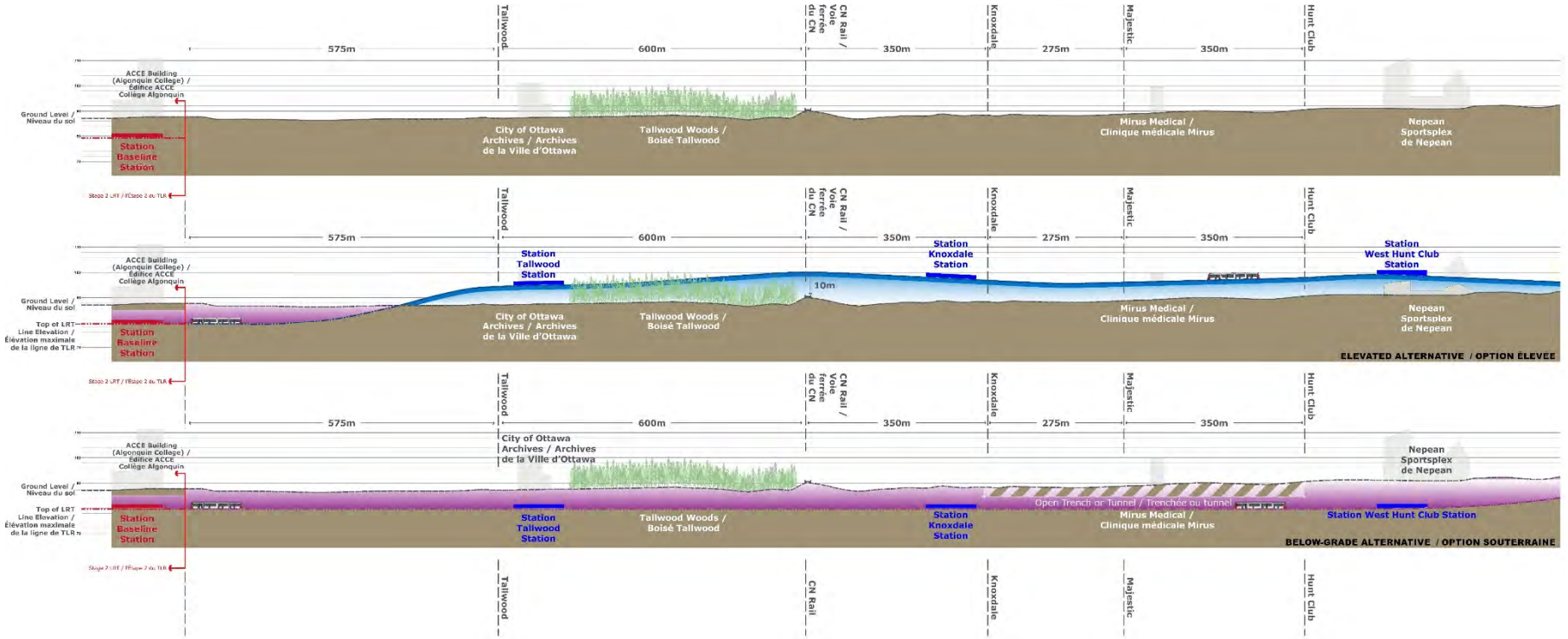
Early in the process, the Study Team examined and screened out two alternative designs:

- LRT alignment at-grade; and,
- LRT alignment in either a shallow or deep bored tunnel.

This project will be an extension of the City's O-Train Confederation Line LRT system. As such, the design standards, operational and safety requirements established for Stage 1 and Stage 2 LRT projects would apply, including requirement for an exclusive segregated corridor with and grade-separations at all road and rail crossings. The LRT at-grade alternative was screened out on the basis of established network criteria. Constructing any bored tunnel alternative would require sourcing and purchasing a dedicated tunnel boring machine to complete any length of bored tunnel for this project. Although a tunnel would not be necessary for most of the alignment, as lands were protected for the future facility as part of the 1997 Southwest Transitway EA (McCormick Rankin), the cost of this machine and associated construction methodology would dictate that any bored tunnel alternative would need to extend the full 2.4 km distance from Baseline Station to the Nepean Sportsplex to be economically viable. A deep bored tunnel located entirely within the underlying bedrock – which is up to 25m deep in some locations would result in very deep and costly stations with reduced LRT access (either by reducing the number of stations due to cost or the extra amount of time needed for riders to travel between the LRT platforms and station entrance). A shallow bored tunnel (above the bedrock level) was screened out based on very limited feasibility due to the challenging subsurface conditions. Further, the specialized tunneling techniques required for a shallow bore carry a significant risk of ground collapse (i.e., sinkholes) during construction. The geotechnical challenges that add construction complexity and risk along with a very high cost for either bored tunnel alternative resulted in the screening out of this option.

It was identified early in the study that combining under- and over-passes for grade-separating this section of the line would not be possible based on existing conditions (close spacing between the streets and the CN Rail line that cross this section of the corridor) and LRT design criteria. (grades and clearances needed to cross above or below) Therefore, the configuration (either below-grade or elevated) must be continuous for the entire 2.4 kilometres length from Baseline Station to the Nepean Sportsplex as shown in the profile (**Figure 6-2**).

Figure 6-2 LRT Profile Considerations



This finding, combined with the previously discussed limited available Right-of-Way through the 'Pinch Point', indicated that determining the preferred LRT design through the 'Pinch Point' was the key issue in developing the recommended plan for this section of the project.

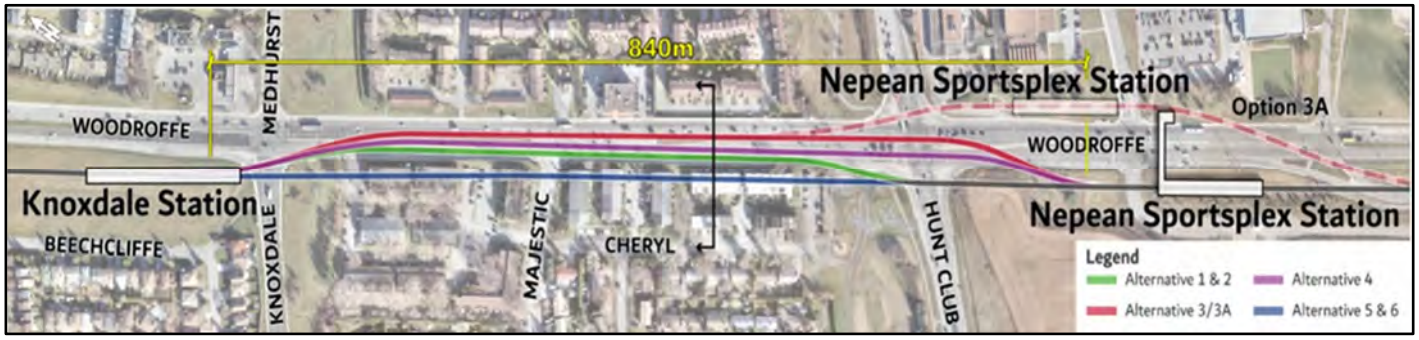
Accordingly, six (6) design alternatives through the Pinch Point were developed for a focussed evaluation. Alternatives were not developed north of the Pinch Point, as the City has already protected land for the transitway to the west of the Woodroffe Avenue corridor north of the Pinch Point. Alignment alternatives located along the east side of Woodroffe Avenue through the Pinch Point were screened out as they are inconsistent with the planned corridor north and south of the Pinch Point. East side alignments also require a significant diversion of the line (having to cross and re-cross Woodroffe Avenue). Further, east side alignments would require the relocation of utilities running below Woodroffe Avenue, would impact above-ground utilities (such as Hydro Ottawa's distribution line as shown in **Figure 6-3**) and would require significant modifications to Hydro One infrastructure (greater impacts with an east side alignment than alternatives located on the west side).

Figure 6-3 Hydro Lines on the East side of Woodroffe Avenue at Majestic Drive

The six design alternatives are shown on **Figure 6-4** and included shallow below-grade (tunnel or trench) and elevated alignments located within or west of the Woodroffe Avenue Right-of-Way over a distance of 840m as detailed below:

Alternative 1. Cut and Cover Tunnel in Woodroffe Avenue Corridor (similar to 1997 SW EA Recommended Plan);
Alternative 2. Trench in Woodroffe Avenue Corridor;
Alternative 3. Elevated in Woodroffe Avenue Corridor (median);
Alternative 4. Elevated in Woodroffe Avenue Corridor (west side);
Alternative 5. Trench west of Woodroffe Avenue; and,
Alternative 6. Elevated west of Woodroffe Avenue.

Figure 6-4 Alternative LRT Alignments through the Pinch Point



6.2.1.1 Description of Alternatives

Alternatives 1 and 2 are below-grade alignments located within the Woodroffe Avenue Right-of-Way (**Figure 6-5**).

Figure 6-5 Alignment of Alternatives 1 and 2 in the Woodroffe Avenue Right-of-Way

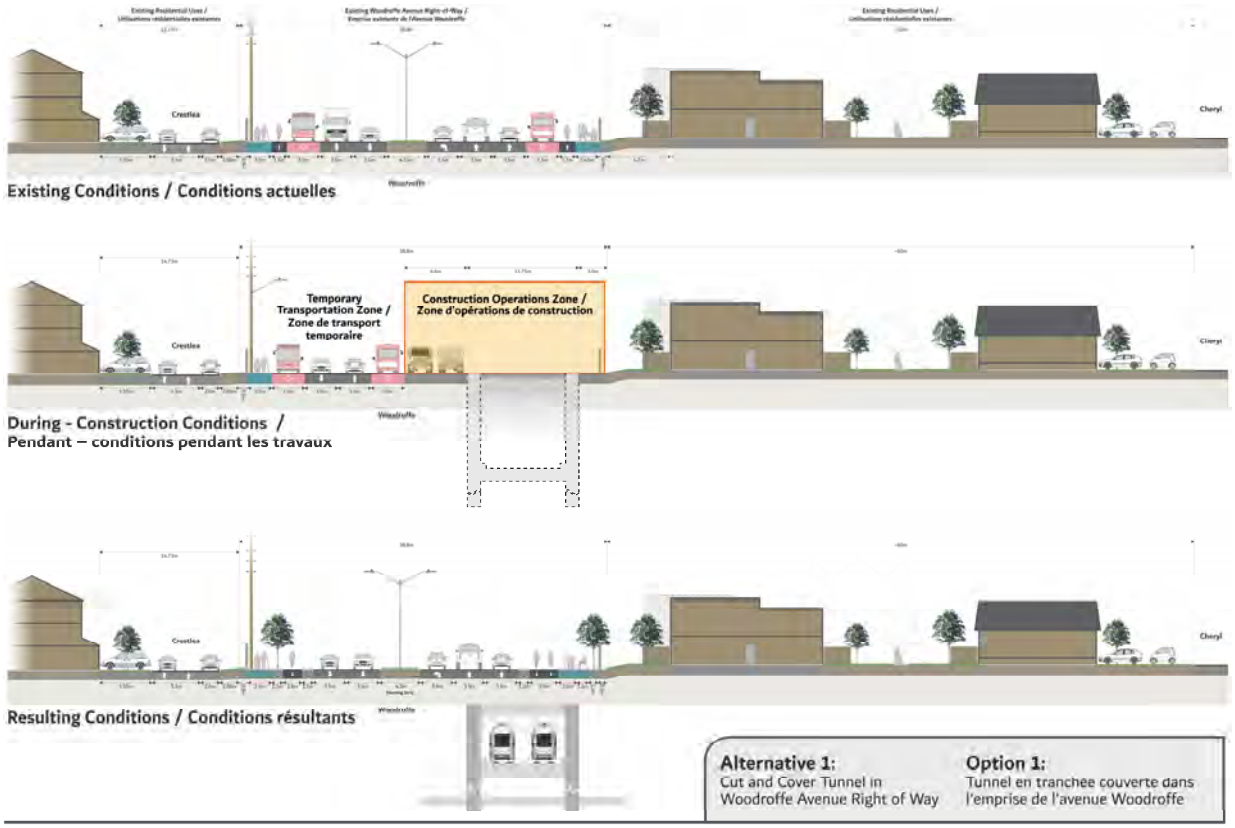
Alternative 1: Cut and Cover Tunnel in Woodroffe Avenue Right-of-Way

Alternative 1 is consistent with the 1997 Southwest Transitway EA Recommended Plan. The LRT facility is located in a shallow tunnel below the existing southbound lanes along Woodroffe Avenue. **Figure 6-6** illustrates cross-sectional views of three scenarios: existing conditions, during construction and post-construction. The tunnel would be constructed using "cut and cover" methods characterized by tunnel excavation and subsequent covering/decking to allow reinstatement of the roadway.

During construction this alternative reduces Woodroffe Avenue to two bus lanes (one in each direction), two general purpose travel lanes (one in each direction), a sidewalk only on one side and no cycling facilities.

The resulting condition provides the opportunity to renew and enhance Woodroffe Avenue as a complete street as rapid transit services would be relocated in the cut and cover tunnel.

Figure 6-6 Alternative 1: Cut and Cover Tunnel in Woodroffe Avenue Right-of-Way

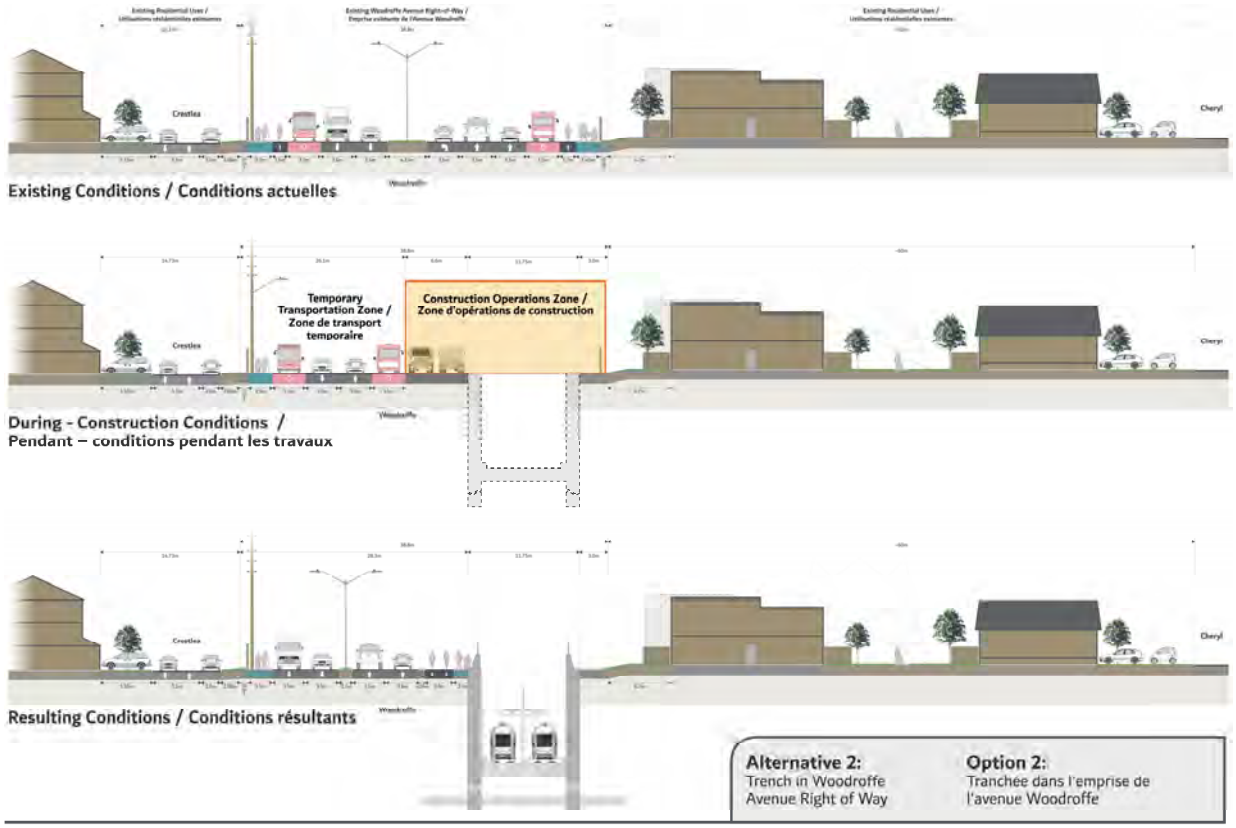


Alternative 2: Trench in Woodroffe Avenue Right-of-Way

In this alternative, the LRT is located in an open trench within the Woodroffe Avenue Right-of-Way adjacent to the west side of Woodroffe Avenue (southbound lanes). **Figure 6-7** illustrates this alternative in cross-section through three scenarios: existing conditions, during construction and post-construction. This alternative would be constructed in a fashion similar to Alternative 1. However, the trench would remain open and not covered over, thereby reducing the opportunity for renewing Woodroffe Avenue and resulting in a narrower road corridor than is present today.

Since rapid transit services would be relocated to the trench facility, it would still be possible to renew Woodroffe Avenue as a complete street. However, opportunities to improve such elements as pedestrian and cycling facilities, landscaping and snow storage would be constrained for ideal street renewal given space taken up by the open trench within the Right-of-Way.

Figure 6-7 Alternative 2: Trench in Woodroffe Avenue Right-of-Way



Under alternatives 3 and 4, the LRT is elevated and located within the Woodroffe Avenue Right-of-Way (**Figure 6-8**).

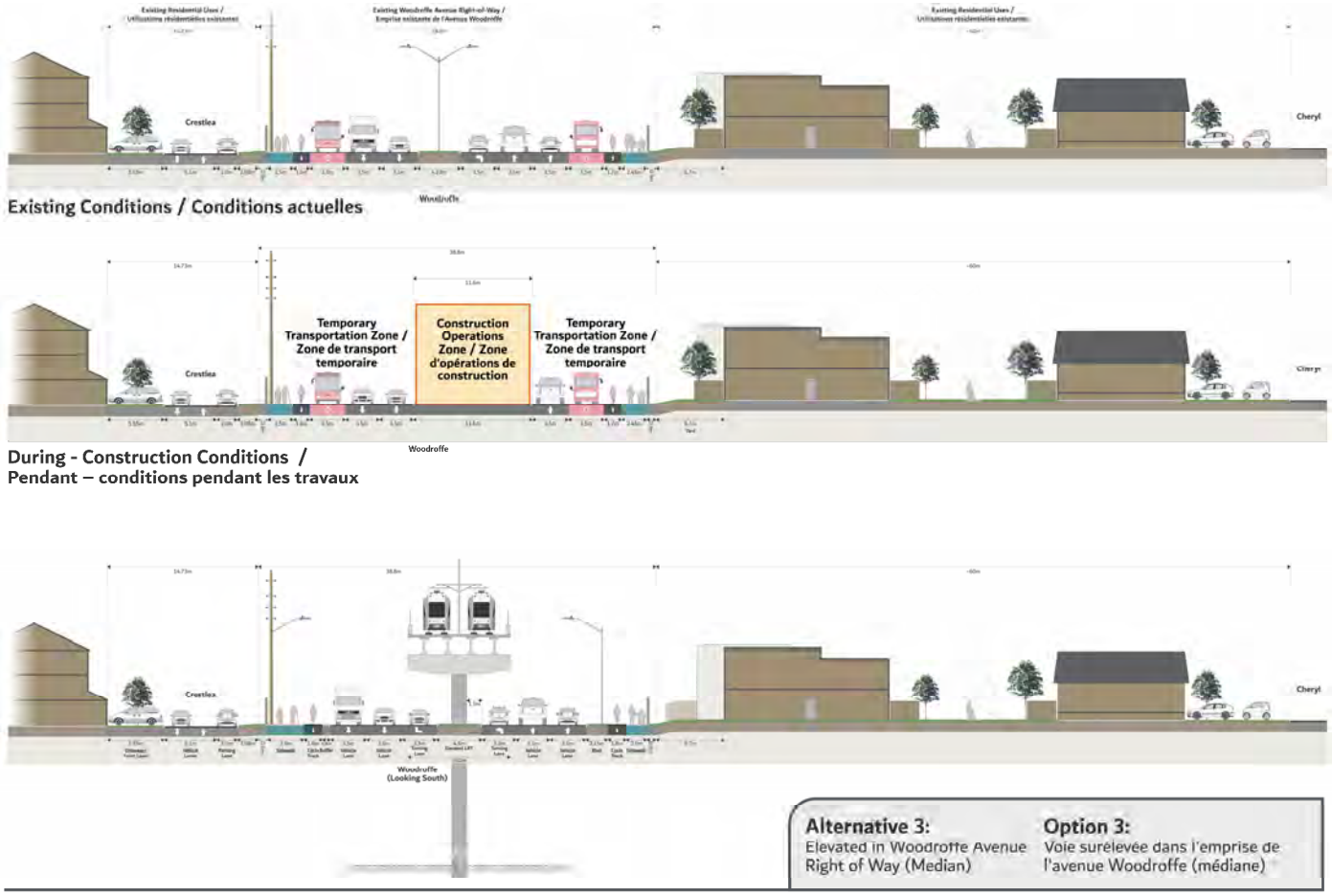
Figure 6-8 Alignment of Alternatives 3 and 4 in the Woodroffe Avenue Right-of-Way

Alternative 3: Elevated in Woodroffe Avenue Right-of-Way (Median)

This alternative locates the LRT as an elevated facility within the middle of a reconstructed Woodroffe Avenue. **Figure 6-9** illustrates this alternative in cross-section through three scenarios: existing conditions, during construction and post-construction. During construction traffic lanes would be reduced to accommodate the construction area.

Under this alternative, the LRT facility would be elevated within the Woodroffe Avenue corridor which would allow for renewal of Woodroffe Avenue. The Right-of-Way width available for complete street renewal would be dependent on design guidelines (including pier offset requirements). A subset of this alternative, referred to as alternative 3A provides the opportunity to locate Nepean Sportsplex Station on the east side of Woodroffe Avenue, adjacent to the Nepean Sportsplex and Confederation Education Centre.

Figure 6-9 Alternative 3: Elevated in Woodroffe Avenue Right-of-Way (Median)

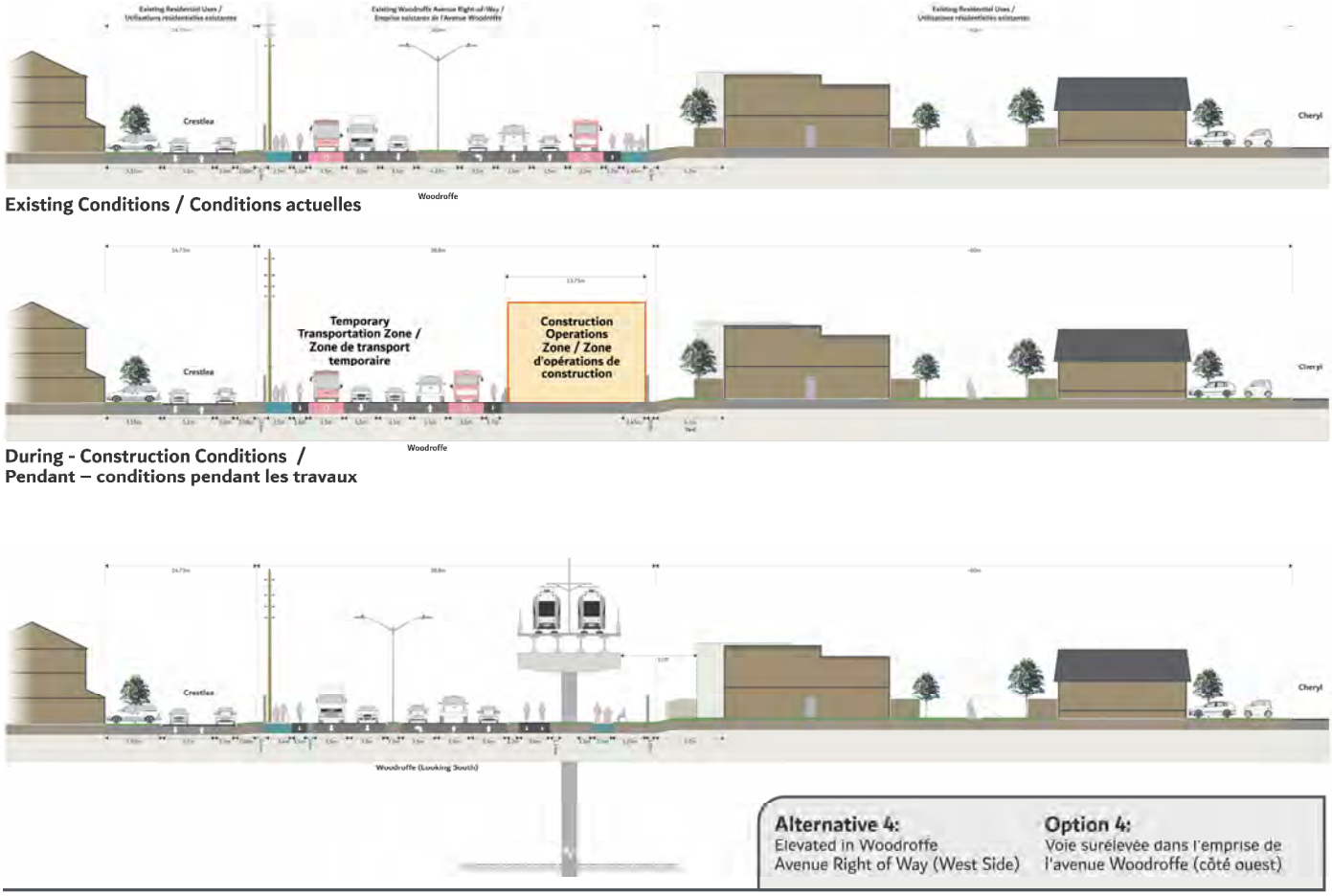


Alternative 4: Elevated in Woodroffe Avenue Right-of-Way (West Side)

This alternative locates the LRT as an elevated facility within the Right-of-Way on the west side of a reconstructed Woodroffe Avenue. **Figure 6-10** illustrates this alternative in cross-section through three scenarios: existing conditions, during construction and post-construction. During construction, traffic lanes would be substantially reduced to accommodate the construction operation zone.

In applying this alternative, the LRT facility would be located within 7m of some of the existing residential buildings and would likely require privacy, noise and vibration mitigation measures for those properties. Compared to Alternative 3, there would be more opportunity for renewal of Woodroffe Avenue as the space under the LRT guideway could be designed to include active modes and other community programming.

Figure 6-10 Alternative 4: Elevated in Woodroffe Avenue Right-of-Way (West Side)



Alternatives 5 & 6 are located beyond the Woodroffe Avenue Right-of-Way (**Figure 6-11**).

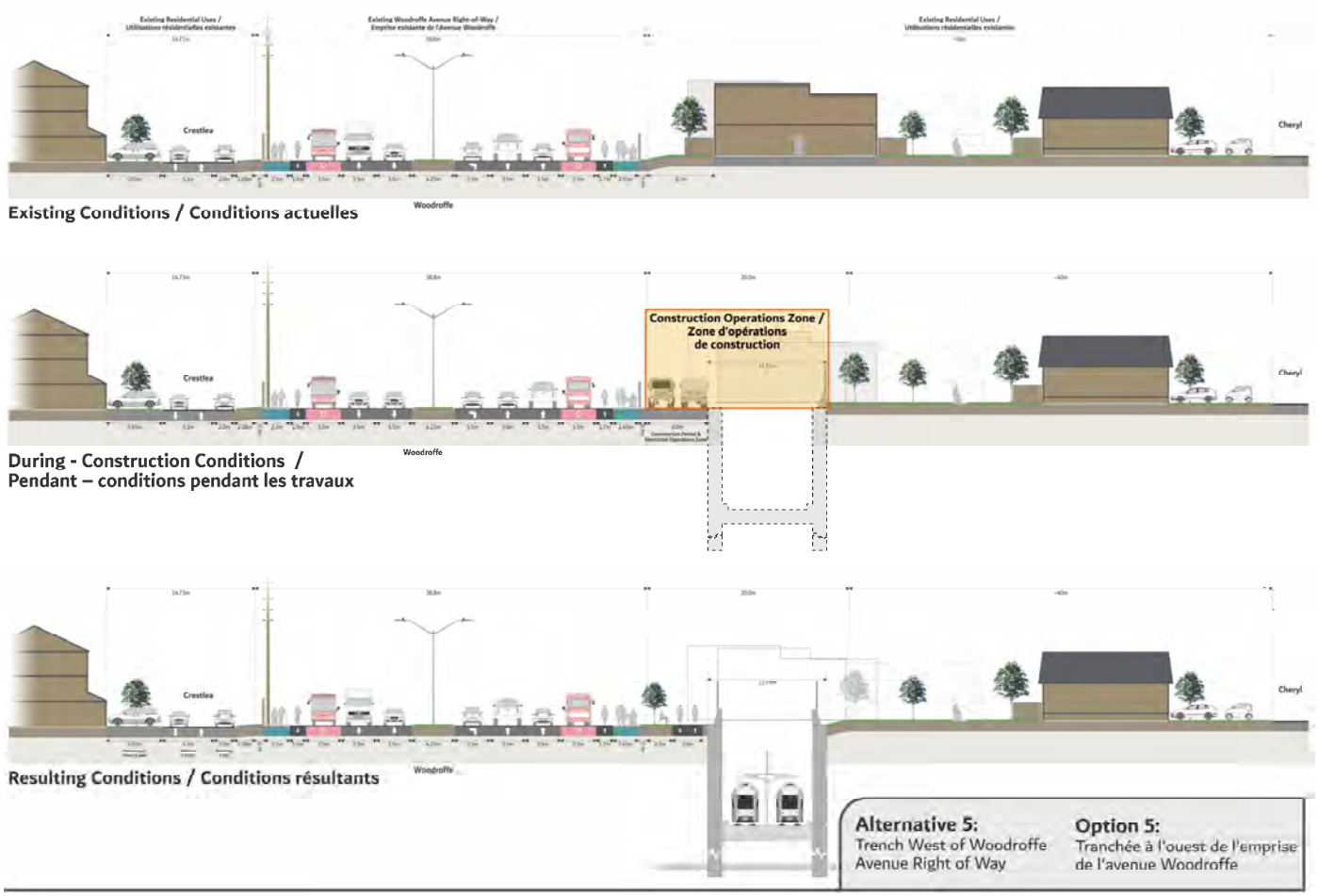
Figure 6-11 Alignment of Alternatives 5 and 6 outside of the Woodroffe Avenue Right-of-Way

Alternative 5: Trench West of Woodroffe Avenue Right-of-Way

This alternative extends the LRT in a trench alignment consistent with the protected corridor located west of the Woodroffe Avenue Right-of-Way north and south of the Pinch Point area. **Figure 6-12** illustrates this alternative in cross-section through three scenarios: existing conditions, during construction and post-construction. Construction methods for this below-grade alternative would be similar to those described for Alternative 2.

As the Woodroffe Avenue corridor would be largely unaffected during construction, renewal of Woodroffe Avenue would not be required. A 20m wide strip of property will be required immediately adjacent to the west side of the corridor through the Pinch Point to form the Right-of-Way necessary to construct this alternative.

Figure 6-12 Alternative 5: Trench West of Woodroffe Avenue Right-of-Way



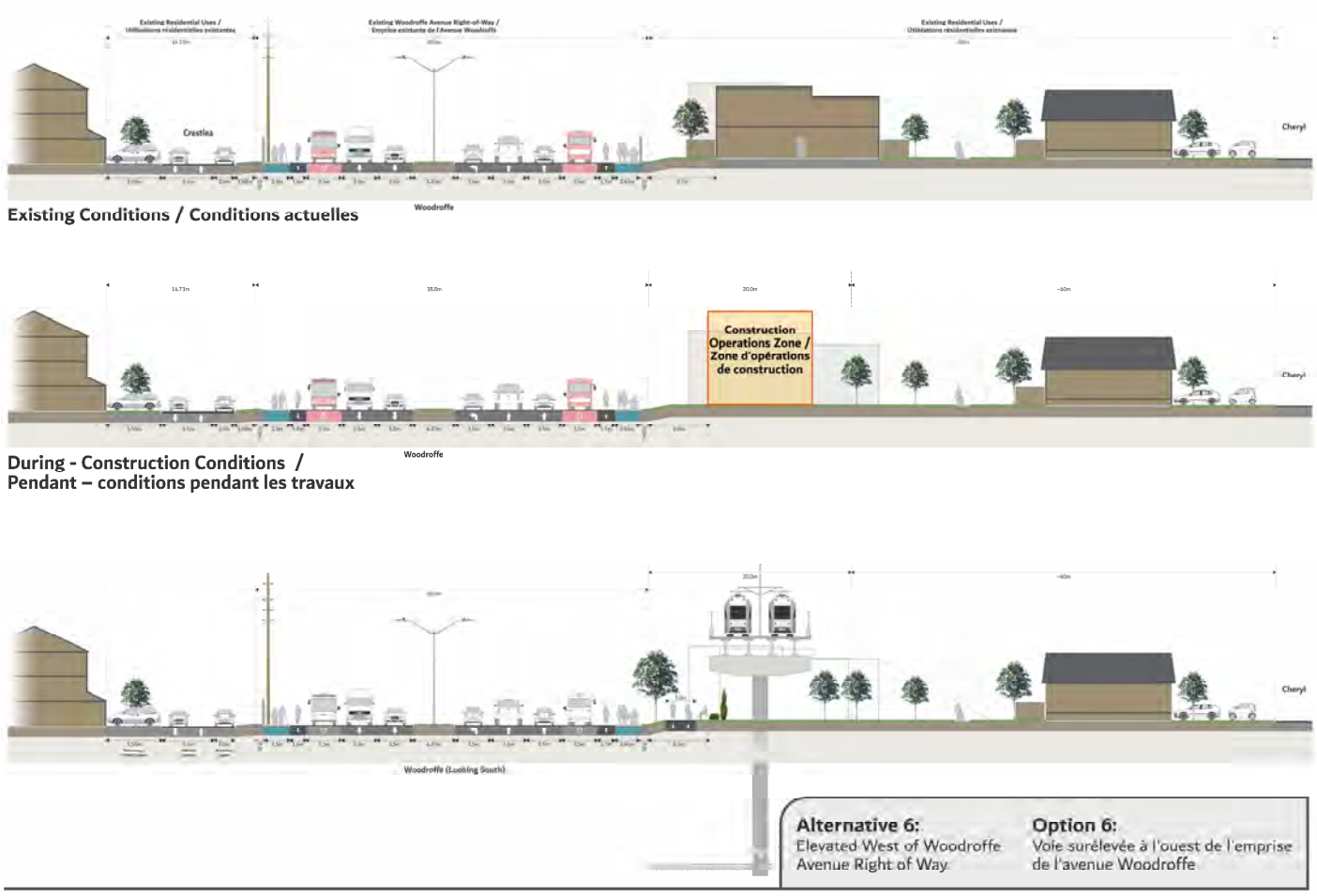
Alternative 6: Elevated West of Woodroffe Avenue

This alternative extends LRT as an elevated facility in an alignment consistent with the protected corridor located west of the Woodroffe Avenue Right-of-Way north and south of the Pinch Point area. **Figure 6-13** illustrates this alternative in cross-section through three scenarios: existing conditions, during construction and post-construction.

As the Woodroffe Avenue corridor would be largely unaffected during construction, renewal of Woodroffe Avenue would not be required. A 20m wide strip of property will be immediately adjacent to the west side of the corridor through the Pinch Point to form the Right-of-Way necessary to construct this alternative.

Unlike Alternative 5, this alternative provides the opportunity to develop the space under the LRT guideway for active transportation modes and other community programming.

Figure 6-13 Alternative 6: Elevated West of Woodroffe Avenue Right-of-Way



To assist with evaluation of the six (6) alternatives for this section, only the differentiating criteria were selected for inclusion in the analysis. This focused evaluation is presented in **Table 6-3.**

Table 6-3 Results of Focused Evaluation for LRT Extension (Baseline Station to West Hunt Club)

			Alternative Number						
Number	Criteria	Indicator	Cut & Cover Tunnel in Woodroffe Ave. Corridor	Trench in Woodroffe Ave. Corridor	Elevated in Woodroffe Ave. Right-of-Way (median)	Elevated in Woodroffe Ave. Right-of-Way (west side)	Trench west of Woodroffe Ave.	Elevated west of Woodroffe Ave.	Qualifier
			1	2	3	4	5	6	
I. Transportation System Sustainability									
1A	TRANSIT NETWORK	Provides optimal LRT geometry (horizontal and vertical) to meet design requirements							Alternatives that provide the best LRT geometry for operating speed perform better for this indicator.
1B		Maximizes opportunity for convenient and accessible light rail transit stations							Alternatives that provide for flexibility in station location perform better for this indicator.
1C		Supports an enjoyable transit user experience, including ride comfort, riders views and integrated station opportunities							Alternatives that maximize visibility by providing long-range views, or an enjoyable transit experience by providing a smooth ride
1D		Maximizes opportunity to provide convenient and accessible connections to existing and future local and rapid transit routes via LRT							Alternatives that provide the most flexibility and opportunity for a range of bus transit routes serving neighbouring communities will perform better for this indicator.
2A	ACTIVE TRANSPORTATION	Provides the opportunity to connect to pedestrian and cycling facilities within the Study Area							Alternatives that provide more flexibility and are more centrally located to land uses to existing or planned facilities will perform better for this indicator.
2B		Provides a direct and efficient north-south pedestrian and cycling travel route through the Study Area							Alternatives that provide a continuous and easy to navigate pedestrian and cycling route will perform better for this indicator.
3A	MAJOR ROAD NETWORK	Provides opportunities to optimize functionality of the existing and future road network							Alternatives that maintain existing road capacity and infrastructure will perform better for this indicator.
3B		Provides/Supports Complete Streets design objective							Alternatives that maintain or improve complete street functionality will perform better for this indicator.
II. Ecological and Physical Sustainability									
7B	NATURAL HERITAGE FEATURES	Minimizes stormwater management complexity and maintenance							Alternatives that minimize stormwater management complexity and maintenance during operation will perform better for this indicator.
7C		Minimizes impact on surface water features including shoreline vegetation zones, or loss of or degradation of existing aquatic habitat							Alternatives that involve the fewest number or length of watercourse crossings will perform better for this indicator. Alternatives that minimize impacts to surface water features will perform better for this indicator.
7E		Minimizes or reduces the amount of natural habitat loss, maximizes protection of urban trees							Alternatives that preserve urban trees and maximizes the ability to maintain natural habitats will perform better for this indicator.
8A	PHYSICAL ENVIRONMENT	Minimizes risk to human health on areas of known contaminated soils and/or groundwater							Alternatives that minimize the footprint on areas of potential or known contamination will perform better for this indicator.
8B		Minimizes risks associated with groundwater and/or sensitive soils							Alternatives that minimize or avoid areas within the Study Area known for having a high groundwater table and/or contain sensitive soils (i.e. clays) will perform better for this indicator.
9A	CLIMATE CHANGE MITIGATION	Minimizes the impact from the project on contributing to climate change							Alternatives that reuse and upgrade existing facilities will minimize the amount of waste and therefore will perform better for this indicator.
10A	CLIMATE CHANGE ADAPTION	Minimizes the impact of extreme weather events on the infrastructure							Alternatives that are more resilient to extreme heat and weather events including extreme rainfall, extreme snowfall, freezing rain, freeze/thaw cycles, wind gusts will perform better for this indicator.
10B		Maximizes the safety and comfort of corridor users exposed to the environment							Alternatives that provide the best shading, sheltering, visibility and are located central to land uses will perform better for this indicator.
III. NCC Greenbelt Sustainability									
12A	GREENBELT ENVIRONMENT	Minimizes impacts to designated NCC Greenbelt lands							Alternatives that minimize or avoid designated NCC Greenbelt lands will perform better for this indicator.
12B		Maximizes opportunity to improve views and vistas within the Study Area							Alternatives that maintain, enhance or provide new views or vistas will perform better for this indicator.

			Alternative Number						
Number	Criteria	Indicator	Cut & Cover Tunnel in Woodroffe Ave. Corridor	Trench in Woodroffe Ave. Corridor	Elevated in Woodroffe Ave. Right-of-Way (median)	Elevated in Woodroffe Ave. Right-of-Way (west side)	Trench west of Woodroffe Ave.	Elevated west of Woodroffe Ave.	Qualifier
			1	2	3	4	5	6	
IV. Land Use and Community Sustainability									
13B	COMMUNITY PLANNING & DESIGN	Minimizes impacts to existing land uses including existing buildings and residences							Alternatives that minimize or avoid acquisition or relocation of built assets will perform better for this indicator. As well, major infrastructure in close proximity to residences or sensitive land uses will result in a reduced performance for this indicator.
13C		Minimizes or avoids disruption to essential municipal services (utilities, potable water and sanitary services)							Alternatives that minimize or avoid interaction and/or disruption to existing infrastructure will perform better for this indicator.
13D		Maximizes opportunities to improve community health and well-being through creation or access to recreation areas/facilities							Alternatives that maximize the opportunity to provide the integration of parks and recreation spaces will perform better for this indicator.
13E		Maximizes opportunities to improve the public realm							Alternatives that maximize the opportunity to provide public art, improve visual environments and incorporate streetscaping within the road corridor will perform better for this indicator.
13F		Maximizes opportunity to provide a safe facility and implement CPTED principles							Alternatives that are safer or provide more perceived added safety through location will perform better for this indicator.
13G		Maximizes accessibility design standards							Alternatives that allow community connectivity to be maintained. Alternatives that provide the best opportunity to include accessible design standards will perform better for this indicator.
13H		Minimizes impacts from winter conditions from a safety, snow removal, accessibility and cost perspective							Alternatives that minimize risk to people, provide efficient and effective snow removal/storage and can be designed in consideration of accessibility perspectives will perform better for this indicator.
14C	CULTURAL HERITAGE RESOURCES	Avoids or minimizes impact on designated or potential cultural heritage landscapes							Alternatives that maintain or enhance the cultural heritage value or interest for cultural heritage landscapes (including cemeteries and farms) as defined under the Ontario Heritage Act will perform better for this indicator.
15A	NOISE AND VIBRATION	Maximizes separation between the [LRT] facility (a potential noise and vibration source) and sensitive receivers							Alternatives that maximize their separation from existing and planned sensitive land uses and minimizes the need to provide noise mitigation will perform better for this indicator.
15B		Maximizes opportunities to reduce noise and vibration by utilizing best practices and design for LRT							Alternatives that minimize curves or elevation changes will perform better for this indicator.
V. Economic Sustainability									
17A	PHASING AND IMPLEMENTATION	Maximizes the ability to phase and incrementally implement the project							Alternatives that utilize existing infrastructure and/or can be implemented as part of adjacent land development will perform better for this indicator. Alternatives that provide the opportunity to be phased in as BRT will perform better for this indicator.
17B		Minimizes the disruption or diversion for all modes (transit and vehicular traffic, sidewalks, cycling facilities, pathways etc.) during construction							Alternatives that avoid disruption to existing roadways and/or pathways or construction of new intersections in the Study Area will perform better for this indicator.
17C		Minimizes overall construction impacts (noise, dust, vibration)							Alternatives that reduce community impacts during construction will perform better for this indicator
18A	LIFE CYCLE COST	Minimizes the capital infrastructure cost including minimizing the need to alter or abandon existing infrastructure							Alternatives that avoid unnecessary or temporary reconstruction of existing infrastructure (municipal services, hydro, corridor facilities) will perform better for this indicator.
18B		Minimizes construction duration and complexity							Alternatives with the shortest time and least complex construction duration will perform better for this indicator.
18C		Minimizes infrastructure maintenance and operation cost							Alternatives with the shortest length, maintenance requirements for stormwater management systems and pedestrian and cycling facilities will perform better for this indicator. Alternatives that implement facilities that require the least amount of on-going maintenance checks will perform better for this indicator.
18D		Minimizes property acquisition cost							Alternatives with the least amount of land acquisition will perform better for this indicator.

6.2.1.2 Discussion of Evaluation

Detailed geotechnical investigations carried out for this EA and other City studies (**Section 5**) identified that the subsurface conditions north of Barrhaven are very challenging and pose significant risk associated with the construction of any below-grade alternative (Alternatives 1, 2, 4 and 5). In this portion of the Study Area, beneath a thin layer of topsoil and fill are layers of sensitive marine clay and permeable materials including sand, silts and glacial till of varying thicknesses that extend down to the underlying bedrock up to 25m below the ground surface. The existing water-table is very high throughout the Study Area and, extends up into the clay layer in some locations. Therefore, construction of any below-grade LRT facility would extend into the permeable sands lying beneath the sensitive marine clay layer. The bottom of the LRT structure would be several metres below the existing groundwater level, so the facility needs to be designed to prevent any lowering of the surrounding groundwater level outside of the trench. This would require building a continuous, completely watertight facility the entire 2.4km stretch from Baseline Station to the Nepean Sportsplex. **Figure 6-14** illustrates these subsurface challenges.

The high possibility of significant groundwater inflows from the surrounding permeable sandy deposits during construction requires technically complex construction techniques to prevent temporary groundwater lowering. Furthermore, any leakage of the permanent continuous 2.4km watertight facility post-construction could cause groundwater lowering which would lead to the dewatering of the sensitive marine clay layer. This dewatering of the clay layer would likely cause settlement for the structures or facilities founded on shallow foundations, and roads and utility infrastructure located in or near the vicinity of the corridor. Analysis indicates that the anticipated drawdown radius of influence extends 250m on either side of the corridor. This settlement risks impacting up to 647 homes and 41 commercial, institutional and office buildings including major centres like Algonquin College, Peter D. Clark Centre and the Nepean Sportsplex.

Maintaining the water-tight integrity of any below-grade facility over its service life would also be a significant challenge. This risk would exist for the lifetime of the below-grade facility. Determining the location of any leak would be very difficult and potentially require costly repairs and long-term maintenance of the watertight facility, crucial for the proper functioning of the LRT and adjacent structures.

The challenge of below-grade alternatives is further exacerbated by the presence of significant underground infrastructure crossing the corridor. The continuous water-tight walls of a below-grade trench would effectively cut-off several of these utilities, including large storm and sanitary sewers. Each crossing will require a unique solution to resolve. Some of the smaller utilities could penetrate the trench walls by using a water-tight sleeve. However, some utilities would require significant and costly relocations to connect elsewhere. **Figure 6-15** illustrates typical underground infrastructure conflicts associated with the below-grade alternatives. Significant conflicts include the 1800mm storm sewer and the 600mm sanitary sewer at Majestic Drive, the 2100mm storm sewer crossing at Tallwood Avenue and the 2200mm Lynwood Sanitary Collector at the CN Rail line. Enbridge gas is also planning for the extension of an extra high-pressure vital gas main along the north side of West Hunt Club which would cross Woodroffe Avenue and would be very costly to relocate or cross in a below-grade alternative.

Below-grade alternatives may have less noise impact, however, these alternatives will reduce pedestrian connectivity and accessibility between Woodroffe Avenue and the community to the east and limit future development above them unless covered over, at additional cost.

Below-grade Alternatives 1, 2 and 5 are not recommended based on the notable risk to the City of Ottawa for the life cycle of this investment.

Figure 6-14 Subsurface Geotechnical Challenges with a Below-Grade Facility

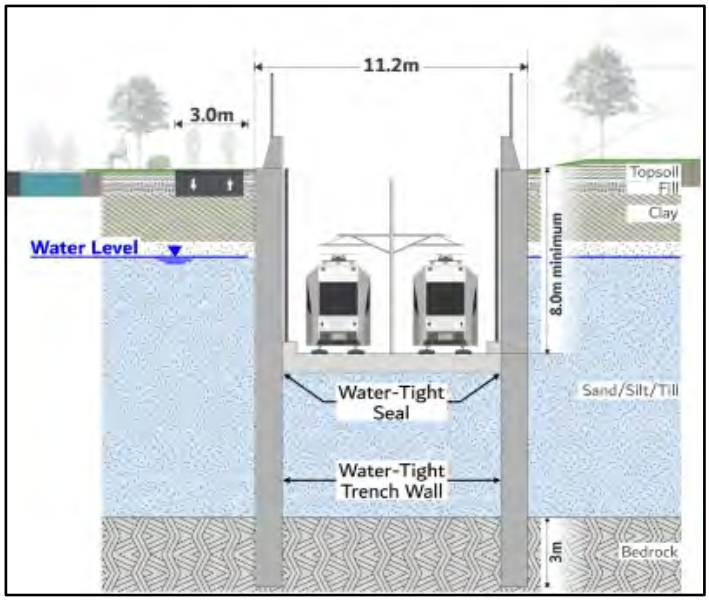
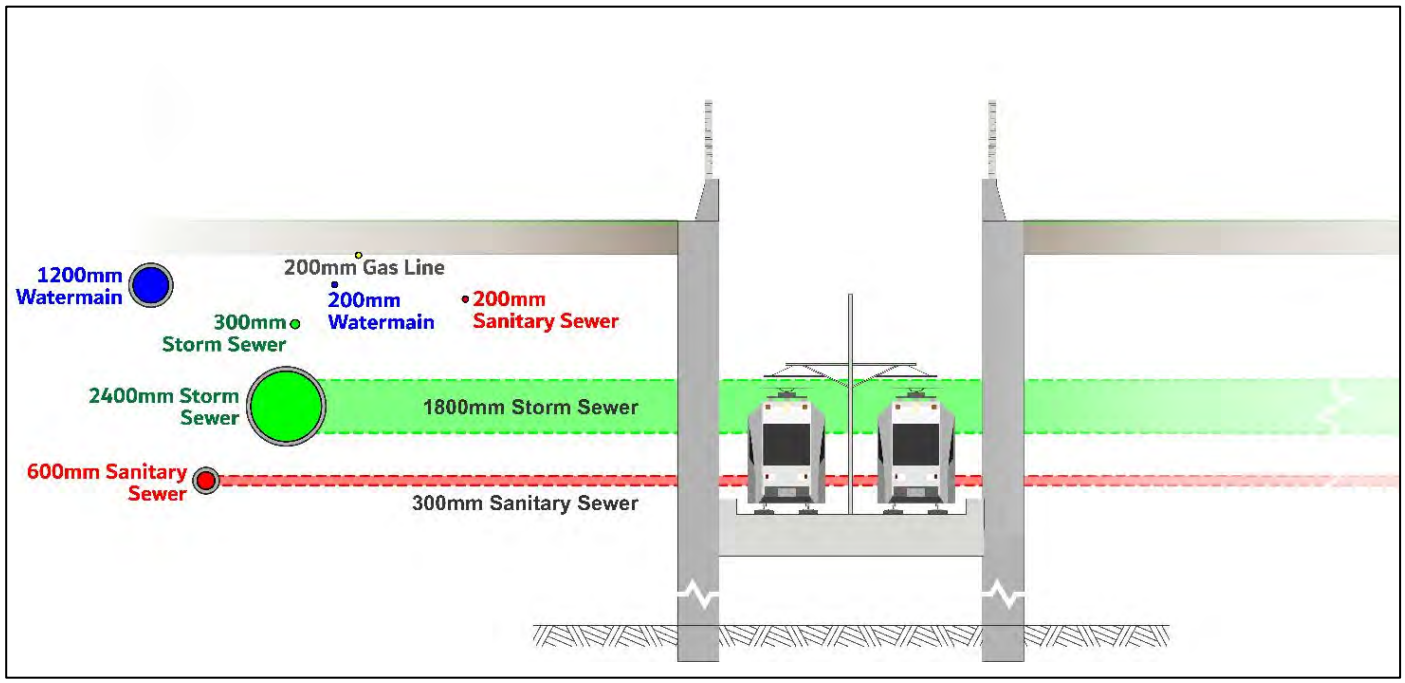


Figure 6-15 Underground Infrastructure Conflicts with Alternative 5



Elevated alternatives, avoid the geotechnical and construction risks and underground utility conflicts associated with below-grade alternatives. Elevated alternatives are also less technically complicated to build. Accordingly, Alternatives 3, 4, and 6 were carried forward for further analysis. Alternatives 3 and 4 are located within the Woodroffe Avenue Right-of-Way and Alternative 6 is located to the west of Woodroffe Avenue.

Alternatives 3 and 4 introduce notable transportation impacts and disruption to all modes both during and post-construction. This is because construction within the Right-of-Way requires that traffic lanes be reduced during construction to build the elevated guideway, and the space beneath the elevated guideway would not be available for general purpose traffic lanes after construction, limiting the ability to adequately accommodate all roadway users as outlined below.

The elevated guideway will rest on beams supported by piers with deep foundations that extend into the underlying bedrock. The general location of the piers would be in the middle of Woodroffe Avenue for Alternative 3 and to the west of Woodroffe

Avenue for Alternative 4. The exact pier location would need to be determined at preliminary/detailed design stage based on roadway geometry requirements (intersection and turning lane needs, etc.) and location of underground utilities (preference to minimize impacts and/or major relocations). Based on initial design review, locating the dripline of the elevated guideway over travel lanes is not recommended, due to the potential for snow/ice fall onto the roadway below, thus an approximately 10-12m space – or possibly slightly wider below the guideway would either form a median at least as wide as the structure above in the middle of the road (Alternative 3) or open space to the west side of the road (Alternative 4). The median space in the middle of the road would not be available for use by active travel modes.

Both alternatives require the full reconstruction of a 600m stretch of Woodroffe Avenue between Knoxdale and West Hunt Club Roads – including intersections at Knoxdale Road, Majestic Drive, West Hunt Club Road and the Nepean Sportsplex north entrance. The remaining space not taken up by the LRT will be constrained for other complete street elements, with reduced space available for pedestrian and cycling facilities, snow storage, landscaping, and left turning vehicles. This would also leave insufficient space for any potential future full renewal of Woodroffe Avenue as a complete street. This ultimately diminishes the capacity of Woodroffe Avenue for all modes and the ability to accommodate all required functions within the existing Right-of-Way.

Alternatives 3 and 4 introduce back-to-back curves into the LRT rail alignment which will require trains to slow down, increasing travel time and reducing ride quality for riders. More importantly, the curves will cause wear-and-tear on both vehicles and tracks, which will result in added maintenance and service disruptions and lead to higher operating costs and reduce service reliability over the lifetime of the facility. Alternative 3 introduces the largest curves as the LRT alignment would have to cross over the southbound lanes of Woodroffe Avenue in the vicinity of both Knoxdale Road and West Hunt Club Road.

Locating the facility within the Right-of-Way would cause the proposed location of Knoxdale Station to be shifted 40 - 45m to the north due to the presence of the horizontal curves in the alignment noted above. It is desirable to locate the station entrance as close to the Woodroffe/Knoxdale/Medhurst intersection as practicable to support a safe and attractive transit experience by:

- creating a focal point for the station and its interface with the community and surrounding road and pathway network.
- providing greater visibility to the station for people coming along Knoxdale or Medhurst.
- decreasing the walking distance for people transferring to/from local bus routes.
- decreasing the amount of station exterior space that will need to be maintained.

By requiring the station to be pushed further north, Alternatives 3 and 4 diminish the attractiveness and perception of safety of transit at this location. Alternatives 3 and 4 do not require the removal of existing residential buildings. Alternative 3, located within the middle of Woodroffe Avenue is relatively equidistant for the residential buildings on the west and east sides. However, Alternative 4 w brings the LRT infrastructure to within 7m of existing residential buildings. This creates long-term concerns regarding privacy, noise, vibration, and overall livability for those residents as the overhead LRT line would be just beyond the private amenity areas of the dwellings that back directly onto the corridor.

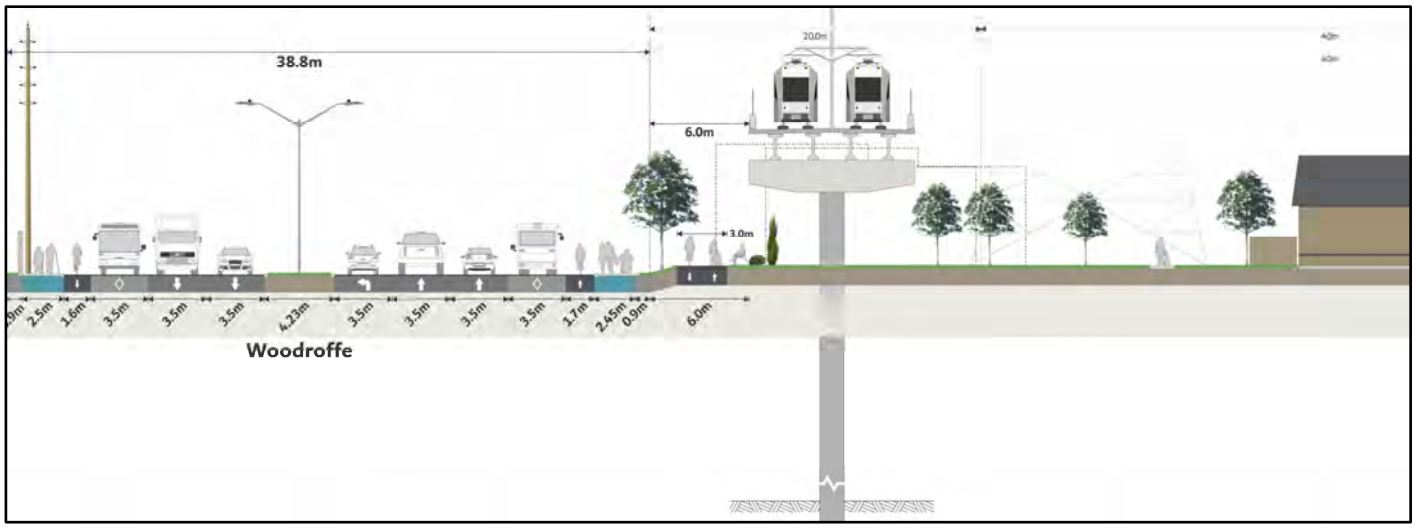
The study team concluded that the above-noted concerns could not easily be mitigated. Based on this, alternatives within the Woodroffe Avenue Right-of-Way were not recommended for further consideration.

Accordingly, Alternative 6 – the elevated LRT facility west of the Woodroffe Avenue Right-of-Way is recommended as the preferred alternative design to extend LRT from Baseline Station to the Nepean Sportsplex (**Figure 6-16**).

This Alternative is consistent with the approved rapid transit alignment to the north and south of the Pinch Point. The straight alignment provides the best ride quality for users and does not cause additional wear and tear from the back-to-back curves and associated added costs over the lifetime of the facility as compared to the other elevated alternatives. Under this alternative, construction occurs outside of the Woodroffe Avenue Right-of-Way, so impacts during construction are minimized. Further, reconstruction of Woodroffe Avenue is not required. Being located west of the Right-of-Way means a greater available width for the potential future Complete Street renewal of Woodroffe Avenue and an opportunity to activate the space underneath the guideway by creating parks and greenways along with facilities for the active modes. This alternative best enables the construction of a continuous MUP connection from Baseline Station to south of West Hunt Club Road as the LRT is situated outside the existing Right-of-Way for the full length of the corridor. Knoxdale Station would be optimally located

with the entrance directly adjacent to the Woodroffe/Knoxdale intersection. Alternative 6 will require some modifications to Hydro One infrastructure. However, through consultation with Hydro One, it has been determined that these can be mitigated.

Figure 6-16 Preferred Alternative for Baseline Station to Nepean Sportsplex section: Alternative 6 Elevated, outside of the Woodroffe Avenue Right-of-Way



Displacement of Rental Units

Alternative 6 will require the acquisition of a 20m wide strip of land across three (3) private properties along the Pinch Point to accommodate the LRT Right-of-Way. This would require removal of 100 of the existing 179 rental units that comprise Cheryl Gardens and Manor Village. Municipal mailing addresses affected include : 1, 3, 5, 19 and 23 Cheryl Road, 1668 Woodroffe Avenue and 5 Majestic Drive as shown in **Figure 6-17** and **Figure 6-18**..

The affected 100 residential rental units are owned by two private companies. As part of the consultation process, the owner of the property located at north-west corner of Woodroffe-Majestic intersection submitted a letter through their solicitor indicating they are not supportive of an option that would require their client's land as it would affect their business and future intensification plans.

Figure 6-17 Affected Properties - Manor Village

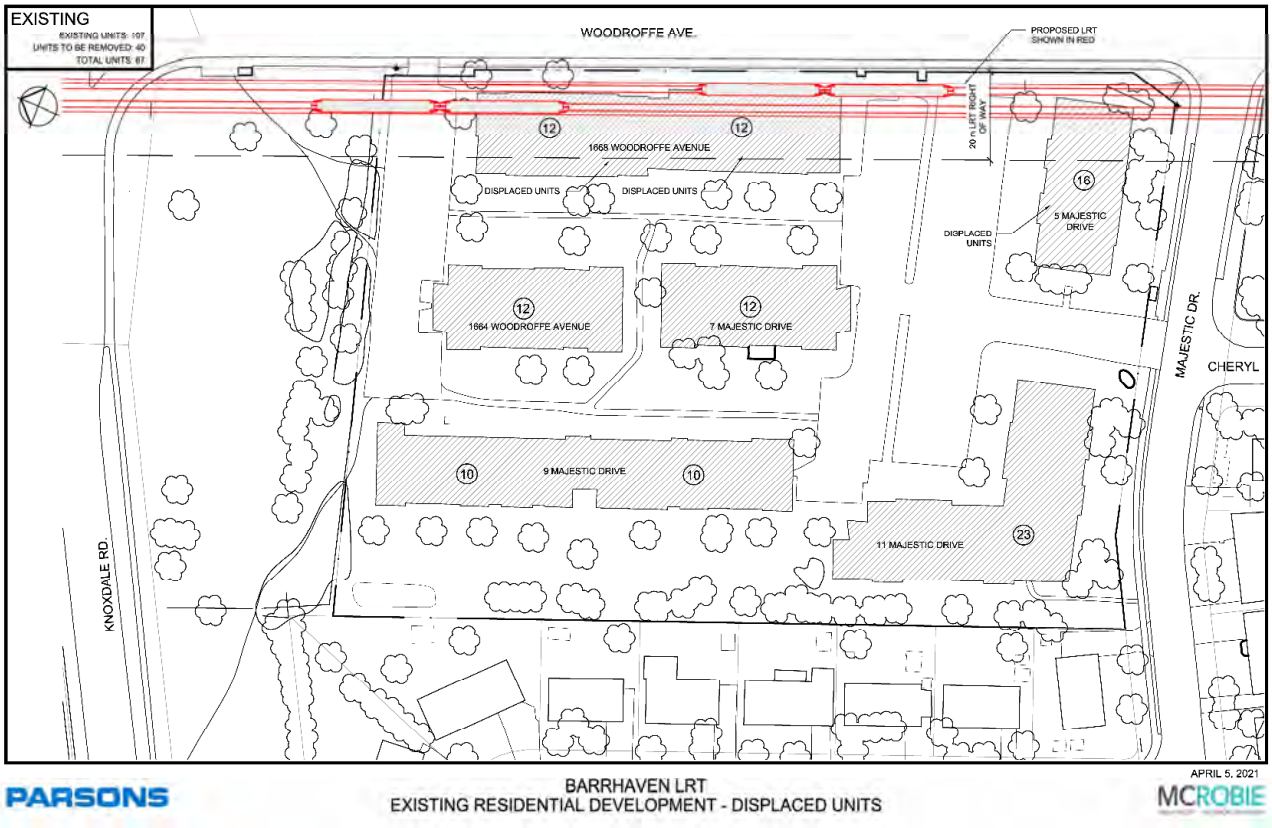
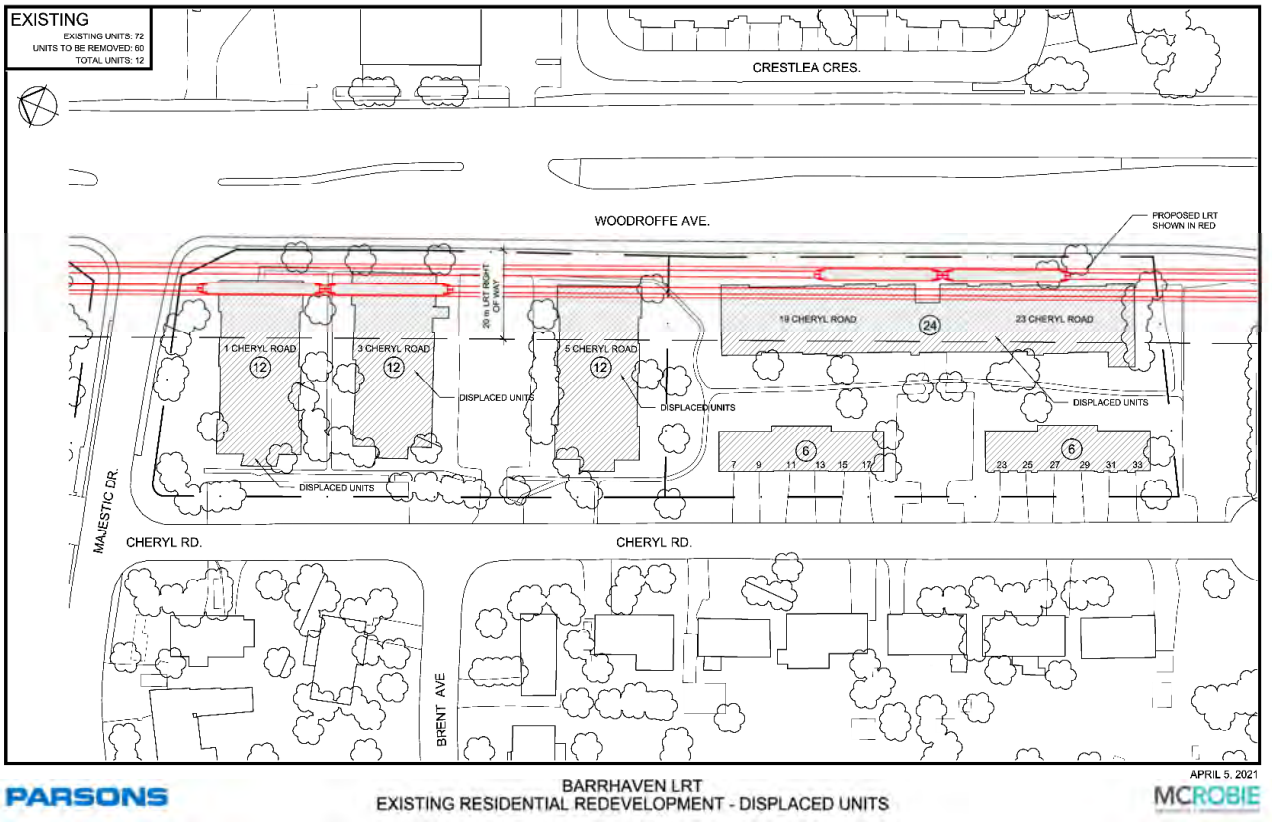


Figure 6-18 Affected Properties - Cheryl Gardens



6.2.2 EVALUATION OF ALTERNATIVE DESIGNS FOR RAIL GRADE-SEPARATION OF WOODROFFE AVENUE AND THE SOUTHWEST TRANSITWAY

The 1997 Southwest Transitway EA (McCormick Rankin) recommended an underpass solution for both the transitway and roadway at this location. Subsequent to this study, in 2003, as part of preparing a Preliminary Design Report (Delcan Corporation, September 2003), additional geotechnical and hydrogeological investigations were undertaken which concluded that an underpass solution was not feasible (**Appendix B**) due to the high-water table and poor ground conditions. An underpass solution would pose significant risk to public safety and be very costly. In 2017 the BMRRGSS Feasibility Study (Parsons) re-evaluated options for grade-separation, identifying a road-over rail overpass as the preferred solution for both crossings. As part of this study, an evaluation of alternatives was completed to re-confirm that an overpass is the preferred alternative utilizing the comprehensive list of criteria established for the study. To ensure all possible alternatives were considered, the underpass alternative was carried forward for evaluation despite knowledge of associated risks. The three (3) alternatives considered for evaluation are listed below and evaluated in **Table 6-4**.

Alternative 1. Overpass: Road over Rail.
Alternative 2. Underpass: Road under Rail.
Alternative 3. Combination: Raise Rail and Lower Road.

To assist with the focused evaluation of the three (3) alternatives for this section, only the differentiating criteria were selected from the list of criteria for inclusion here. The focused evaluation for this section is shown in **Table 6-4** and discussion follows.

Table 6-4 Results of Focused Evaluation for Rail Grade-Separation of Woodroffe Avenue and Southwest Transitway

			Alternative Number			
Number	Criteria	Indicator	Overpass Road over Rail	Underpass Road under Rail	Combination Raise Rail and Lower Road	Qualifier
			1	2	3	
I. Transportation System Sustainability						
1C	TRANSIT NETWORK	Supports an enjoyable transit user experience, including ride comfort, riders views and integrated station opportunities				Alternatives that maximize visibility by providing long-range views, or an enjoyable transit experience by providing a smooth ride will perform better for this indicator.
1F		Minimizes impacts to transit operations				Alternatives that avoid reconstruction or minimize impacts to the operation of the VIA Rail station and tracks, City Park n' Ride and OC Transpo will perform better for this indicator.
2A	ACTIVE TRANSPORTATION	Provides the opportunity to connect to pedestrian and cycling facilities within the Study Area				Alternatives that provide more flexibility and are more centrally located to land uses to existing or planned facilities will perform better for this indicator. Alternatives that maintain connection with the existing NCC multi-use pathway network will perform better for this indicator.
4A	RAIL NETWORK	Minimizes or avoids impacts to existing and planned rail networks				Alternatives that avoid the requirement for rail detours or disruption will perform better for this indicator.
4B		Maximizes safe operation of the Rail network				Alternatives that maximize sight-lines, minimize incoming speeds and geometry to Fallowfield Station will perform better for this alternative.
II. Ecological and Physical Sustainability						
7A	NATURAL HERITAGE FEATURES	Minimizes or avoids impacts on designated features of the City's natural heritage system or other identified natural areas				Alternatives that minimize or avoid impacts (including limiting fragmentation) to areas designated in the City's natural heritage system or other identified natural areas will perform better for this indicator.
7B		Minimizes stormwater management complexity and maintenance				Alternatives that minimize stormwater management complexity and maintenance during operation will perform better for this indicator.
7C		Minimizes impact on surface water features including shoreline vegetation zones, or loss of or degradation of existing aquatic habitat				Alternatives that involve the fewest number or length of watercourse crossings will perform better for this indicator. Alternatives that minimize impacts to surface water features will perform better for this indicator.
7E		Minimizes or reduces the amount of natural habitat loss, maximizes protection of urban trees				Alternatives that preserve urban trees and maximizes the ability to maintain natural habitats will perform better for this indicator.
7F		Minimizes the disruption to ecosystem connectivity and natural habitats				Alternatives that minimize impacts on or avoid Black Rapids Creek corridor will perform better for this indicator.
7G		Maximizes the opportunity to reduce/avoid wildlife collisions				Alternatives that do not create new barriers to core natural areas or links, create fragmentation of natural environments or impact watercourses will perform better for this indicator.
8A	PHYSICAL ENVIRONMENT	Minimizes risk to human health on areas of known contaminated soils and/or groundwater				Alternatives that minimize the footprint on areas of potential or known contamination will perform better for this indicator.
8B		Minimizes risks associated with groundwater and/or sensitive soils				Alternatives that minimize or avoid areas within the Study Area known for having a high groundwater table and/or contain sensitive soils (i.e. clays, sensitive slopes) will perform better for this indicator.
8C		Maximizes the opportunity to adopt enhanced stormwater management techniques to reduce impacts on water quality and quantity				Alternatives that provide the opportunity to implement low impact design (LID) methods or utilize natural systems such as wetlands will perform better for this indicator.
9A	CLIMATE CHANGE MITIGATION	Minimizes the impact from the project on contributing to climate change				Alternatives that reuse and upgrade existing facilities will minimize the amount of waste and therefore will perform better for this indicator.
10A	CLIMATE CHANGE ADAPTATION	Minimizes the impact of extreme weather events on the infrastructure				Alternatives that are more resilient to extreme heat and weather events including extreme rainfall, extreme snowfall, freezing rain, freeze/thaw cycles, wind gusts will perform better for this indicator.
10B		Maximizes the safety and comfort of corridor users exposed to the environment				Alternatives that provide the best shading, sheltering, visibility and are located central to land uses will perform better for this indicator.
III. NCC Greenbelt Sustainability						
11A	AGRICULTURAL RESOURCES	Minimizes impact to designated prime agricultural lands				Alternatives that minimize or avoid impacts to designated prime agricultural lands will perform better for this indicator.
12A	GREENBELT ENVIRONMENT	Minimizes impacts to designated NCC Greenbelt lands				Alternatives that minimize or avoid designated NCC Greenbelt lands will perform better for this indicator.

			Alternative Number			
Number	Criteria	Indicator	Overpass Road over Rail	Underpass Road under Rail	Combination Raise Rail and Lower Road	Qualifier
			1	2	3	
12B		Maximizes opportunity to improve views and vistas within the Study Area				Alternatives that maintain, enhance or provide new views or vistas will perform better for this indicator.
IV. Land Use and Community Sustainability						
13A	COMMUNITY PLANNING & DESIGN	Supports the orderly arrangement and organization of land uses/diminishes fragmentation of land uses				Alternatives that do not result in the fragmentation of land or create awkward development parcels will perform better for this indicator.
13B		Minimizes impacts to existing land uses including existing buildings and residences				Alternatives that minimize or avoid acquisition or relocation of built assets will perform better for this indicator. As well, major infrastructure in close proximity to residences or sensitive land uses will result in a reduced performance for this indicator.
13C		Minimizes or avoids disruption to essential municipal services (utilities, potable water and sanitary services)				Alternatives that minimize or avoid interaction and/or disruption to existing infrastructure will perform better for this indicator.
13D		Maximizes opportunities to improve community health and well-being through creation or access to recreation areas/facilities				Alternatives that maximize the opportunity to provide the integration of parks and recreation spaces will perform better for this indicator.
13F		Maximizes opportunity to provide a safe facility and implement CPTED principles				Alternatives that are safer or provide more perceived added safety through location will perform better for this indicator.
13G		Maximizes accessibility design standards				Alternatives that allow community connectivity to be maintained. Alternatives that provide the best opportunity to include accessible design standards will perform better for this indicator.
13H		Minimizes impacts from winter conditions from a safety, snow removal, accessibility and cost perspective				Alternatives that minimize risk to people, provide efficient and effective snow removal/storage and can be designed in consideration of accessibility perspectives will perform better for this indicator.
14A	CULTURAL HERITAGE RESOURCES	Avoids or minimizes impact on existing archaeological resources or areas with potential				Alternatives that minimize impacts on or avoid areas of archaeological potential will perform better for this indicator.
14B		Avoids or minimizes impact on designated or potential built heritage resources				Alternatives that maintain or enhance the cultural heritage value or interest for a built heritage resource as defined under the Ontario Heritage Act will perform better for this indicator.
14C		Avoids or minimizes impact on designated or potential cultural heritage landscapes				Alternatives that maintain or enhance the cultural heritage value or interest for cultural heritage landscapes (including cemeteries and farms) as defined under the Ontario Heritage Act will perform better for this indicator.
15A	NOISE AND VIBRATION	Maximizes separation between the facility (a potential noise and vibration source) and sensitive receivers				Alternatives that maximize their separation from existing and planned sensitive land uses and minimizes the need to provide noise mitigation will perform better for this indicator.
V. Economic Sustainability						
17A	PHASING AND IMPLEMENTATION	Maximizes the ability to phase and incrementally implement the project				Alternatives that utilize existing infrastructure and/or can be implemented as part of adjacent land development will perform better for this indicator. Alternatives that provide the opportunity to be phased in as BRT will perform better for this indicator.
17B		Minimizes the disruption or diversion for all modes (transit and vehicular traffic, sidewalks, cycling facilities, pathways etc.) during construction				Alternatives that avoid disruption to existing roadways and/or pathways or construction of new intersections in the Study Area will perform better for this indicator.
17C		Minimizes overall construction impacts (noise, dust, vibration)				Alternatives that reduce community impacts during construction will perform better for this indicator
18A	LIFE CYCLE COST	Minimizes the capital infrastructure cost including minimizing the need to alter or abandon existing infrastructure				Alternatives that avoid unnecessary or temporary reconstruction of existing infrastructure (municipal services, hydro, corridor facilities) will perform better for this indicator.
18B		Minimizes construction duration and complexity				Alternatives with the shortest time and least complex construction duration will perform better for this indicator.
18C		Minimizes infrastructure maintenance and operation cost				Alternatives with the shortest length, maintenance requirements for stormwater management systems and pedestrian and cycling facilities will perform better for this indicator. Alternatives that implement facilities that require the least amount of on-going maintenance checks will perform better for this indicator.
18D		Minimizes property acquisition cost				Alternatives with the least amount of land acquisition will perform better for this indicator.

6.2.2.1 Discussion of Evaluation

Geotechnical investigations undertaken to support this study re-confirmed significant subsurface challenges as detailed in the 2003 Preliminary Design Report (Delcan Corporation) The significant issue with respect to an underpass is groundwater control. Excavations below the groundwater level, which penetrate the overburden soils and are near/in the bedrock surface, will experience significant groundwater inflow. The previous pumping test indicated that the water table in the bedrock would need to be lowered significantly in order to complete construction. In addition, based on the results of previous investigations referenced above, the excavations may encounter basal heave and/or soil boiling when the base of excavation is within about 3 or 4m of the bedrock. Water drawn into the bedrock could potentially cause consolidation of the overlying soil due to water depletion in the silty clay and very loose and loose silt material. This would result in settlement of adjacent structures supported on and within the overburden in the area. While the magnitude of consolidation settlement due to groundwater lowering is difficult to predict, it is likely greater than what structures can typically tolerate (i.e., greater than 25mm).

These challenges would increase construction complexity and cost, assume high risk during operation and require significant ongoing maintenance to remain operational. Any alternative that requires subsurface excavation incurs these risks, challenges, and cost. Further, Alternative 3 involves a large scale raising or lowering of the rail and would result in grade and safety issues for the VIA station as well as significant interruptions to train service and costly and complex detours. Alternative 1 presents the least amount of geotechnical risk, least impact to the transportation network and is the most cost effective.

Alternative 1 provides the opportunity to create a new access to the Fallowfield Station via Woodroffe Avenue, reducing dependence on the Fallowfield Road entrance. Safety can be improved for the access to the Royale Equestrian Centre at 2191 Woodroffe Avenue by tying into a new signalized intersection on Woodroffe which would be shared with the new Fallowfield Station entrance. Temporary and permanent impacts to NCC Greenbelt lands will result from this alternative, however, access to the NCC agricultural lands and private farmhouse can be maintained through all phases of the project.

Visual impacts created with the new overpass structure will need to be mitigated, however, new views and vistas of the NCC Greenbelt lands will be created.

This alternative requires the plan for the feeder main relocation to be changed so that it is not located within the footprint of the overpass and is discussed further in **Section 7.2.9**. Overhead utility lines will also need to be relocated. This alternative will present fewer drainage constraints, a reduced construction footprint, is easier to construct, will not require a rail detour or pump station, and will overall be lower in cost to operate… Alternative 1 also provides the opportunity to create an eco-crossing allowing movement of wildlife and connections within the Black Rapids Creek vicinity while also providing the opportunity to maintain or enhance natural habitats and particularly riparian areas. Construction detours will be required while the permanent overpasses are constructed and will be discussed in **Section 7**

Following evaluation, Alternative 1 – a Road over Rail Overpass is the preferred alternative design for the rail grade-separation of Woodroffe Avenue and the Southwest Transitway from the VIA Rail line.

6.2.3 EVALUATION OF ALTERNATIVE DESIGNS FOR RAIL GRADE-SEPARATION OF FALLOWFIELD ROAD

The 1997 Southwest Transitway EA (McCormick Rankin) recommended an underpass solution for Fallowfield Road at this location. Subsequent to this study, in 2003, as part of preparing a Preliminary Design Report (Delcan Corporation, September 2003), additional geotechnical and hydrogeological investigations were undertaken which concluded that an underpass solution was not feasible (**Appendix B**). Due to the high-water table and poor ground conditions, an underpass solution would pose significant risk to public safety and would be very costly. In 2017 the BMRRGSS Feasibility Study (Parsons) re-evaluated, at a high-level, options for grade-separation. The outcome of this study was that a road over rail overpass was the preferred solution. As part of this study, an evaluation of alternatives was completed to re-confirm that an overpass is the preferred alternative utilizing the comprehensive list of criteria established. In order that all possible alternatives are considered, the underpass alternative was carried forward for evaluation despite knowledge of the associated risks associated. The three (3) alternatives were considered for evaluation and are listed below and evaluated in **Table 6-5**. In all cases, for the purposes of this evaluation, the preferred alternative design includes grade-separation of both the VIA Rail line and the LRT (Southwest Transitway).

1. Overpass: Road over Rail.
2. Underpass: Road under Rail.
3. Combination: Raise Rail and Lower Road.

To assist with the focused evaluation of the three (3) alternatives, only the differentiating criteria were selected from the list of criteria for inclusion. The focused evaluation for this section is shown in **Table 6-5** and discussion follows.

Table 6-5 Results of Focused Evaluation for Rail Grade-Separation of Fallowfield Road

			Alternative Number			
Number	Criteria	Indicator	Overpass Road over Rail	Underpass Road under Rail	Combination Raise Rail and Lower Road	Qualifier
			1	2	3	
I. Transportation System Sustainability						
1C	TRANSIT NETWORK	Supports an enjoyable transit user experience, including ride comfort, riders views and integrated station opportunities				Alternatives that maximize visibility by providing long-range views, or an enjoyable transit experience by providing a smooth ride
1F		Minimizes impacts to transit operations				Alternatives that avoid reconstruction or minimize impacts to the operation of the VIA Rail station and tracks, City Park n' Ride and OC Transpo will perform better for this indicator.
4A	RAIL NETWORK	Minimizes or avoids impacts to existing and planned rail networks				Alternatives that avoid the requirement for rail detours or disruption will perform better for this indicator.
4B		Maximizes safe operation of the Rail network				Alternatives that maximize sight-lines, minimize incoming speeds and geometry to Fallowfield Station will perform better for this alternative.
II. Ecological and Physical Sustainability						
7B	NATURAL HERITAGE FEATURES	Minimizes stormwater management complexity and maintenance				Alternatives that minimize stormwater management complexity and maintenance during operation will perform better for this indicator.
8A	PHYSICAL ENVIRONMENT	Minimizes risk to human health on areas of known contaminated soils and/or groundwater				Alternatives that minimize the footprint on areas of potential or known contamination will perform better for this indicator.
8B		Minimizes risks associated with groundwater and/or sensitive soils				Alternatives that minimize or avoid areas within the Study Area known for having a high groundwater table and/or contain sensitive soils (i.e., clays, sensitive slopes) will perform better for this indicator.
8C		Maximizes the opportunity to adopt enhanced stormwater management techniques to reduce impacts on water quality and quantity				Alternatives that provide the opportunity to implement low impact design (LID) methods or utilize natural systems such as wetlands will perform better for this indicator.
9A	CLIMATE CHANGE MITIGATION	Minimizes the impact from the project on contributing to climate change				Alternatives that reuse and upgrade existing facilities will minimize the amount of waste and therefore will perform better for this indicator.
10A	CLIMATE CHANGE ADAPTATION	Minimizes the impact of extreme weather events on the infrastructure				Alternatives that are more resilient to extreme heat and weather events including extreme rainfall, extreme snowfall, freezing rain, freeze/thaw cycles, wind gusts will perform better for this indicator.
10B		Maximizes the safety and comfort of corridor users exposed to the environment				Alternatives that provide the best shading, sheltering, visibility and are located central to land uses will perform better for this indicator.
III. NCC Greenbelt Sustainability						
11A	AGRICULTURAL RESOURCES	Minimizes impact to designated prime agricultural lands				Alternatives that minimize or avoid impacts to designated prime agricultural lands will perform better for this indicator.
11B		Minimizes impacts on existing farm infrastructure including buildings and tile drainage systems				Alternatives that minimize or avoid decommissioning of farm-related infrastructure will perform better for this indicator.
12A	GREENBELT ENVIRONMENT	Minimizes impacts to designated NCC Greenbelt lands				Alternatives that minimize or avoid designated NCC Greenbelt lands will perform better for this indicator.
12B		Maximizes opportunity to improve views and vistas within the Study Area				Alternatives that maintain, enhance or provide new views or vistas will perform better for this indicator.
IV. Land Use and Community Sustainability						
13A	COMMUNITY PLANNING & DESIGN	Supports the orderly arrangement and organization of land uses/diminishes fragmentation of land uses				Alternatives that do not result in the fragmentation of land or create awkward development parcels will perform better for this indicator.
13B		Minimizes impacts to existing land uses including existing buildings and residences				Alternatives that minimize or avoid acquisition or relocation of built assets will perform better for this indicator. As well, major infrastructure in close proximity to residences or sensitive land uses will result in a reduced performance for this indicator.

			Alternative Number			
Number	**Criteria**	**Indicator**	**Overpass Road over Rail**	**Underpass Road under Rail**	**Combination Raise Rail and Lower Road**	**Qualifier**
			1	**2**	**3**	
13C		Minimizes or avoids disruption to essential municipal services (utilities, potable water and sanitary services)				Alternatives that minimize or avoid interaction and/or disruption to existing infrastructure will perform better for this indicator.
13D		Maximizes opportunities to improve community health and well-being through creation or access to recreation areas/facilities				Alternatives that maximize the opportunity to provide the integration of parks and recreation spaces will perform better for this indicator.
		Maximizes opportunities to improve the public realm				Alternatives that maximize the opportunity to provide public art, improve visual environments and incorporate streetscaping within the road corridor will perform better for this indicator.
13F		Maximizes opportunity to provide a safe facility and implement CPTED principles				Alternatives that are safer or provide more perceived added safety through location will perform better for this indicator.
13H		Minimizes impacts from winter conditions from a safety, snow removal, accessibility and cost perspective				Alternatives that minimize risk to people, provide efficient and effective snow removal/storage and can be designed in consideration of accessibility perspectives will perform better for this indicator.
14A	CULTURAL HERITAGE RESOURCES	Avoids or minimizes impact on existing archaeological resources or areas with potential				Alternatives that minimize impacts on or avoid areas of archaeological potential will perform better for this indicator.
14C		Avoids or minimizes impact on designated or potential cultural heritage landscapes				Alternatives that maintain or enhance the cultural heritage value or interest for cultural heritage landscapes (including cemeteries and farms) as defined under the Ontario Heritage Act will perform better for this indicator.
15A	NOISE AND VIBRATION	Maximizes separation between the facility (a potential noise and vibration source) and sensitive receivers				Alternatives that maximize their separation from existing and planned sensitive land uses and minimizes the need to provide noise mitigation will perform better for this indicator.
V. Economic Sustainability						
17A	PHASING AND IMPLEMENTATION	Maximizes the ability to phase and incrementally implement the project				Alternatives that utilize existing infrastructure and/or can be implemented as part of adjacent land development will perform better for this indicator.
17B		Minimizes the disruption or diversion for all modes (transit and vehicular traffic, sidewalks, cycling facilities, pathways etc.) during construction				Alternatives that avoid disruption to existing roadways and/or pathways or construction of new intersections in the Study Area will perform better for this indicator.
17C		Minimizes overall construction impacts (noise, dust, vibration)				Alternatives that reduce community impacts during construction will perform better for this indicator
18A	LIFE CYCLE COST	Minimizes the capital infrastructure cost including minimizing the need to alter or abandon existing infrastructure				Alternatives that avoid unnecessary or temporary reconstruction of existing infrastructure (municipal services, hydro, corridor facilities) will perform better for this indicator.
18B		Minimizes construction duration and complexity				Alternatives with the shortest time and least complex construction duration will perform better for this indicator.
18C		Minimizes infrastructure maintenance and operation cost				Alternatives with the shortest length, maintenance requirements for stormwater management systems and pedestrian and cycling facilities will perform better for this indicator. Alternatives that implement facilities that require the least amount of on-going maintenance checks will perform better for this indicator.
18D		Minimizes property acquisition cost				Alternatives with the least amount of land acquisition will perform better for this indicator.

6.2.3.1 Discussion of Evaluation

Geotechnical investigations undertaken (**Annex 9, Appendix B**) to support this study re-confirmed the findings of the 2003 Preliminary Design Report (Delcan Corporation) that significant subsurface challenges exist with groundwater control identified as the chief concern. Excavations below the groundwater level, which penetrate the overburden soils and are near/in the bedrock surface will experience significant groundwater inflow. Based on the previous pumping test carried out at the Fallowfield Road crossing, the water table in the bedrock will need to be lowered significantly to complete construction. In addition, based on the results of the previous investigations, the excavations may encounter basal heave and/or soil boiling when the base of excavation is within about 3 or 4m of the bedrock. Water drawn down in the bedrock would also potentially cause consolidation of the overlying soil due to water depletion in the silty clay and very loose and loose silt material, resulting in settlement of adjacent structures supported on and within the overburden in the area. The magnitude of the consolidation settlement as a result of groundwater lowering is difficult to predict but it is likely greater than what structures can typically tolerate (i.e., greater than 25mm), which is in addition to the settlement previously experienced by the structures.

These challenges would increase construction complexity and cost, assumes high risk during operation and require significant ongoing maintenance to remain operational. Any alternative that requires subsurface excavation incurs these risks, challenges, and cost. Further, Alternative 3 involves a large scale raising or lowering of the rail and would result in grade and safety issues for the VIA station as well as significant interruptions to train service and costly and complex detours.

Of the alternatives evaluated, Alternative 1 presents the least amount of geotechnical risk, least impact to the transportation network and is most cost effective. Permanent impacts to NCC Greenbelt lands (requirements for land, changing views/vistas, interim impact on farm uses) will result as would with each alternative, mitigation will be discussed further in **Section 7**. The decommissioning of Fallowfield Road may also provide opportunity to mitigate the potential impacts identified for this alternative. Access to businesses south of Fallowfield Road can be designed compatible with an overpass. This alternative will present less drainage constraints, a reduced construction footprint, is easier to construct, and will not require a rail detour or pump station and will overall be lower in cost to operate. No construction detour will be required because the existing Fallowfield Road can remain operational while the overpass realignment is being constructed.

Following evaluation, Alternative 1 –a Road over Rail Overpass is the preferred alternative design for the rail grade-separation of Fallowfield Road from the VIA Rail line and Southwest Transitway.

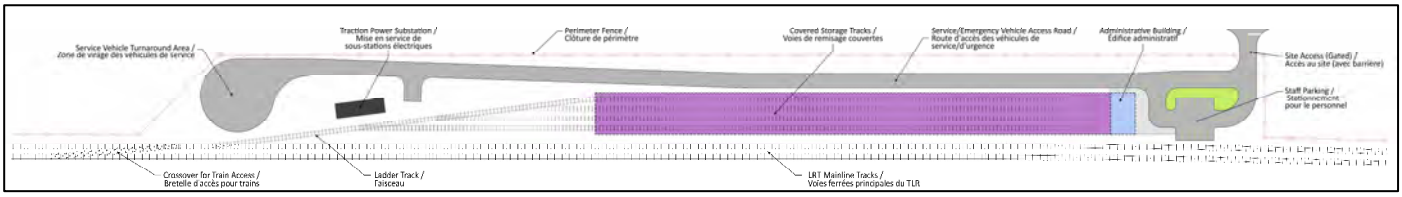
6.2.4 EVALUATION OF ALTERNATIVE LOCATIONS FOR THE TRAIN STORAGE AND SERVICING FACILITY

Stages 1 and 2 of the Confederation Line include heavy maintenance and storage facilities (MSF) at Belfast Road and Moodie Drive, accommodating the entire Confederation Line fleet including future extensions to Kanata and Barrhaven. However, given the long distance between Barrhaven Town Centre and these MSF sites a supporting train storage facility was identified as a requirement for this project. Based on initial ridership and fleet requirements, a facility capable of accommodating up to eight (8) trains (16 Light Rail Vehicles) was identified. This facility will enable more efficient and cost-effective operations for the Barrhaven LRT by:

- Reducing non-revenue movement of trains;
- Allowing for a longer overnight window to perform daily inspection and track maintenance activities along the LRT corridor; and,
- Providing the ability to efficiently scale service up or down at the beginning or end of the peak periods.

Preliminary consultations with the Rail Office indicated that this facility needs to only to provide train storage. The general arrangement for a facility such as this was shown to the public during the first round of public consultation and is illustrated in **Figure 6-19**.

Figure 6-19 General Arrangement for the TSSF



Subsequent consultations with the Rail Office following the first round of public consultation identified additional requirements for the facility to include the ability to carry out light maintenance and servicing activities which would increase the footprint of the general arrangement layout provided in **Figure 6-19**. The facility was renamed to: "Train Storage and Servicing Facility (TSSF)" and the requirements expanded to support the following activities related to LRT operations:

- Off-peak and overnight storage of trains;
- Light maintenance activities such as cleaning, vacuuming, washing of trains;
- Visual inspection of trains before/after service; and,
- Interior cleaning of trains.

The TSSF will consist of the following elements:

- covered storage and service tracks;
- light maintenance bay with overhead walkway access;
- handover track/platform with grade-separated operator access;
- administrative building for LRT staff;
- staff parking;
- security (fencing, lighting); and,
- landscaping.

Given the scale and role of the facility, a site located directly adjacent to the LRT corridor and near the end of the line is preferred. The TSSF requirements include a site large enough to accommodate eight (8) trains, provide for mid-day and overnight storage of trains, and can provide secure access.

For this evaluation six (6) potential alternative locations in the Study Area were considered. These are:

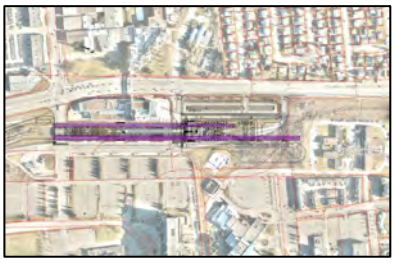
1. Baseline Station - located below-grade within an extended footprint from the existing station. Oriented parallel to Woodroffe Avenue/LRT alignment.
2. Woodroffe Open Space - located to the east side of Woodroffe Avenue, north of the CN Rail line. Oriented perpendicular to Woodroffe Avenue/LRT alignment. Approximately same space as was identified for the light maintenance and storage facility for Stage 2 LRT.
3. Slack Road - located in a constricted space parallel to Woodroffe Avenue/LRT alignment on NCC Greenbelt lands adjacent to Pineland Avenue and Slack Road.
4. Fallowfield - located under the realigned Fallowfield Road overpass parallel to LRT alignment abutting homes off Montana Way.
5. Greenbank - located south of VIA Rail Smiths Falls Subdivision to Highbury Park Drive, east of Greenbank Road. Oriented parallel to LRT alignment.
6. Barrhaven Town Centre - located below-grade under Chapman Mills Drive extending further south of Barrhaven Station to approximately Jockvale Road.

Figure 6-20 includes the general footprint for a facility at each of these locations prior to the direction that servicing must also be provided. With the added need for servicing, the required footprint for the TSSF will be slightly larger than shown.

To assist with the evaluation of the six (6) alternatives for focused evaluation for this section, only the differentiating criteria were selected from the long list of criteria for inclusion here. The focused evaluation for this section is shown in **Table 6-6** and discussion follows.

Figure 6-20 Potential TSSF Sites for Evaluation

1. Baseline Station

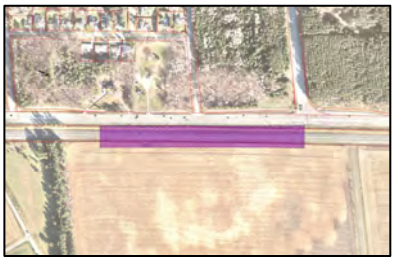


4. Fallowfield

2. Woodroffe Open Space

5. Greenbank

3. Slack Road



6. Barrhaven Town Centre

Table 6-6 Results of Focused Evaluation for the Location of the TSSF

			Alternative Number						
Number	Criteria	Indicator	Baseline Station	Woodroffe Open Space	Slack Road	Fallowfield	Greenbank	Barrhaven Centre	Qualifier
			1	2	3	4	5	6	
I. Transportation System Sustainability									
5A	TRANSPORTATION NETWORK	Provides opportunity to maintain or optimize functionality of existing and planned networks for all modes							Alternatives that provide the best flexibility to LRT operations and minimize deadhead time will perform better for this indicator.
6A	FACILITY OPERATIONS	Maximizes LRT operation reliability							Alternatives that provide the best flexibility to LRT operations and minimize deadhead time will perform better for this indicator.
6B		Maximizes the opportunity to connect to utilities and infrastructure							Alternatives that provide the best flexibility to connect to necessary utilities and infrastructure will perform better for this indicator.
6C		Maximizes the opportunity to provide a safe and secure access to the facility from the surrounding road network							Alternatives that provide safe and efficient site access for service vehicles and staff.
6D		Maximizes ability to provide secure access to the facility							Alternatives that provide the best ability to restrict/control unauthorized access to the site will perform better for this indicator.
II. Ecological and Physical Sustainability									
7A	NATURAL HERITAGE FEATURES	Minimizes or avoids impacts on designated features of the City's natural heritage system or other identified natural areas							Alternatives that minimize or avoid impacts (including limiting fragmentation) to areas designated in the City's natural heritage system or other identified natural areas will perform better for this indicator.
7B		Minimizes stormwater management complexity and maintenance							Alternatives that minimize stormwater management complexity and maintenance during operation will perform better for this indicator.
7E		Minimizes or reduces the amount of natural habitat loss, maximizes protection of urban trees							Alternatives that preserve urban trees and maximizes the ability to maintain natural habitats will perform better for this indicator.
8B	PHYSICAL ENVIRONMENT	Minimizes risks associated with groundwater and/or sensitive soils							Alternatives that minimize or avoid areas within the Study Area known for having a high groundwater table and/or contain sensitive soils (i.e., clays) will perform better for this indicator.
9A	CLIMATE CHANGE MITIGATION	Minimizes the impact from the project on contributing to climate change							Alternatives that reuse and upgrade existing facilities will minimize the amount of waste and therefore will perform better for this indicator.
10A	CLIMATE CHANGE ADAPTION	Minimizes the impact of extreme weather events on the infrastructure							Alternatives that are more resilient to extreme heat and weather events including extreme rainfall, extreme snowfall, freezing rain, freeze/thaw cycles, wind gusts will perform better for this indicator.
III. NCC Greenbelt Sustainability									
11A	AGRICULTURAL RESOURCES	Minimizes impact to designated prime agricultural lands							Alternatives that minimize or avoid impacts to designated prime agricultural lands will perform better for this indicator.
11B		Minimizes impacts on existing farm infrastructure including buildings and tile drainage systems							Alternatives that minimize or avoid decommissioning of farm-related infrastructure will perform better for this indicator.
12A	GREENBELT ENVIRONMENT	Minimizes impacts to designated NCC Greenbelt lands							Alternatives that minimize or avoid designated NCC Greenbelt lands will perform better for this indicator.
IV. Land Use and Community Sustainability									
13B	COMMUNITY PLANNING & DESIGN	Minimizes impacts to existing land uses including existing buildings and residences							Alternatives that minimize or avoid acquisition or relocation of built assets will perform better for this indicator. As well, major infrastructure in close proximity to residences or sensitive land uses will result in a reduced performance for this indicator.
13C		Minimizes or avoids disruption to essential municipal services (utilities, potable water and sanitary services)							Alternatives that minimize or avoid interaction and/or disruption to existing infrastructure will perform better for this indicator.
14B	CULTURAL HERITAGE RESOURCES	Avoids or minimizes impact on designated or potential built heritage resources							Alternatives that maintain or enhance the cultural heritage value or interest for a built heritage resource as defined under the Ontario Heritage Act will perform better for this indicator.

			Alternative Number						
Number	Criteria	Indicator	Baseline Station	Woodroffe Open Space	Slack Road	Fallowfield	Greenbank	Barrhaven Centre	Qualifier
			1	2	3	4	5	6	
14C		Avoids or minimizes impact on designated or potential cultural heritage landscapes							Alternatives that maintain or enhance the cultural heritage value or interest for cultural heritage landscapes (including cemeteries and farms) as defined under the Ontario Heritage Act will perform better for this indicator.
15A	NOISE AND VIBRATION	Maximizes separation between the [LRT] facility (a potential noise and vibration source) and sensitive receivers							Alternatives that maximize their separation from existing and planned sensitive land uses and minimizes the need to provide noise mitigation will perform better for this indicator.
V. Economic Sustainability									
18A	LIFE CYCLE COST	Minimizes the capital infrastructure cost including minimizing the need to alter or abandon existing infrastructure							Alternatives that avoid unnecessary or temporary reconstruction of existing infrastructure (municipal services, hydro, corridor facilities) will perform better for this indicator.
18B		Minimizes construction duration and complexity							Alternatives with the shortest time and least complex construction duration will perform better for this indicator.
18D		Minimizes property acquisition cost							Alternatives with the least amount of land acquisition will perform better for this indicator.

6.2.4.1 Discussion of Evaluation

Alternative 1 performed well for some criteria but has significant design challenges being located below-grade, and is not located at the preferred end of the line location. The facility would be considerably constrained within the footprint available. Constructing the facility at Baseline would be more challenging as it would need to be a below-grade facility in unfavourable soil and groundwater conditions which come with an associated high-cost premium. Further challenges arise from incorporating the facility into a below-grade location that requires quick transition to an elevated LRT alignment south of Baseline Station. For these reasons, Alternative 1 is not the preferred location.

Alternatives 2, 3, 4 and 6 are all significantly constrained by surrounding existing lands (Open Space, Greenbelt and Town Centre lands) and planned land uses which conflict with community plans and policies and would require property acquisition. Alternatives 2 and 4 disrupt existing and planned pathway networks. The City's Pedestrian Plan identifies a MUP in the location of Alternative 2, and informal pathways exist currently. Alternative 4 displaces an existing MUP and eliminates its connection to the broader pathway network. Alternatives 2 and 4 also disrupt underground infrastructure and stormwater management. Alternative 2 displaces valued open space and would require a yard track crossing to the east side of Woodroffe Avenue, adding to cost and construction and operational complexity. Further, Alternative 2 would require realignment of critical underground infrastructure, the Lynnwood Collector, which runs perpendicular to Woodroffe Avenue in this location. Alternative 3 is not desirable as it is located within the NCC Greenbelt and impacts agricultural operations and infrastructure. Because of the surrounding agriculture operations, the only way to fit the TSSF in this space would be in a long and narrow configuration which is not optimal from a train operations perspective. In addition, Alternative 3 does not have access to sanitary services. Connecting to them or installation of a private septic system would result in additional impacts and acquisition of NCC lands, in addition to the disrupted views of the lands which the TSSF facility itself will present. Alternative 4 would require a challenging design so as not to impact the grade-separation of Fallowfield Road to the VIA Rail line and the LRT alignment and station. This alternative would also be located close to residential properties. Alternative 6 results in higher construction costs due to ground conditions at this location, and the need for a below-grade facility based on existing topography and future planned land uses.

Following evaluation, Alternative 5, the Greenbank location was selected as the preferred location for the TSSF. It is recommended as it is located on existing City-owned property, immediately adjacent to the existing Southwest Transitway corridor. It is located near the end of the line, which is an optimal location for train operations, especially for the start of morning service. This location consolidates existing municipal infrastructure including an existing stormwater management facility. It is currently buffered from the existing residential land uses to the west by Greenbank Road, the VIA Rail line to the north, Highbury Park Drive to the south, and to the east by the existing Southwest Transitway and adjacent vegetated/treed multi-use pathway corridor.

The preferred location for the TSSF at 1005--1045 Greenbank Road will displace a site earmarked for Affordable Housing by Council on April 10, 2019 (Report ACS2019-PIE-GEN-001). Mitigation of this impact includes directing staff to remove the site from future consideration as an Affordable Housing location and, direct the Interdepartmental Task Force on Affordable Housing to undertake a comprehensive review of the planned Stage 3 LRT corridors to identify short-term alternative locations for future affordable housing development to replace the 1005-1045 Greenbank Road site.

6.3 Stakeholder Consultation

6.3.1 SECOND ROUND OF CONSULTATION GROUP MEETINGS

The second round of Consultation Group meetings consisted of two ACG meetings, one BCG and PCG meeting and a POH. The first POH was held in late October which provided the opportunity for the Study Team to further develop and refine the information to be presented. The information presented at these meetings did not include the determination of the preliminary preferred alternative for the extension of LRT from Baseline Station to the Nepean Sportsplex nor the location of the TSSF. The preliminary preferred plans for the rail grade-separations at the Southwest Transitway and Fallowfield Road and conversion of the Southwest Transitway from BRT to LRT between Nepean Sportsplex to Barrhaven Town Centre were presented. Consultation group, meeting dates and items discussed are presented in Table 6-7.

Table 6-7 Second Round of Consultation Group Meetings

Meeting and Date		Main Agenda Topics
ACG	June 12, 2019	Preferred Solutions, Evaluation of Alternative Designs Methodology and Criteria, Results of Technical Studies, Alternative Alignments and Designs, Alternative Train Storage Facility Locations
ACG	October 16, 2019	Alternative Alignments and Designs (Baseline-West Hunt Club), Preliminary Plan to Convert Southwest Transitway to LRT, Preliminary Plan for Rail Grade-Separations, Alternative Train Storage Facility Locations
BCG	October 17, 2019	
PCG		
POH	October 30, 2019	

The Study Team, including members from the City of Ottawa and the consultant team, were available to discuss the project and answer questions. At these meetings, participants were presented information that was to be communicated at the first POH in advance of that event, including: confirmation of project need and opportunities for the study, an overview of existing conditions, evaluation of alternative solutions and the preliminary preferred solution, the design alternatives, evaluation methodology and criteria. Input received at these meetings included comments and discussion on the following topics:

- Desire for overpasses to be designed to best limit impacts to NCC Greenbelt lands;
- Providing pedestrian connections to either side of Woodroffe Avenue to/from Nepean Sportsplex Station;
- Minimizing traffic impacts on Woodroffe Avenue during construction as best as possible;
- Considering redevelopment plans for Barrhaven Town Centre;
- Considering plans to phase improvements to the area transportation network sooner;
- Considering extension of the southerly limit of the study to serve the quickly growing communities south of the Jock River; and,
- Concern for potential impacts to water quality and quantity in nearby residential areas with private wells.

A record of discussions from the consultation group meetings are provided in **Appendix A**.

6.3.2 PUBLIC OPEN HOUSE #1

POH #1 was held on Wednesday October 30, 2019 at the Nepean Sportsplex – 1701 Woodroffe Avenue from 6:00 to 9:00 PM. The POH included a series of display boards (provided in **Appendix A**) which presented the work completed to date, with a focus on:

1. The six alternative LRT alignments being evaluated for the Baseline Station to the Nepean Sportsplex portion of the Study Area – with a focus on the 'bottleneck' between Knoxdale and West Hunt Club;
2. The six alternative locations being evaluating for a supporting TSF; and,
3. A Preliminary Plan to convert the Southwest Transitway to LRT from the Nepean Sportsplex to Barrhaven Town Centre, including three rail grade-separations of the VIA Rail line.

The material presented on the display boards at the Public Open House included:

- Welcome
- Study Overview
- Study Process and Schedule
- Study Progress to Date
- Consultation
- Existing Conditions - Overview
- Existing Conditions - Geotechnical (maps)
- Existing Conditions – Geotechnical Details
- Existing Conditions - Land Use
- Existing Conditions - National Capital Commission Greenbelt
- Existing Conditions - Transportation
- Need and Opportunities/Alternative Solutions
- Planning and Design Principles/Accessibility In The Design
- Evaluation Criteria (3 boards)
- Baseline Station to Nepean Sportsplex: Overview
- Baseline Station to Nepean Sportsplex: Development of Alternatives
- Trench and Elevated Design Concepts
- Alternatives 1 and 2: Below-grade in Woodroffe Avenue Corridor

- Alternatives 3 and 4: Elevated in Woodroffe Avenue Corridor
- Alternatives 5 and 6: Below-Grade and Elevated West of Woodroffe Avenue
- Baseline Station to West Hunt Club Road: Profile Considerations
- Baseline Station to Nepean Sportsplex: Initial Findings
- Nepean Sportsplex to Barrhaven Town Centre
- Barrhaven and Merivale Road Rail Crossing Grade-Separation Study
- Southwest Transitway and Woodroffe Avenue Rail Grade-Separations – Preferred Option
- Southwest Transitway and Woodroffe Avenue Rail Grade-Separations – Preliminary Plan
- Fallowfield Road Rail Grade-Separation – Preferred Option
- Fallowfield Road Rail Grade-Separation – Preliminary Plan
- Fallowfield Station – Preliminary Plan
- Preliminary Plan for Longfields Station & Strandherd Station
- Preliminary Plan for Barrhaven Centre Station
- Train Storage Facility-Overview
- Train Storage Facility –Description
- Train Storage Facility – Six Potential Sites
- Train Storage Facility – Sites 1-3
- Train Storage Facility – Sites 4-6
- LRT Station Design, Accessibility and Multi-modal Connectivity
- Next Steps

Notification of the POH occurred through email reminders to the project stakeholders list as well as advertisements in citywide newspapers, Le Droit and the Ottawa Citizen, on Friday October 18 and 25, 2019.

Indigenous communities were also informed of the public consultation event by email on October 21, 2019.

A resource table was provided which included copies of the City of Ottawa OP, TMP, the Ontario *Environmental Assessment Act*, the Pedestrian and Cycling Plans, a guide to Municipal Class Environmental Assessments, and the Provincial Policy Statement. A handout for the study was also made available highlighting the study's need and objectives and progress made to date.

Attendees were asked to sign-in upon entering the POH. A total of 114 people signed in over the course of the evening.

To further assist in obtaining feedback from attendees, a Comment-Questionnaire was distributed at the POH. Members of the public were encouraged to provide written comments via the Comment-Questionnaire and submit them either before leaving the event or by email or regular mail. A total of 19 sets Comment-Questionnaires were filled out during the POH. Following the consultation events, a total of 24 additional emailed comments were received. A total of 43 sets of comments were received from this POH. Key themes received from this round of consultation included:

- Evaluation of Alternatives, Baseline Station to Nepean Sportsplex Considerations
  - Preference for a below-ground alternative located outside of the Woodroffe Avenue corridor;
  - Elevated facility not favoured due to noise and visual concerns;
- Requested a pedestrian connection across Woodroffe Avenue to connect to Nepean Sportsplex Station;
- Supporting the preliminary plan presented to convert the Southwest Transitway to LRT as well as the rail grade-separations;
- Preferring the Barrhaven Town Centre location for the TSSF site;
- Clarifying potential noise impacts during project operation;
- Protecting residents from construction noise and impacts;
- Clarifying potential reduction of property value after project implementation;
- Protecting Greenbelt views;
- Assuring safety and residential community environment after project implementation;
- Recognizing the barrier to community connections with below-grade alternatives;
- Compensating the loss of low-income housing in the pinch point with Alternative 5 or 6;
- Limiting impacts to Tallwood woods;
- Minimizing traffic disruptions during construction; and,
- Maximizing opportunities to include parking at stations.

Some of the key themes were common to those identified as part of the consultation group meetings. The record of comments received during this round of consultation is provided in **Appendix A**.

6.4 Preliminary Preferred Designs

The Study Team reviewed the feedback received during and after the second round of Consultation Group Meetings and the first POH. Additional meetings with individual stakeholders were held as required to discuss comments. The preliminary recommendations were presented to senior City Transportation Planning staff for feedback and approval.

The preliminary preferred design for this study includes extending twin-track electric LRT from Baseline Station to the Nepean Sportsplex as an elevated facility to the immediate west of the Woodroffe Avenue Right-of-Way (Alternative 6) and converting the remaining portion of the Southwest Transitway corridor from the Sportsplex to Barrhaven Centre from BRT to LRT technology. It also includes road-over-rail overpasses for the rail grade-separation of Woodroffe Avenue, the Southwest Transitway and Fallowfield Road form the existing VIA Rail tracks and the Greenbank Road location as the preferred site for the TSSF (Location 5).

6.5 Stakeholder Consultation

6.5.1 THIRD ROUND OF CONSULTATION GROUP MEETINGS

The third round of consultation consisted of one meeting each of ACG, BCG and PCG and a POH. Feedback on the Recommended Plan was requested during this round of consultation. (**Table 6-8**).

Table 6-8 Third Round of Consultation Group Meetings

Meeting and Date		Main Agenda Topics
ACG	August 20, 2020	Study objectives, process and schedule, feedback received to date, Baseline Station to Nepean Sportsplex: Evaluation of Alternative Designs, Preliminary Recommended Plan and New Station Designs, Preliminary Recommended Plan for Woodroffe, Southwest Transitway and Fallowfield Road rail grade-separations at the VIA Rail Smiths Falls Subdivision, Train Storage and Servicing Facility (TSSF): Evaluation of Alternative locations and Preliminary Recommended Plan design, Preliminary impact assessment, Implementation and staging plans; and Next steps.
BCG	September 3, 2020	
PCG	September 8, 2020	
POH	September 9-23, 2020	

Due to the public health guidelines for COVID-19 these meetings were held virtually via MS Teams. Stakeholders were invited to participate via email. A presentation was provided followed by discussion. The Study Team, including members from the City of Ottawa and the consultant team, were available to discuss the study and answer questions at each of the consultation group meetings. Input received at these meetings included discussion on the following topics:

- Preliminary Recommended Plan to extend LRT from Baseline Station to Nepean Sportsplex:
  - Noise impacts from the elevated facility on the surrounding community;
  - Concerns for displacement of homes in the pinch point (Knoxdale to West Hunt Club);
  - Optimizing the programming opportunities provided by the elevated facility to include enhanced active mode facilities, greenscaping and public realm elements;
- Support for the new/improved MUP connections and links incorporated into the design;
- Project life cycle costs;
- Integration with the planned Barrhaven civic complex;
- Impacts to the Royale Equestrian Centre;
- Support for the additional multi-use pathways, wildlife corridors and consideration for snow removal on the elevated LRT facility;
- Impacts resulting from the temporary detour required for construction of the rail grade-separations and safety measures for all modes utilizing the detour;

- Permanent and temporary land requirements;
- Reducing impacts to landscaping throughout the corridor; and,
- Concern for potential impacts to water quality and quantity in nearby residential areas on private wells.

Full detail of discussion at these consultation group meetings are provided in **Appendix A**.

6.5.2 LANDSCAPING AND SPACE PROGRAMMING STRATEGY WORKSHOP

A Landscaping and Space Programming Strategy Workshop meeting was held with City staff and the Study Team on April 29, 2020 to provide an opportunity for discussion pertaining to landscaping and space programming for all six alternatives considered. The specific objectives of the workshop were to discuss the opportunities and constraints for landscaping and programming space within the anticipated 20m LRT Right-of-Way and adjacent lands and to develop parameters for landscaping and space programming strategies for various contexts within the LRT corridor. The record of discussion from this workshop is provided in **Appendix A.** Outcomes of this workshop provided the basis for development of the Corridor Landscaping and Space Programming Strategy for the Recommended Plan outlined in **Section 7.4**.

6.5.3 PUBLIC OPEN HOUSE #2

Due to the public health guidelines for COVID-19, the second POH took place on-line. On September 9, 2020, three (3) recorded presentations along with information boards were provided on the study's website for stakeholders' review with an open comment period of two weeks, September 9-23, 2020. Stakeholders were encouraged to provide feedback on the information presented by September 23, 2020.

The Open House included a series of display boards presenting the work completed to date, focusing on:

- The evaluation of alternative designs;
- The functional design of the recommended plan;
- Preliminary impact assessment;
- Implementation and staging plans; and,
- Next steps.

The material presented on the display boards for the online public consultation event included:

- Introduction
- Study Overview
- Study Process and Schedule
- Study Progress and What We've Heard So Far
- Planning and Design Principles and Accessibility in the Design
- Evaluation Criteria and Process
- Baseline Station to Nepean Sportsplex Overview: Context Overview
- Baseline Station to Nepean Sportsplex: Development of Alternatives
- Alternatives 1 and 2
- Alternatives 3 and 4
- Alternatives 5 and 6
- Baseline Station to Nepean Sportsplex: Evaluation Results
- Evaluation Rationale: Why not Below-Grade?
- Activating Space Under the Guideway
- Tallwood Station
- Knoxdale Station
- Nepean Sportsplex Station
- Nepean Sportsplex to Barrhaven Town Centre: Preliminary Recommended Plan
- Southwest Transitway and Woodroffe Avenue Rail Grade-Separations Preliminary Recommended Plan
- Fallowfield Road Rail Grade-Separation Preliminary Recommended Plan
- Fallowfield Station
- Longfields Station
- Strandherd Station
- Barrhaven Centre Station
- Train Storage and Servicing Facility
- Alternative Sites Evaluation for a Train Storage and Service Facility
- Evaluation Results - Train Storage and Servicing Facility
- Project Implementation - Phasing
- Project Implementation - Construction Staging

- Preliminary Impact Assessment and Required Mitigation Measures
- Next Steps

Notification of the consultation period occurred through virtual and physical mediums. Email reminders were sent on three occasions to the study stakeholders on the project mailing list on Friday September 4, 11 and 18, 2020. Individuals within the Study Area were also notified through circulation of approximately 18,500 buckslip notices. Notification was posted to the project website as well as on social media. Advertisements were also placed in citywide newspapers including the Ottawa Citizen on September 5, 9 and 12, LeDroit on September 5,2020 and September 12,2020 as well as the Barrhaven Independent paper on September 18, 2020.

Indigenous communities were also informed of the public consultation event by email on Friday September 4, 11 and 18, 2020.

To assist with obtaining feedback on the materials presented, a comment-questionnaire was provided on the project website. Feedback was also encouraged through submission of emails or by contacting the City project manager to arrange other means of providing feedback. A total of 153 responses to the comment-questionnaire and emails from 29 individuals were received. Key themes received from this round of consultation includes:

- Preliminary Recommended Plan to extend LRT from Baseline Station to Nepean Sportsplex:
  - Support for Alternative 6, an elevated facility located outside of the Woodroffe Avenue corridor;
  - Concerns for impacts to noise, visual and privacy from the elevated LRT facility;
  - Concerns for general community impacts i.e., crime, lighting, unwanted behaviour and safety;
  - Support for programming the space under the guideway;
  - Concerns for displacement of homes in the pinch point (Knoxdale to West Hunt Club);
- Support for the rail grade-separations;
- Support for improved/enhanced facilities for the active modes associated with the project;
- Support for maintaining /creating greenspace as part of the project design;
- Requests to provide more parking;
- Support for the Greenbank Road TSSF location;
- Support for extending LRT to Barrhaven as soon as possible;
- Inquiries regarding project costs;
- Request to extend LRT further south in Barrhaven (south of the Jock River); and,
- Concerns for loss of property value.

Some of key themes were common to those identified as part of the consultation group meetings.

In addition, letters were received from ACORN Canada (Association of Community Organizations for Reform Now) membership stating their concerns related to the preferred LRT alignment and resulting displacement of tenants in rental units. ACORN Canada is a multi-issue, membership-based community union of low- and moderate-income people. A number of ACORN Canada members are also tenants of the Manor Village property. The record of all comments received during this round of consultation are provided in **Appendix A.**

6.6 Transportation Committee and Council Meetings and Directions November 2020

The Preferred Design was presented for approval to the City of Ottawa Transportation Committee on November 2, 2020 and to the full Council on November 25, 2020 (**Appendix A**). The staff report and supporting documents were posted on the City's website prior to the meetings with the recommendation that the Transportation Committee recommend that Council:

1. Approve the functional design for the Barrhaven Light Rail Transit (Baseline Station to Barrhaven Town Centre) and Rail Grade-Separations Planning and Environmental Assessment (EA) study and interim transit priority measures as described in this report and supporting documents;
2. Direct staff to complete the Transit Project Assessment Process (TPAP) in accordance with the Regulation 231/08 of the Ontario *Environmental Assessment Act*, including the preparation and filing of the Environmental Project Report for final public review and comment; and,
3. Direct staff to remove the 1005--1045 Greenbank Road site earmarked for affordable housing by Council on April 10, 2019 (Report ACS2019-PIE-GEN-001) from the list of affordable housing development sites; and,
4. Direct the Interdepartmental Task Force on Affordable Housing to undertake a comprehensive review of the planned Stage 3 LRT corridors to identify short-term alternative locations for future affordable housing development to replace the 1005-1045 Greenbank Road site that is now recommended for the Barrhaven LRT's Train Storage and Servicing Facility.
5. Direct staff to establish a Working Group to examine options on how to assist the residents who are facing a future relocation because of the LRT project and that this working group consist of: General Manager, Planning, Infrastructure and Economic Development, General Manager, Community and Social Services, General Manager, Transportation Services, and/or their respective delegates; Ottawa Community Housing; community representatives from Manor Village and Cheryl Gardens; the ward Councillor; and the Councillor Liaison for Housing and Homelessness.
6. Direct staff to report back to the Finance and Economic Development Committee by end of 2021 on the Working Group's recommendations including justifications, and policy and financial implications.

A total of 14 delegations were made to Transportation Committee by residents of Manor Village, the Barrhaven BIA and other interest groups both against and for the Preferred Design.

Additional motions were introduced at Council to further mitigate against the loss of rental housing units and to assist in finding additional affordable housing in the City in proximity to Stage 3 LRT projects included:

7. That staff assess the site at 40 Beechcliffe Street for its development potential for affordable housing, as it is in close proximity to the 100 private rental units that will be impacted by the Stage 3 LRT expansion, and report back to Council by the end of 2021 on its suitability and potential development timeline.
8. Direct staff in Transportation Services, Housing Services, and Planning, Infrastructure and Economic Development to re-initiate the Interdepartmental Task Force on Affordable Housing to explore to explore opportunities for affordable housing in close proximity (600m) to Light Rail Transit (LRT) and Bus Rapid Transit (BRT) stations associated with Stage 3 LRT.

Further, a motion introduced as follows would be referred to and considered by the Working Group.

- Council establish a Rental Replacement Program for the residents who are facing relocation because of the LRT project and that the Working Group, identified in recommendation 5 of the Report, assist tenants in securing rental housing that is of a similar dwelling type and bedroom count to their existing rental housing;
- the City, subject to Council approval in the annual budget, provide a housing allowance to pay the difference between the rent for the expropriated property and the rent for a replacement unit, up to the Average Market Rent for the City of Ottawa as defined by the Canada Mortgage and Housing Corporation, should the replacement unit have a rent that is higher than the rent of the expropriated unit; and,
- Council direct the Working Group to identify a source of funding to support such a Rental Replacement Program set out herein and finalize the details of the Rental Replacement Program such that only tenants who are, as of the date

of this motion, tenants of the land to be expropriated and continue to be tenants of the land at time of eviction, qualify for the Program, encourage those who qualify for other housing benefits to apply for such benefits, with any other Program requirement to be brought forward to Finance and Economic Development Committee in accordance with Recommendation 6 of the Report

A further motion was raised to direct staff to report back to Transportation Committee with an alternative option that includes retaining the housing in Manor Village or Cheryl Gardens was not carried.

The staff report and supporting documents, motions presented, and the voting record are provided in **Appendix A.**

6.7 Modification to the Preferred Design

An outcome to Committee and Council's approval of the Preferred Design included the action item to establish a task force and working group on affordable housing (hereafter, "working group") to address the displacement of 100 privately owned rental units for the properties located with municipal mailing addresses of: 1, 3, 5, 19 and 23 Cheryl Road, 1668 Woodroffe Avenue and 5 Majestic Drive (Recommendation #5). The working group was initiated prior to issuing the Notice of Commencement of the TPAP. The Notice of Commencement was first issued on October 23, 2021, which formally started the TPAP process and commenced the 120-day public consultation period as per the regulation. During the meetings the number of displaced units was discussed and further refined to 100 units, not the previously communicated 120 units as per public consultation materials.

The working group explored numerous options to mitigate the housing loss, including modifying the LRT alignment to eliminate the loss of housing altogether. Accordingly, the Study Team prepared a functional design plan shifting the LRT alignment to the median of Woodroffe Avenue between north of Knoxdale Road and the Nepean Sportsplex Station (the "Pinch Point"). As part of the new median LRT alignment, the Pinch Point also requires reconstruction to accommodate the elevated LRT alignment. The functional design for the remainder of the corridor remained generally unchanged.

Several months after the Notice of Commencement was issued, the Study Team returned to Transportation Committee on June 8, 2022 with the median LRT alignment and was subsequently approved by Transportation Committee and Council with the following recommendations:

That the Transportation Committee recommend Council:

1. Approve the replacement of the previously approved alignment for the Barrhaven LRT for the section between north of Knoxdale Road and the Nepean Sportsplex, with the revised alignment as described in this report, to avoid displacing the tenants of Manor Village and Cheryl Gardens;
2. Direct staff to finalize the functional design for the revised alignment, conduct public consultation on the design change, document the process and inform Transportation Committee of the consultation outcome prior to re-initiating the Transit Project Assessment Process with the revised alignment as part of the larger Light Rail Transit project from Baseline Station to the Barrhaven Town Centre.

Reporting updates and memos produced to document changes to the Preferred Design are provided in **Appendix B**.

6.8 New City of Ottawa Official Plan (November 2022)

During the course of the Study, a new OP was adopted by Council on November 24th, 2021 and approved by the Ontario Ministry of Municipal Affairs and Housing on November 4th, 2022. The new OP directs how the city will grow over time and sets out policies to guide the development and growth of the city to the year 2046 and beyond (the previous OP was to the year 2036). The new OP has been reviewed in the context of this Study to ensure that the recommendations and preceding analyses is consistent with the policies of the new OP.

Section 2 – Strategic Directions. Section 2 of the new OP outlines the strategic and broad-based policy directions with the objective to assist the city in becoming the most liveable mid-size city in North America over the next century. To this end, Section 2.1 outlines five big moves. These are:

1. *Achieve, by the end of the planning period, more growth by intensification than by greenfield development.*
2. *By 2046, the majority of trips in the city will be made by sustainable transportation.*
3. *Improve our sophistication in urban and community design and put this knowledge to the service of good urbanism at all scales, from the largest to the very small;*
4. *Embed environmental, climate and health resiliency and energy into the framework of our planning policies;*
5. *Embed economic development into the framework of our planning policies.*

Six cross-cutting issues (Section 2.2 of the new OP) essential to the achievement of a liveable city are to be implemented through the policies in multiple sections of the Plan. **Table 6-9** summarizes these issues and identifies the objectives that are applicable to this Study.

Table 6-9 Issues and Objectives of the New OP 2022

Cross Cutting Issues	Key Objectives
Intensification	Direct residential growth within the built-up urban area to support an evolution towards 15-minute neighbourhoods. Improve public amenities and services including transit and active transportation facilities.
Economic Development	Direct Major Employment to Hubs, Corridors and Special Districts in proximity to Rapid Transit Stations.
Energy and Climate Change	Plan a compact and connected City where higher densities are encouraged close to transit and walking distance to a wide range of services. Prioritize the shift to energy efficient transportation modes such as frequent and efficient transit service and walking and cycling facilities. Reduce the urban heat island effect and help protect the vulnerable from extreme heat by providing more shading and access to cooling amenities. Build resilience to future flood risks and increased stormwater runoff by designing infrastructure that is resilient to future extreme weather events and using Low Impact Development stormwater features for smaller events.
Healthy and Inclusive Communities	Encourage development of healthy, walkable, 15-minute neighbourhoods that support transit that feature a range of housing options, supporting services and amenities. Build accessible, inclusive communities, and design for all ages, including children and older adults including active transportation facilities and transit.
Gender and Racial Equality	Improve mobility options for women and access to amenities that are available by foot, cycling or using transit.
Culture	Reinforce neighbourhood and place identity through architecture and urban design. Promote the arts as an important element of placemaking.

Section 3 – Growth Management Framework. Section 3 of the new OP outlines the City's Growth Management Framework and premised on *"the ability to provide sufficient development opportunities and an appropriate range of choices, locating and design growth so as to increase sustainable transportation mode shares and use existing infrastructure efficiently, while reducing greenhouse gas emissions."* Ottawa's population is projected to grow 40% from 2018 to 2046, reaching an estimated 1.4 million people. The new OP allocates 93% of the city's growth within urban areas of the city and 47% to be within exiting built-up areas with the balance being with greenfield areas. During the same period, employment is expected to grow by about 189,000 jobs from 2018 to 2046. The Downtown Core is anticipated to remain the most important employment hub of the City, whereas Inner Urban, Outer Urban, Corridors, Hubs and Suburban Town Centres will also play a significant role as places for employment growth. The Barrhaven LRT corridor is located with the City's urban area and the alignment connects inner and outer urban areas as well as Hubs (including Algonquin Station to Tallwood Station, and Strandherd Station) and Suburban Down Centres (Barrhaven Town Centre) and parallels important City corridors that will be focus of growth within the City.

Section 4 – City-Wide Policies. Section 4 of the new OP outlines general policies that apply across the City. These include Mobility, Housing, Large-Scale Institutions and Facilities, Parks and Recreation Facilities, Cultural Heritage and Archaeology, Urban Design, Drinking Water, Wastewater and Stormwater Infrastructure, Natural Heritage, Greenspace and Urban Forest, Water Resources, School Facilities, and Generally Permitted Uses. Most relevant to this study are the overarching policies related to mobility which underscores the Big Policy Moves, support a shift to sustainable modes of transportation, and allow residents to safely and equitable navigate the city by developing seamless and multi-modal travel across the city.

Section 5 -9 Land Use Transects and Designations. The new OP divides the City into six concentric land use policy areas called transects, illustrated on Schedule A – Transect Policy Areas, each of which represents a different gradation in the type and evolution of the built environment and its planned function the growth management framework ranging from urban to rural. Policies related to the land use designations are outlined in Section 6 through 9 of the OP and similar to the transects, are described based on their function and land use intensity. The designations maps (Schedule B series of the new OP), recognize the Barrhaven LRT facility by identifying its station locations on these maps and support the transit facility by generally focusing intensification along the corridor and around stations. A summary of the OP land use designations as they relate to land use within the Barrhaven LRT corridor is provided in **Table 6-10** and illustrated in **Figure 6-21 –Figure 6-23**. A description of the land use designations follows.

Table 6-10 City of Ottawa Official Plan Land Use Designations (new 2022 Official Plan)

Official Plan Schedule	Designation	Location within the Study Area
A – TRANSECT POLICY AREAS	Outer Urban Greenbelt Suburban	Algonquin Station to West Hunt Club Road West Hunt Club Road to Fallowfield Road Fallowfield Road to Barrhaven Town Centre
B3 – OUTER URBAN TRANSECT B6 – SUBURBAN (SOUTHWEST) TRANSECT	Hub	Algonquin Station to Tallwood Station Strandherd Station Barrhaven Town Centre
	Evolving Neighbourhood Overlay	Baseline Road to West Hunt Club Road Longfields Station Strandherd Station Barrhaven Town Centre
	Greenspace	Tallwood woods Hydro corridor crossing near Knoxdale and Medhurst West Hunt Club Road North and south of rail corridor in the vicinity of Longfields Station to Strandherd Station
	Corridor – Mainstreet	Woodroffe Avenue Highway 417 to West Hunt Club
	Corridor – Minor	Meadowlands Drive Tallwood Drive Greenbank Road Chapman Mills
B4 – GREENBELT TRANSECT	Agricultural Resource Area	West Hunt Club Road to VIA Rail Crossing
	Greenbelt Rural	Bounded by Coleway Street, Woodroffe Avenue and Pineland Avenue
	Greenbelt Facility	West of Woodroffe Avenue, south of West Hunt Club Road Southeast corner of intersection of West Hunt Club Road and Woodroffe Avenue.
	Greenspace	East side of Woodroffe Avenue West Hunt Club Road to Grenfell Crescent

Figure 6-21 Excerpt from the 2022 Official Plan, Schedule B6 - Suburban (Southwest) Transect

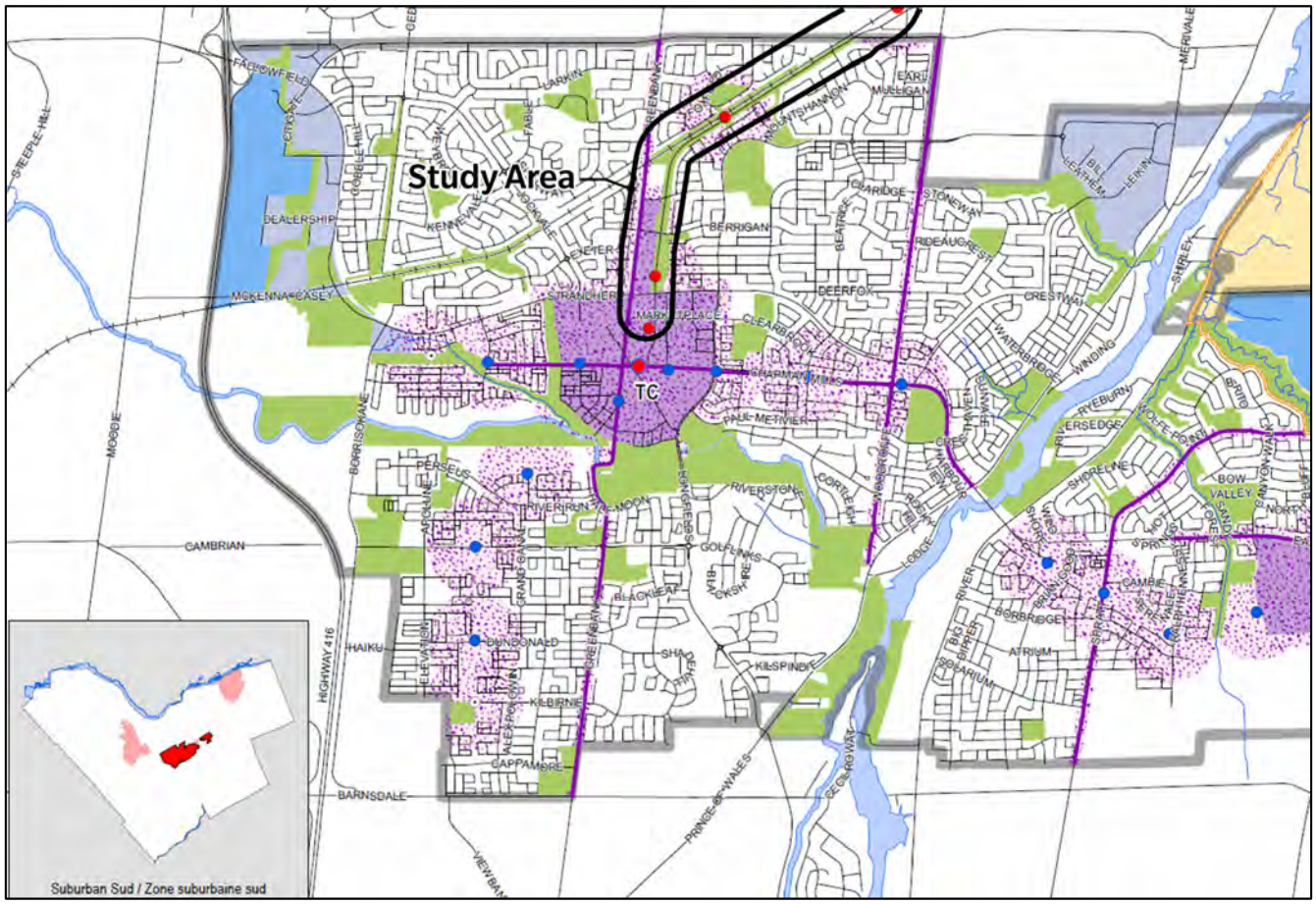


Figure 6-22 Excerpt from the 2022 Official Plan, Schedule B3 - Outer Urban Transect

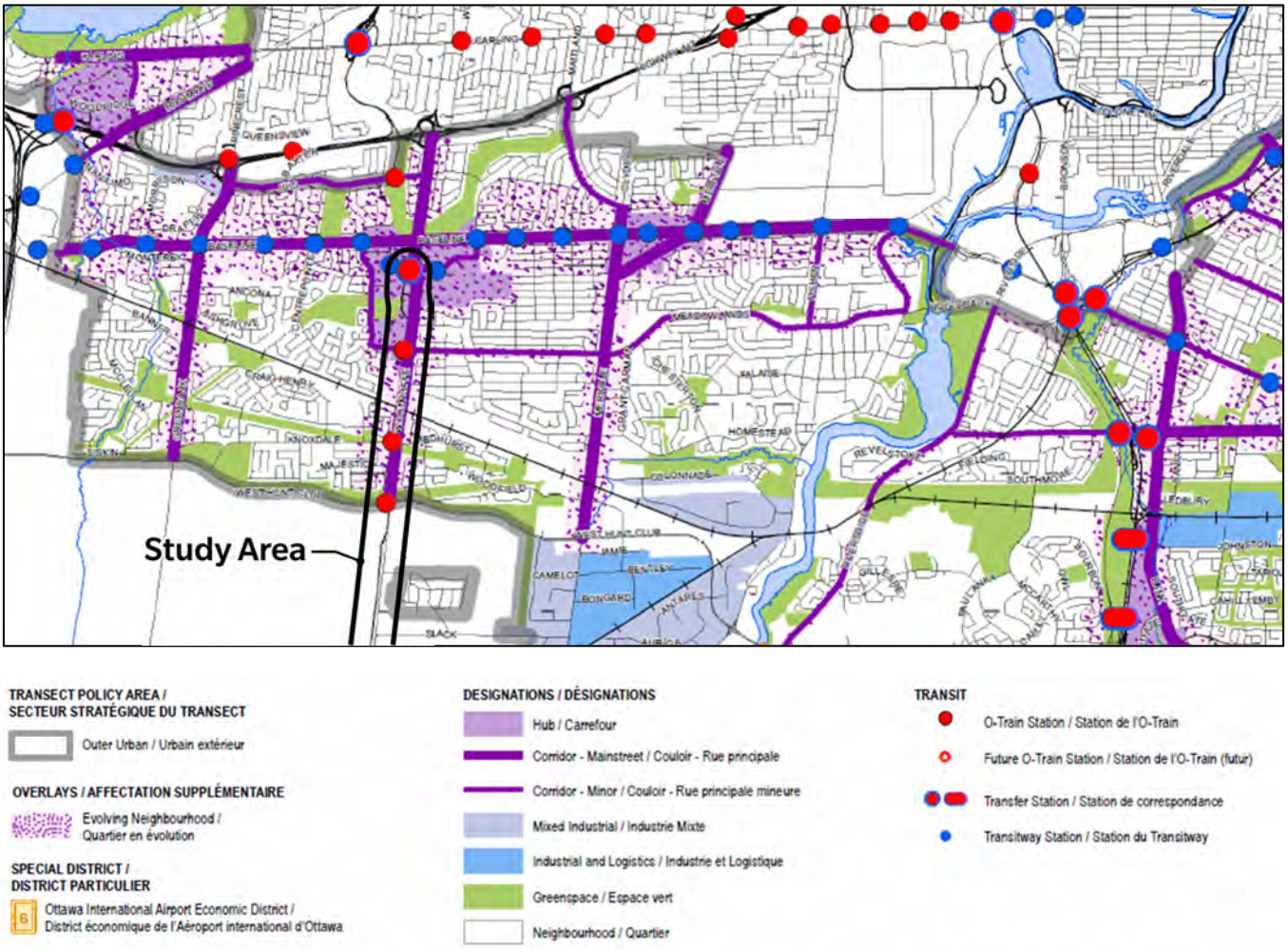
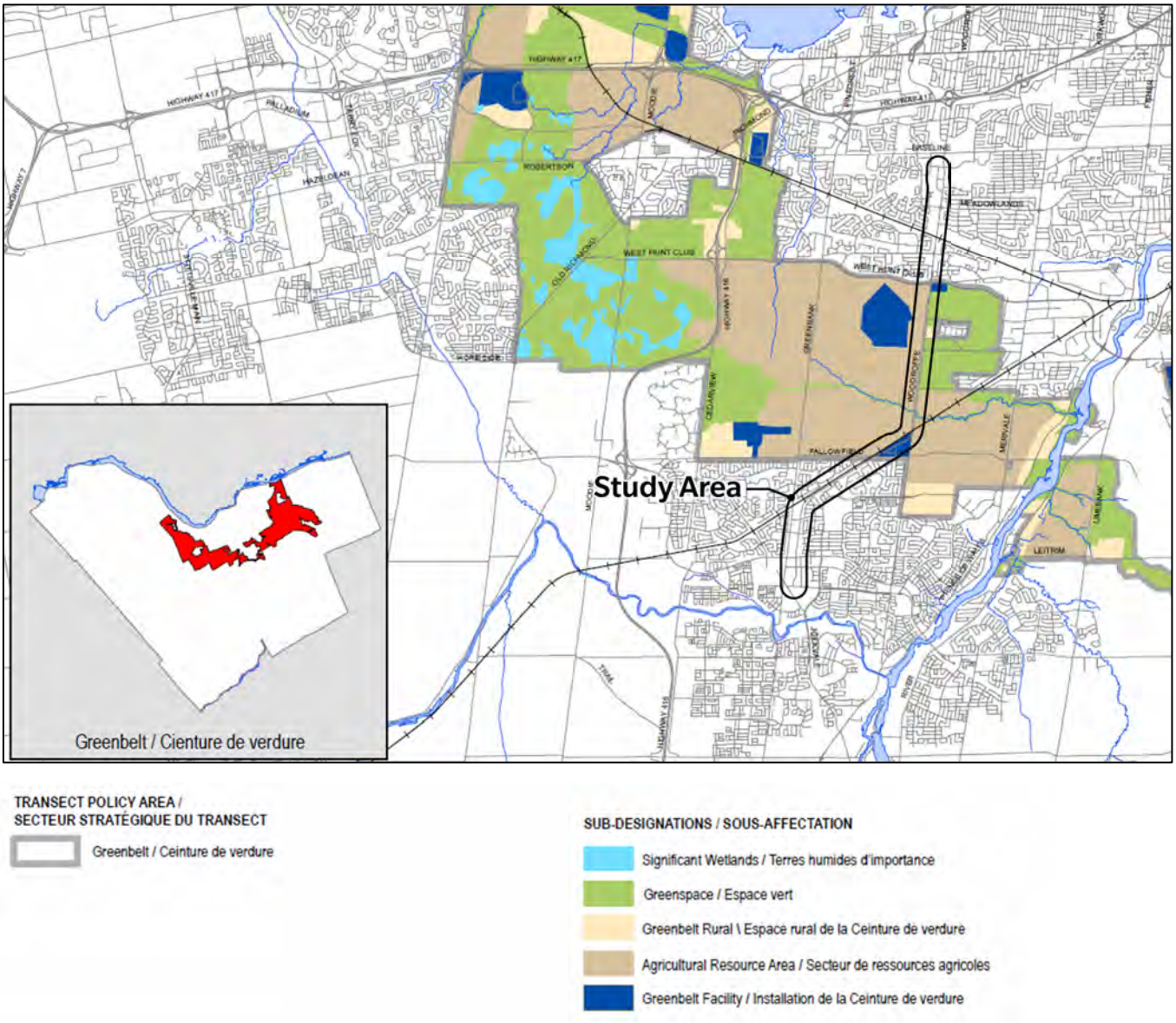


Figure 6-23 Excerpt from the 2022 Official Plan, Schedule B4 - Greenbelt Transect



The land use policies for the designations listed in **Table 6-10** are described below:

- The *Corridor* designation applies to lands that are planned to accommodate higher density developments, mixed uses, and higher street transit service levels. These areas support moderate pedestrian volumes and are characterized by their regional attractions related to leisure, entertainment, nature, or culture.
- The *Hub* designation applies to areas centred on planned or existing rapid transit stations or frequent street transit stops. These areas are also the focus high density developments, a greater degree of mixed uses, and a range of functions including employment within easy access of transit to provide higher levels of connectivity.
- The *Evolving Neighbourhood Overlay* is applied to areas close to *Hubs* and *Corridors* that provide opportunities to achieve an urban form and establish a gradual evolution to support intensification.
- The *Greenspace* designation generally applies to a network of public parks, natural lands, and other spaces that support biodiversity, recreation, and healthy living. The policies are intended to protect and enhance the city greenspaces and their various functions in recognition of their role in establishing climate resilience. The OP seeks to provide convenient and inclusive access and preservation of existing public access where possible, particularly in urban areas.

- The *Agricultural Research Area* designation includes a variety of types and intensities of agricultural uses and their associated practices with the objective of increasing local supply of goods and services.
- *Greenbelt Facility* designation recognizes areas where institutional, cultural and creative industries, recreation and research may be located with the National Capital Greenbelt and are to be designed, in coordination with the National Capital Commission, to respect the Greenbelt's natural and rural character.

The C-series schedules support the land use designations schedules by identifying the supporting transportation networks and targeted intensification areas as well as identifying the City's valued natural heritage system and greenspaces and environmental constraints. These are to be considered in the planning and design for new developments as well as the city's infrastructure. These designations have largely been carried forward from the previous Official Plan and, as such, have been considered as part of this Study. A summary of these additional OP designations around the Barrhaven LRT corridor are provided in Table 6-10 and illustrated in Figure 6-29. Schedules depicting road designations have been excluded from these figures as they can be described in segments as presented in the Table below.

Table 6-11 Additional Official Plan Designations

Official Plan Schedule	Designation	Location within the Study Area
C1 – PROTECTED MAJOR TRANSIT STATION AREA	Algonquin Station Tallwood Station Knoxdale Station Barrhaven Town Centre	
C2 – TRANSIT NETWORK (ULTIMATE)	O-Train – Grade Separated Crossing	Algonquin Station to Barrhaven Town Centre
C3 –ACTIVE TRANSPORTATION NETWORK (URBAN – MAJOR PATHWAYS)	Major Pathway	West side of Woodroffe Avenue Algonquin Station to Knoxdale West side of Woodroffe Avenue Southern Nepean Sportsplex entrance to Fallowfield Road and Station. East side of LRT alignment Fallowfield Road to Barrhaven Town Centre
C4 – URBAN ROAD NETWORK	Arterial Road	Woodroffe Avenue West Hunt Club Chapman Mills Drive
C7-A – DESIGN PRIORITY AREAS	Design Priority Area	Area around Algonquin Station Area around Barrhaven Town Centre
C11-C – NATURAL HERITAGE SYSTEM (EAST)	Natural Heritage Features Overlay	Pinhey Forest Tallwood woods
	Natural Heritage System Linkage Area	Black Rapids Creek
	Natural Heritage System Core Area	Pinhey Forest
C12 – URBAN GREENSPACE	Park	Ben Franklin Place and Legacy Skate Park Nepean Sportsplex Neill Nesbitt Park Berrigan Park
	Open Space	Hydro corridor crossing near Knoxdale and Medhurst West Hunt Club Road North and south of rail corridor in the vicinity of Longfields Station to Strandherd Station
	Greenbelt Natural Area	Pinhey Forest
	Greenbelt Natural Linkage	Black Rapids Creek

Official Plan Schedule	Designation	Location within the Study Area
C15 – ENVIRONMENTAL CONSTRAINTS	Intake Protection Zone (Vulnerability Score 8.1)	Study Area: Algonquin Station to south of West Hunt Club
	Unstable Slopes	Black Rapids Creek
C16 – ROAD CLASSIFICATION AND RIGHTS-OF-WAY PROTECTION	Woodroffe Baseline to Knoxdale	44.5m
	Woodroffe Knoxdale to West Hunt Club	44.5m *additional 30m subject to the results of this EA
	Woodroffe West Hunt Club to 225m south of West Hunt Club	G to 82.2m *subject to the results of this EA

Figure 6-24 Excerpt from 2022 Official Plan, Schedule C1 - Protected Major Transit Stations (PMTSA)

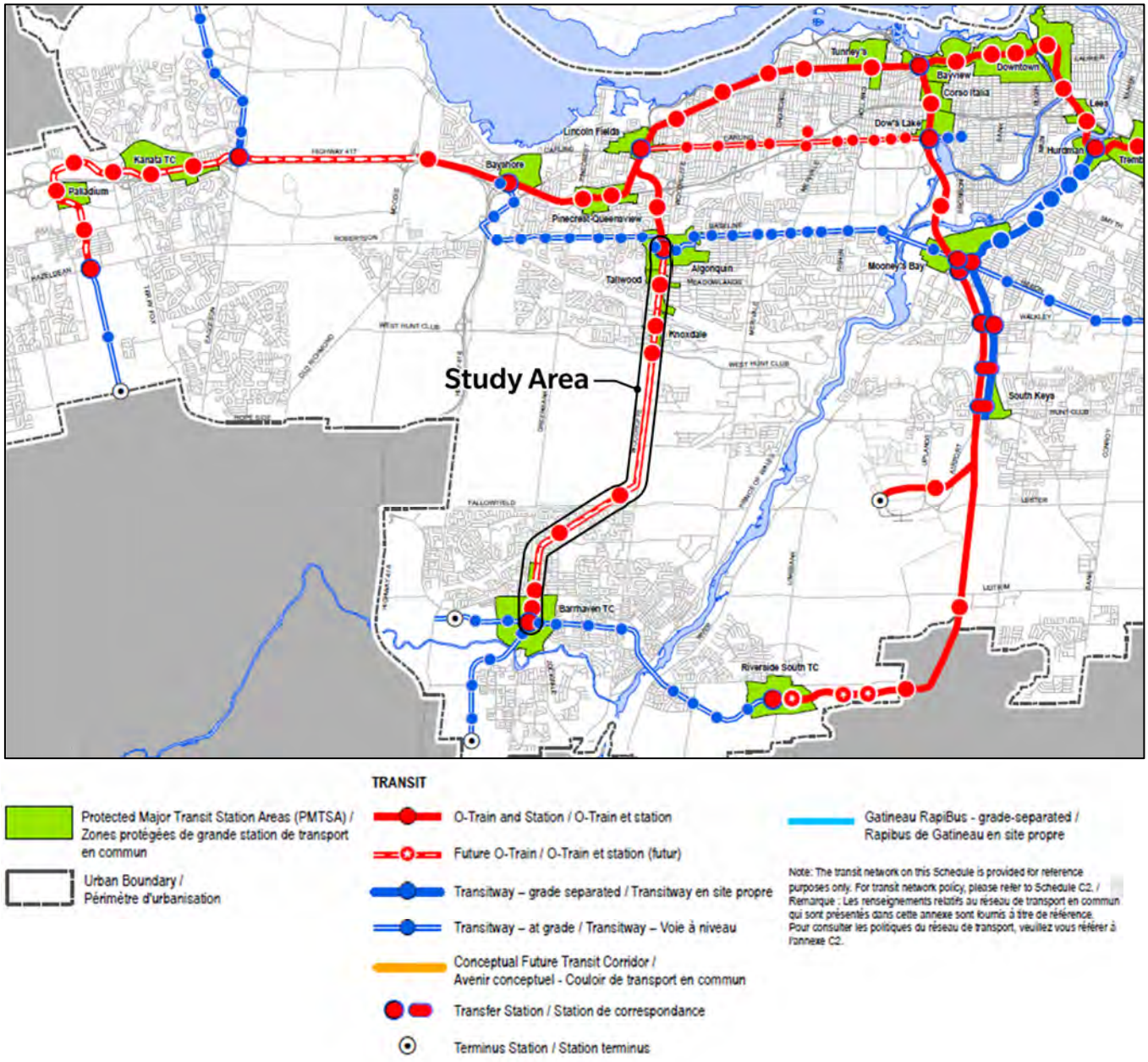


Figure 6-25 Excerpt from the 2022 Official Plan, Schedule C3 - Active Transportation Network, Urban Major Pathways

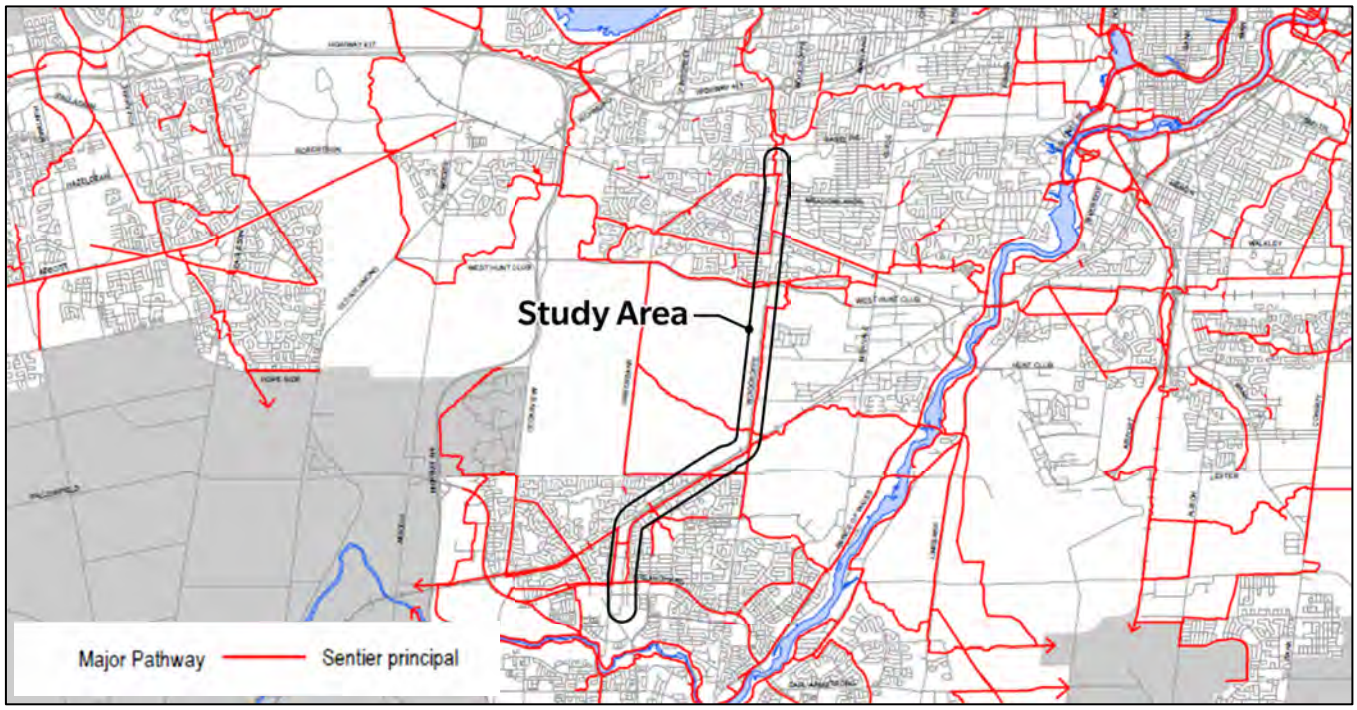
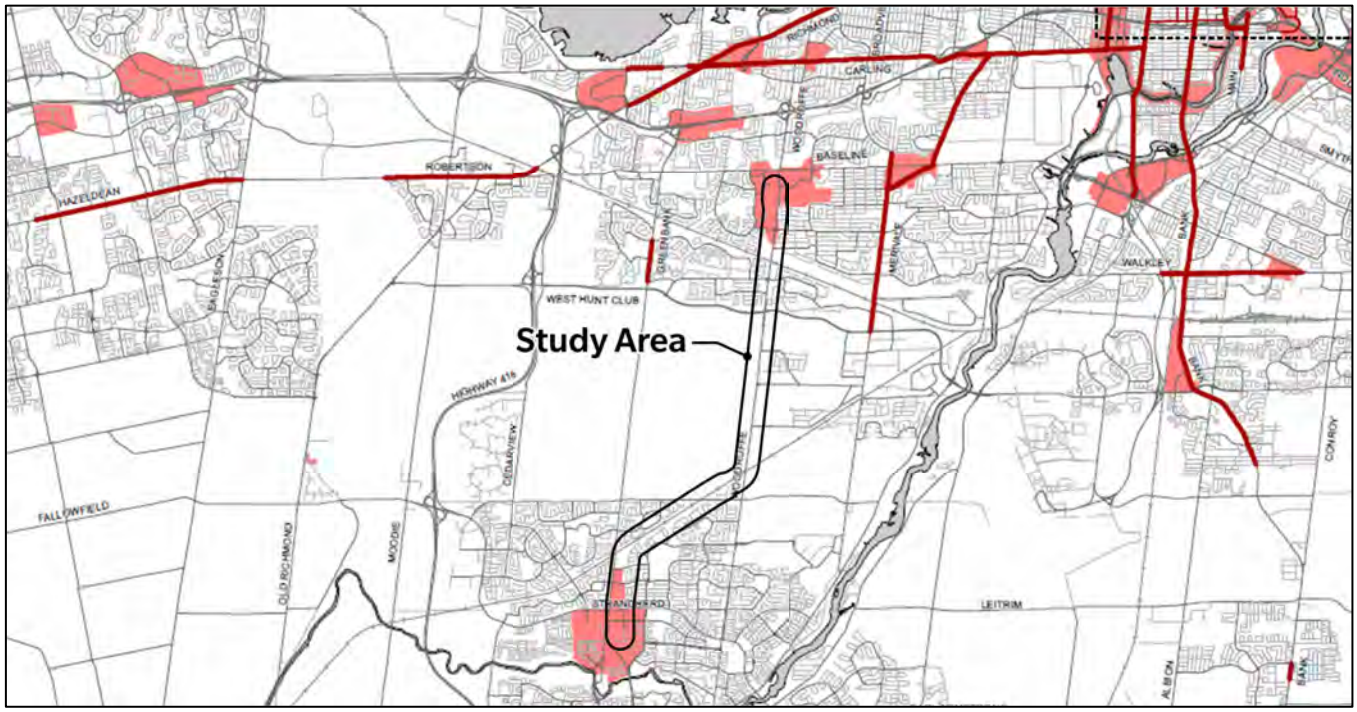
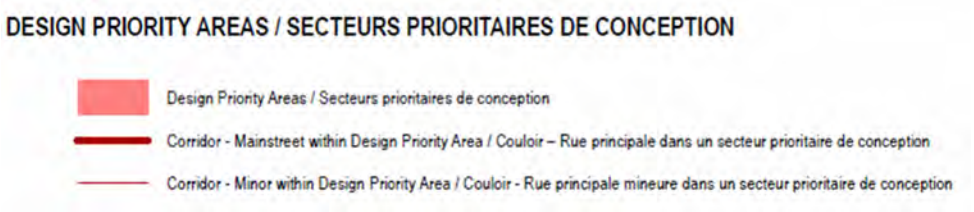


Figure 6-26 Excerpt from the 2022 Official Plan, Schedule C7-A Design Priority Areas - Urban





The City recognizes and protects its natural landscape by identifying natural heritage features and designating the most important features in the Natural Heritage System. These overlap with the connected greenspace network of natural and semi-natural areas, open spaces and parks and pathways. The natural heritage features include such features as significant woodlands, habitat for endangered and threatened species, significant wildlife habitat, areas of natural and scientific interest, surface water features including fish habitat and urban natural features that were inventoried as part of baseline conditions. Thes areas also contribute to improving resilience to the effects of climate change.

Figure 6-27 Excerpt from the 2022 Official Plan, Schedule C-11-A Natural Heritage System West

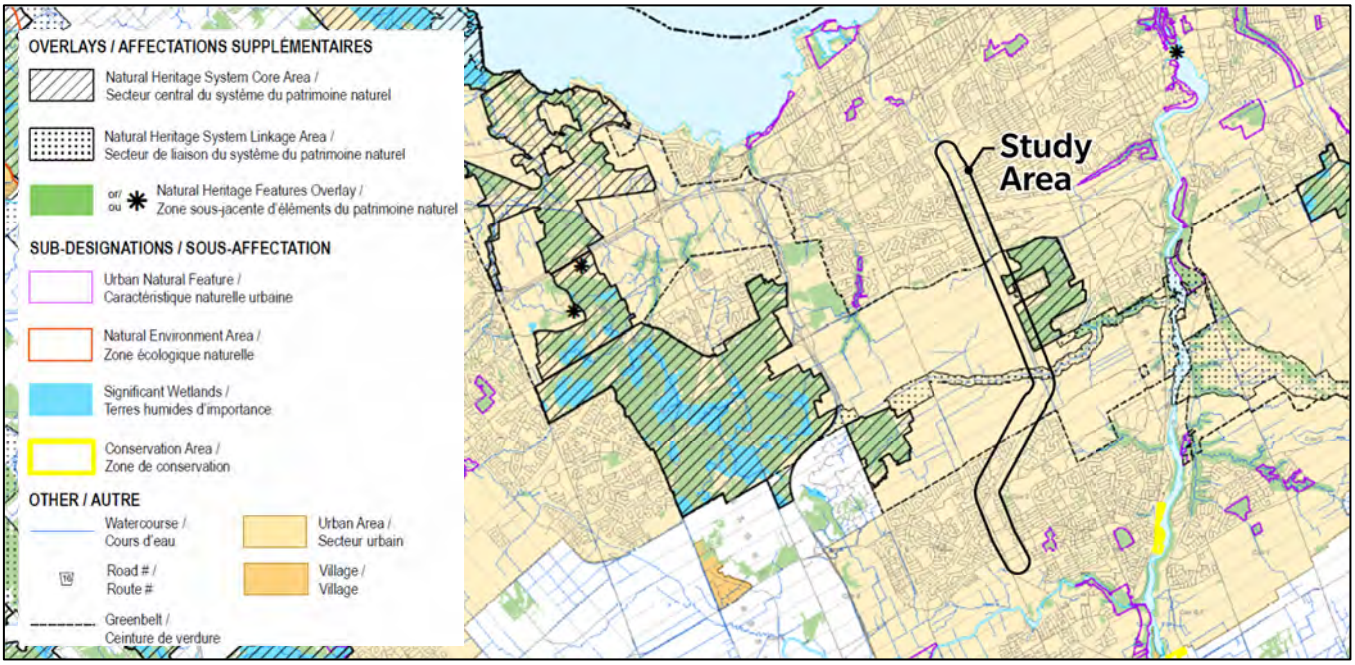


Figure 6-28 Excerpt from the 2022 Official Plan, Schedule C12 - Urban Greenspace

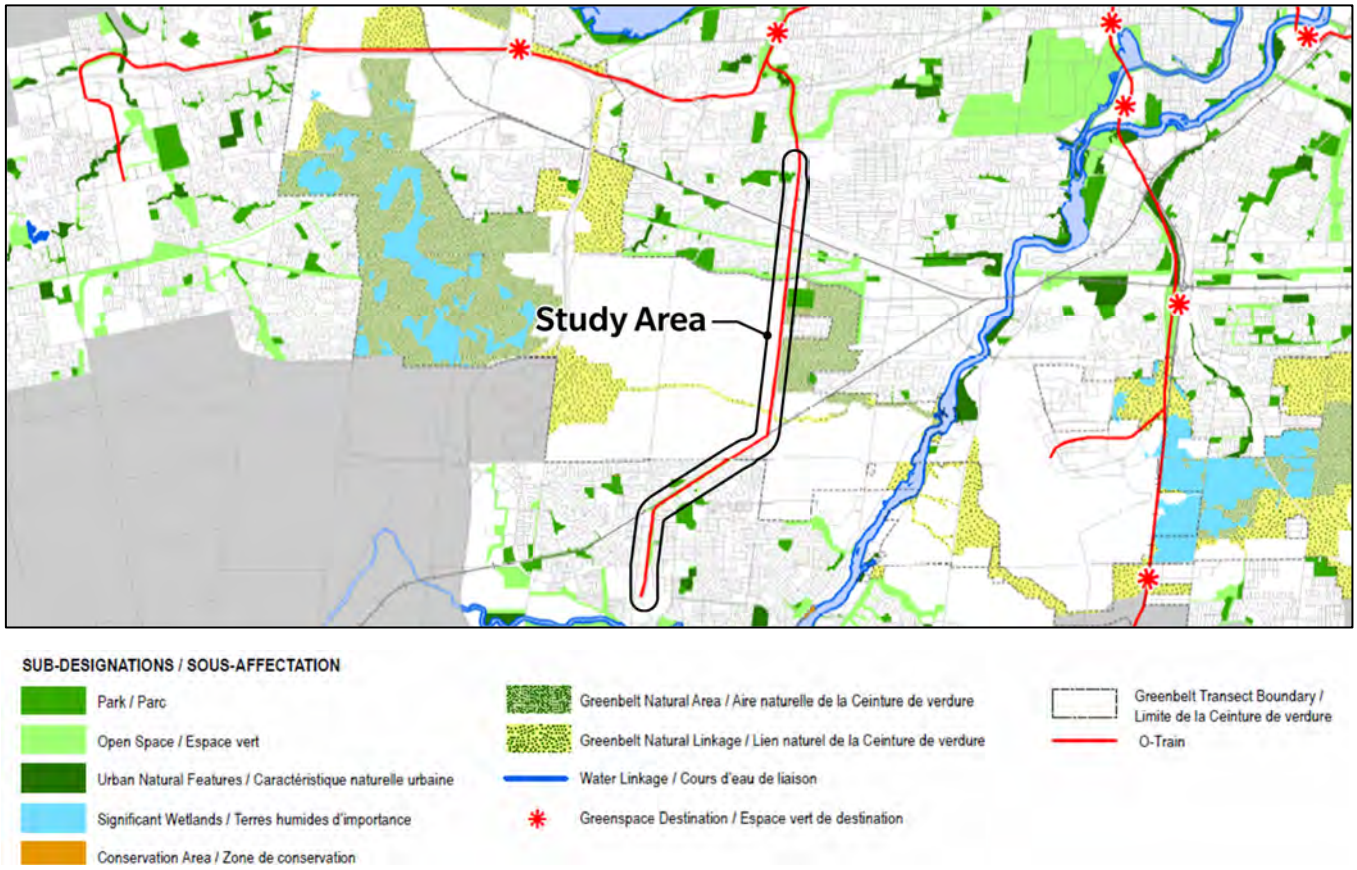
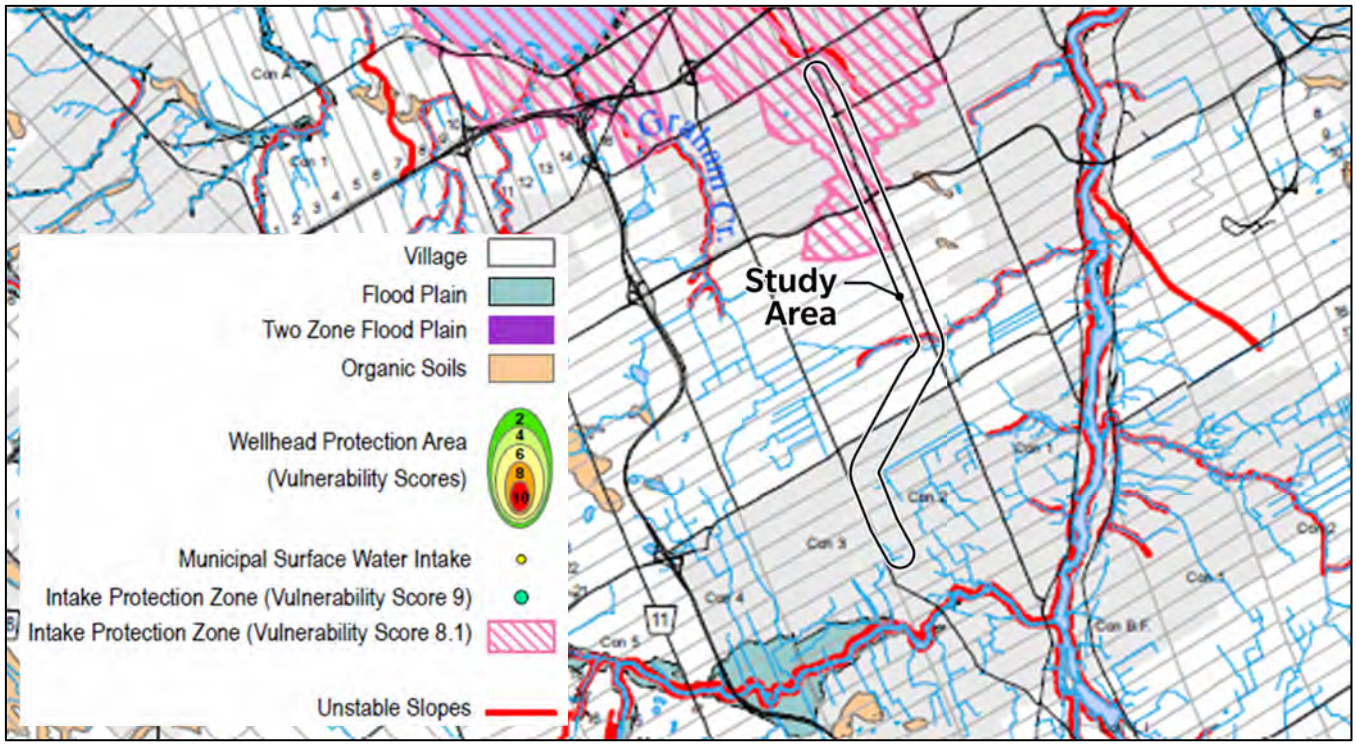


Figure 6-29 Except from the 2022 Official Plan, Schedule C15 - Environmental Constraints



6.8.1 NEW CITY OF OTTAWA TRANSPORTATION MASTER PLAN

The City of Ottawa commenced an update of its 2013 TMP in 2018. Due to a number of factors, including delayed launch of Stage 1 of the Confederation Line LRT and the 2020 Covid-19 Pandemic, the TMP update is still ongoing and will not be finalized until 2025, after completion of this study. Part 1 of the TMP update was approved by City Council on April 26, 2023 and includes the TMP policies, Active Transportation Projects and Networks and the Transit and Road Project Prioritization Framework. Part 2 of the TMP update, anticipated to be completed in 2025, will consist of the Capital Infrastructure Plan. Results from this study will inform Part 2 of the TMP with respect to prioritizing of projects. The updated TMP will encompass all modes of travel, whereas previously the Ottawa Cycling Plan and Ottawa Pedestrian Plan were supporting documents to the TMP.

The new TMP includes 69 policies to guide transportation decisions and priorities to 2046. The policies contribute to the City's vision of becoming North America's most liveable mid-sized city. They support the OP's goal that in 2046, the majority of trips in Ottawa will be made by walking, cycling, transit, or carpool. The TMP policies also consider and respond to the key drivers of change in the Ottawa mobility context.

Within Part 1 of the updated TMP, policies are organized into eleven themes. These themes are consistent with previous (2013) TMP directions with respect to providing direction to shape the City's transportation system but have been updated to incorporate guidance from City projects completed since 2013 as well as emerging trends in transportation system planning such as equity. Of the eleven themes, five present policies which cover multiple travel modes and subject areas ("Cross-cutting policies") detailed below:

1. Build a Sustainable and Resilient Transportation System shows how the TMP will respond to climate change and other environmental issues.
2. Create a Healthier and More Equitable Transportation System addresses issues of fairness in the City's planning for and operation of the transportation system.
3. Advance Regional Competitiveness discusses the links between transportation and economic development, with a particular focus on regional transportation.
4. Respond to Change describes the City's approach to managing new mobility options, leveraging data and technology, and establishing a nimble transportation system.
5. Use Transportation to Support the City We Want to Build focuses on land use and development, including addressing connections between the Official Plan and TMP Update.

In addition, there are six focused policy areas which address specific travel modes or subject areas as follows:

1. Maximize Walkability identifies the City's approach to expanding and improving its pedestrian network to create more supportive environments for walking, improve access to transit, and address pedestrian safety.
2. Develop a Great Cycling City discusses how the City will strengthen and expand its cycling network; encourage cycling as part of multimodal trips (such as using a bicycle to access the O-Train); expand and improve parking facilities for bicycles (including secure options); improve cyclist safety; and promote cycling.
3. Expand and Improve Transit City-Wide describes how the City will expand rapid transit and transit priority to improve transit connections within and between communities; increase the attractiveness of using transit; and enhance the customer experience.
4. Provide Safe, Multimodal Streets addresses the importance of complete streets that consider the needs of all road users and identifies how the road network can be made safer and more efficient.
5. Manage the Curb, Parking, and the Movement of Goods describes the ways that the City will proactively manage curbside space, parking, passenger drop-off, and goods movement to support City objectives.
6. Encourage Sustainable Travel Choices describes the tools that the City will use to manage travel demand and encourage residents to make more sustainable travel choices for a greater range of trips, including incentives, educational programs, and promotions.

The updated TMP policies continue to support the need and justification for the study. Policy Area 1 "Build a Sustainable and Resilient Transportation System" is reflected in the conversion from BRT to electric LRT. Policy Area 5 "Use Transportation to Support the City We Want to Build" is reflected in the use of high-capacity rapid transit in the Southwest

Transitway corridor and planned network integration with other rapid transit and transit priority corridors. Policy area 8 "Expand and Improve Transit City-Wide" supports continued investment in the City's LRT network and the further expansion to serve growing communities and major intensification areas such as Barrhaven Town Centre. The project also supports other policy areas through provision of new pedestrian and cycling connections, the provision of a Complete Street design for the reconstructed portion of Woodroffe Avenue as well as at other locations where the LRT will impact existing roadways.

Part 2 of the new TMP will address the development of a Capital Infrastructure Plan. This process will review and assess the existing transportation system and propose changes or updates to the City's road, rapid transit and transit priority networks. This study will form part of the inputs to this exercise, with the recommendations being used to help assess the Barrhaven LRT Extension and Rail Grade-Separations relative priority in relation to other infrastructure projects identified in the Capital Infrastructure Plan.

6.8.2 NEW CITY OF OTTAWA INFRASTRUCTURE MASTER PLAN

The City of Ottawa commenced an update of its 2013 IMP in 2019. Due to a number of factors, the IMP update is still ongoing however, is anticipated to be finalized by the end of 2023, after completion of this study. In early 2022, the Preliminary Policies and Program Recommendations for the IMP were shared with the public for comment.

The 2022 Preliminary Policies and Program Recommendations identifies twelve key policies established supporting the 2022 OP these are:

1. Level of Service
2. Public Service Areas
3. Capacity Planning
4. Greenfield Infrastructure Planning and Design
5. Master Servicing Studies
6. Intensification
7. Legal Stormwater Outlets
8. Riverine Flood Hazards
9. Groundwater Resource Protection
10. Low Impact Development
11. Monitoring, Modelling and Forecasting
12. Affordability and Financing

Cross-cutting policies of the IMP include:

- Climate Change;
- Sustainability;
- Extension of Services;
- Affordability; and
- Intensification.

The IMP states: *"the IMP's primary objective will be to ensure that the city's infrastructure, specifically regarding drinking water supply, wastewater collection, and stormwater management, can adequately and sustainably serve the population in both the present and future. This plan is specifically intended to maintain service levels in existing areas while also accommodating anticipated growth area through greenfield and infill development. Safety, affordability, and sustainability are the principles that guide the design and implementation of the IMP, ensuring that the city's water-related infrastructure services are delivered effectively, affordably and responsibly."*

While the Barrhaven LRT extension is a transportation and transit infrastructure project, there are still related elements of stormwater and piped infrastructure modifications, improvements and considerations that are tied into the projects' implementation. The Recommended Plan remains consistent with the updated IMP policies as it relates to stormwater management, modifications to existing infrastructure and future maintenance/end of service life for existing elements.

To address Policy 8 Riverine Flood Hazard, available 1:350yr riverine flood mapping was reviewed and the Recommended Plan does not encroach on these flood risk areas. Policy 9 Groundwater Resource Protection was incorporated through the mitigation measures and construction considerations as presented given the sensitive nature of the lands north of West Hunt Club Road to Baseline Station which are located within an IPZ-2 area as outlined in **Section 7.6.1**. Policy 10 Low Impact Development was incorporated into the Corridor Drainage and Stormwater Management approach as outlined in **Section 7.3**. Further, the stormwater approach does not recommend downsizing, additional stormwater management measures are recommended and the approach developed is consistent with MECP's runoff volume control criteria. Policies 5 and 12 Master Servicing Studies and Affordability and Financing are recognized in the recommendations to coordinate end of service life/upgrades to piped infrastructure with the timing of the construction of the Recommended Plan and described throughout **Section 7**.

6.9 Stakeholder Consultation

6.9.1 FOURTH ROUND OF CONSULTATION GROUP MEETINGS

The fourth round of consultation consisted of one meeting each of ACG, BCG and PCG. Feedback on the changes to functional design was requested during this round of consultation. Consultation groups, meeting dates and main agenda topics are presented in **Table 6-12**.

Table 6-12 Fourth Round of Consultation Group Meetings

Meeting and Date		Main Agenda Topics
ACG	August 16, 2022	Introduction, purpose of meeting, background, what has evolved since last meeting, Woodroffe new median LRT plan overview, current study scope, next steps and timelines and roundtable discussion.
BCG	August 18, 2022	
PCG	August 18, 2022	

These meetings were held virtually via MS Teams and included a presentation followed by discussion. The Study Team, including members from the City of Ottawa and the consultant team, were available to discuss the study and answer questions at each of the consultation group meetings. Input received at these meetings included discussion on the following topics:

- Clearances and potential impacts to Hydro One infrastructure were discussed;
- Impacts to traffic flow during construction and sightlines/safety and cross section design were discussed;
- Future OC Transpo service as well as operations during construction were discussed;
- Potential changes to property impacts within this segment from the median design were discussed;
- Landscaping strategy and maximizing/enhancing active transportation facilities and public realm nodes were discussed;
- Traffic-related concerns such as movements/congestion/cut through traffic and access during construction;
- Confirmation that an overhead walkway to access the Nepean Sportsplex remained as part of the design;
- Whether the new Nepean Sportsplex sign design was considered as part of the functional design;
- Future development/intensification in proximity to the elevated LRT guideway specifically allowable building heights;
- It was discussed whether post-COVID traffic studies have been undertaken/considered as part of the design; and
- Accessibility considerations, navigation of the corridor as well as safety.

The record of all comments received during this round of consultation are provided in **Appendix A.**

6.9.2 FIFTH ROUND OF CONSULTATION GROUP MEETINGS

The fifth round of consultation consisted of one meeting each of ACG, BCG and PCG and a POH. Feedback on the functional design for the new median LRT alignment and changes to the impact assessment were requested during this round of consultation. Consultation group, meeting date and main agenda topics are presented in **Table 6-13**.

Table 6-13 Fifth Round of Consultation Group Meetings

Meeting and Date		Main Agenda Topics
ACG	January 24, 2023	Background, what we've heard so far, detailed description of the Recommended Plan, constructability review, impact assessment, next steps and timelines and roundtable discussion. Narration of the plan and profile.
BCG	January 26, 2023	
PCG	January 26, 2023	
POH	February 8, 2023	

These meetings were held virtually via MS Teams and included a presentation followed by discussion. The Study Team, including members from the City of Ottawa and the consultant team, were available to discuss the study and answer questions at each of the consultation group meetings. Input received at these meetings included discussion on the following topics:

- Clearances and potential impacts to Hydro One infrastructure during construction were discussed;
- Passenger Pickup/dropoff (PPUDO) facilities in the corridor and discussion of their absence at Knoxdale Station;
- Traffic capacity concerns on detour routes and alternative travel routes during construction;
- Future OC Transpo service as well as congestion concerns with the removal of the bus lane south of Knoxdale;
- Noise concerns;
- Emphasis on landscaping opportunities wherever possible, particularly in the median and the benefits of greening to health, safety and climate change;
- Setbacks, property requirements and the interim control by-law effect on the property to the west of the Pinch Point
- Timing of the project and funding;
- Accessibility considerations, navigation of the corridor, incorporation of contemporary measures, rest areas as well as safety;
- Changes to local bus routes, transfers to/from LRT via local bus routes. As well as future bus lane and transit stop arrangements in the corridor; and
- Support for the shift in LRT alignment to avoid displacement of tenants on the properties west of Woodroffe Avenue.

The record of all comments received during this round of consultation are provided in **Appendix A.**

6.9.3 PUBLIC OPEN HOUSE #3

The Public Consultation Event was arranged as a live presentation with question-and-answer period as well as an online comment period of two weeks to provide feedback. Stakeholders were encouraged to provide feedback between February 8-22, 2023.

The consultation event included a series of display boards presenting the work completed to date focusing on:

- Introduction and Background
- Original Functional Design Overview: Baseline Station to Barrhaven Town Centre
- Recommended Plan: Knoxdale –Nepean Sportsplex
- Functional Design Refinements and What We've Heard So Far
- Recommended Plan: Elevated Median LRT Alignment
- Recommended Plan -Knoxdale Station
- Recommended Plan-Nepean Sportsplex Station
- Recommended Plan: Woodroffe Avenue Reconstruction
- Constructability Review
- Constructability Review –Potential Phasing
- Constructability Review –Transportation Impacts
- Constructability Review –Utilities

- Impact Assessment: Air Quality, Noise and Ground Vibrations
- Impact Assessment: Property Requirements, Privacy
- Impact Assessment: Land Use Designations, Development Applications, Zoning, Landscaping Strategy
- Study Process and Schedule
- Next Steps
- Background: Study Overview

Notification of the consultation period occurred through virtual and physical mediums. An email invitation was sent to the general project mailing list and members of the ACG, BCG and PCG on January 30, 2023. The study team also notified attendees present at each of the ACG, BCG and PCG meetings of the date, time, and virtual platform of the event and encouraged sharing of this information. Buckslips (3,484) were mailed to residents within and surrounding the pinch point corridor. Advertisements were placed in the Ottawa Citizen and LeDroit on January 25,2023 and February 4, 2020. Details regarding the consultation event were posted on the project website and social media platforms in advance of the event.

In January 2023, Indigenous Communities were contacted via emails to provide an update of the design change. No responses were received following that communication.

To assist with obtaining feedback on the materials presented, a comment-questionnaire was provided on the project website. Alternatively, emails could be submitted, or the City project manager could be contacted to arrange other means of providing feedback. A total of 48 responses to the comment-questionnaire and emails from 5 individuals were received. A number of key themes were repeated from the comments received from the consultation group meetings. Key themes received from this round of consultation included:

- Noise and vibration and privacy concerns through the Pinch Point
- Support for avoiding the displacement of residential homes west of the Pinch Point
- Support for and against the median elevated LRT alignment;
- Concerns related to operational challenges with the LRT system;
- Concerns related to cost of the LRT system;
- Requests for additional landscaping;
- Concerns for ease of connections for passengers transferring to/from local bus service at Knoxdale Station;
- Accessibility and inclusivity considerations;
- Support for reconstruction of Woodroffe Avenue including active transportation connections;
- Support for maintaining local road connection to/from Woodroffe Avenue during construction;
- Concerns for property value loss in the Pinch Point and
- Requests for the design to include providing affordable housing adjacent to Beechcliffe Street/Knoxdale Station.

The record of all comments received during this round of consultation are provided in **Appendix A.**

6.10 Transportation Committee and Council Meetings and Direction April/May 2023

Following consultation and refinement of the median elevated LRT alignment, the Recommended Plan was presented for approval to the City of Ottawa Transportation Committee on April 27, 2023 and to Council on May 10, 2023. The staff report and supporting documents were posted on the City's website prior to the meetings with the recommendation that the Transportation Committee recommend that Council:

1. Receive for information the revised functional design for the Barrhaven LRT Environmental Assessment Study between Knoxdale Road and West Hunt Club Road and the associated consultation outcome as described in this report and supporting documents; and
2. Direct staff to re-initiate the Transit Project Assessment Process (TPAP) in accordance with Regulation 231/08 of the Ontario Environmental Assessment Act, including the preparation and filing of the Environmental Project Report for final public review and comment.

One delegation was made at Transportation Committee. The resident from Manor Village and member of ACORN spoke to support for the project and the need for City Staff to consider a renoviction By-Law. The project was approved with one dissention.

At the full Council meeting, the project was approved with one dissention.

The staff report, supporting documents and voting record are provided in **Appendix A.**

7 Recommended Plan and Assessment

This section of the EPR describes the Recommended Plan for the Barrhaven LRT and Rail Grade-Separations project, which encompasses all elements required to support design, construction and operation of the extension of the Confederation Line southwest from Baseline (renamed to Algonquin Station as part of the Stage 2 LRT project) Station to Barrhaven Centre Station. This includes the required reconstruction of Woodroffe Avenue to accommodate the median LRT guideway through the Pinch Point as well as the rail grade-separations of the existing Woodroffe Avenue, Southwest Transitway and Fallowfield Road crossings of the VIA Rail Smiths Falls Subdivision in the vicinity of Fallowfield Station. An impact assessment follows the description of the Recommended Plan including recommended mitigation and monitoring measures.

In accordance with Section 9.2 (2) of the Transit and Rail Project Assessment Process regulation (O. Reg. 231/08), the project elements described in this section are considered to be the final description of the Recommended Plan, to the functional design level. Methods of implementation, including the preferred method, are described. **Section 8** provides alignment and general arrangement drawings, renderings and other supporting material for the final description of the Recommended Plan.

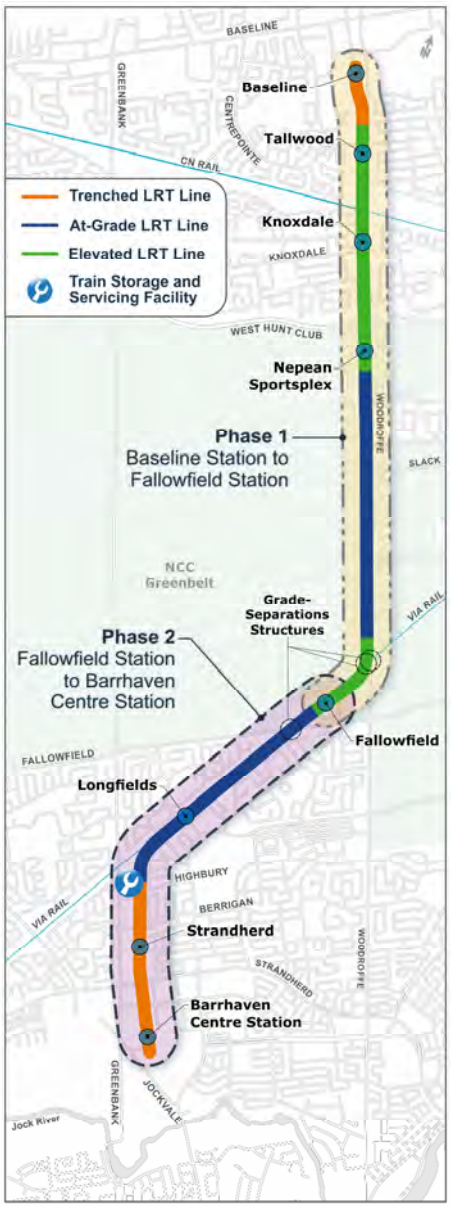
Upon MECP approval and subject to project funding, the functional design will be refined through the next stages of design. The preliminary and detailed design will align with the footprint, study corridor and impact assessment detailed for the functional design. The Transit Project that is to be implemented and exempted from Part II of the *Environmental Assessment Act* will be consistent with the description of the Transit Project presented herein.

Should any changes be made in subsequent design phases after completion of the Transit and Rail Project Assessment Process that are inconsistent with this final description and change any potential impacts of the project, the proponent will be subject to the addendum process and subject to MECP approval. The proponent will, as per the regulation, be required to complete either an addendum, or a revised Environmental Project Report. This process is described in full detail in **Section 9.8**.

7.1 Recommended Plan Overview

Development of the Recommended Plan was based on the preferred design alternatives identified in **Section 6** of this EPR and consists of the major elements outlined below. **Figure 7-1** illustrates the planned alignment and station locations.

Figure 7-1 Recommended Plan Overview



Most of the proposed LRT corridor has been defined, protected and constructed as a Bus Rapid Transit (BRT) corridor through previous studies from the mid-1990s. The total length of the project is 10km. Approximately 7.6km of the proposed project represents a conversion of an existing rapid transit corridor from bus to light rail technology. The remaining 2.4km represents a new alignment, along which approximately 1.6km of Right-of-Way has been protected for rapid transit through the 1997 EA Study. Key elements of the project include:

- 10km of twin-track, fully segregated electric LRT, of which:
  - 2.4km consists of new alignment on an elevated structure within the Woodroffe Avenue corridor between Baseline Station and Nepean Sportsplex; and
  - 7.6km consists of converted alignment along the existing Southwest Transitway between Nepean Sportsplex and Barrhaven Town Centre, including 1.7km of below-grade open trench at the southern end of the alignment.
- Seven LRT stations:
  - Three new stations – Tallwood, Knoxdale and Nepean Sportsplex Stations;

  - Conversion of four existing BRT stations to LRT – Fallowfield, Longfields, Strandherd and Barrhaven Centre Stations.
- Improved and new facilities for pedestrians and cyclists along the corridor, including a pedestrian bridge over Woodroffe Avenue at Nepean Sportsplex Station;
- Reconstruction of Woodroffe Avenue from north of Knoxdale to the southern Nepean Sportsplex intersection including modification to five intersections (Knoxdale, Majestic, West Hunt Club, Sportsplex North, Sportsplex South) conforming to the City's Protected Intersections Design Guidelines (2021);
  - Inclusion of uni-directional cycle tracks on both sides of Woodroffe Avenue between Knoxdale Avenue and West Hunt Club Road; and
  - Corridor Landscaping.
- Three new grade-separation structures (overpasses) over the VIA Rail Smiths Falls Subdivision (currently at-grade crossing at Woodroffe Avenue), the Southwest Transitway and Fallowfield Road;
- Three new underpasses for the LRT line crossing beneath Berrigan Drive, Marketplace Avenue and Chapman Mills Drive;
- A TSSF located on City-owned land (1005 and 1045 Greenbank Road) bounded by Greenbank Road, the Southwest Transitway, the VIA Rail corridor and Highbury Park Drive; and,
- A new off-street bus terminal and 250 space Park and Ride facility at Barrhaven Centre Station.

7.2 Recommended Design

This section provides a more detailed description of the project elements, including alignment, stations, structures, and multimodal connections. Functional design drawings (plates) illustrating the horizontal and vertical alignment, stations, and ancillary facilities and property necessary to support the project are included in **Section 8**.

The proposed LRT corridor, station locations, and TSSF are broadly illustrated in **Figure 7-1**. The Recommended Plan has been advanced to a functional level of design, which permits identification of infrastructure footprint, property requirements, project impacts, and cost estimates which can be evaluated as part of the assessment of effects, with appropriate mitigation measures developed where necessary.

7.2.1 LRT ALIGNMENT AND STATIONS

7.2.1.1 Baseline (Algonquin) Station to Tallwood Station

Baseline (Algonquin) Station will be the terminus of the Stage 2 LRT project, with revenue service expected to commence in the later part of 2025. The Barrhaven LRT extension will start at the south end of Baseline Station, run in a below-grade open trench south of College Avenue and south through the future bus terminal area, which has been designed to accommodate future LRT extension. A connecting bus-only roadway along the south side of the future bus terminal will need to be relocated and shifted slightly north to accommodate the LRT extension and provide sufficient vertical clearance as the LRT alignment exits the Baseline Station area.

Immediately south of the station area, the LRT alignment will curve to the east to run parallel to Woodroffe Avenue and begin to climb out of the open trench and onto an elevated guideway before crossing over Tallwood Avenue and entering Tallwood Station.

7.2.1.2 Tallwood Station

Tallwood Station, located approximately 600m south of Baseline Station, will be an elevated station located on the southwest corner of the Woodroffe/Tallwood/Meadowlands intersection, with the station entrance and platforms located south of Tallwood Avenue. A station entrance building will provide access from street level, with stairs, escalators and elevators provided to connect to the elevated LRT station platforms. A small public plaza outside the ground-level station entrance will accommodate elements such as hardscaping, landscaping, benches, public art, and bicycle parking. Connections to local bus routes will be made via on-street stops.

Passenger pick-up and drop-off activity will be accommodated on-street, likely on Tallwood Avenue. Opportunities to provide an off-street facility integrated with the adjacent City of Ottawa Central Archives (James K. Bartleman Centre) may be further explored during future design phases. The impact of construction on traffic and circulation on the Archives facility will need to be addressed with the operators of the facility based on operational concerns raised during consultation.

Figure 7-2 illustrates the proposed design concept for Tallwood Station. Future design work will confirm station-specific requirements.

Figure 7-2 Artistic Rendering of Proposed Tallwood Station Looking Southwest

South of Tallwood Station, the LRT alignment remains elevated along the west side of Woodroffe Avenue, in the corridor previously identified and protected for rapid transit. The elevated alignment provides opportunities for a parallel MUP to be integrated into the corridor and has a reduced impact on Tallwood Woods as compared to the 1997 Southwest Transitway EA recommended plan. A Landscaping and Open Space Programming strategy has been developed to provide high level concepts and direction for future design phases of the project to consider the proposed elevated LRT alignment and structure and ways the space around and under the elevated guideway and can be purposed for community uses (Section 7.4).

7.2.1.3 Knoxdale Station

Knoxdale Station will be located approximately 750m south of Tallwood Station, on the northwest corner of the Woodroffe/Knoxdale/Medhurst intersection. The station alignment will be rotated slightly to angle towards Woodroffe Avenue to assist in reducing the angle of curvature needed to transition the LRT alignment into the median of Woodroffe Avenue while providing sufficient tangent length and constant gradient needed through the station area. The station entrance and platforms will be located north of Knoxdale Avenue. A station entrance building will provide access from street level, with stairs, escalators and elevators provided to connect to the elevated LRT station platforms. A public plaza will be created at the station entrance, extending to the adjacent Woodroffe Avenue/Knoxdale Road intersection and will provide opportunities for landscaping and public art. Bicycle parking will be integrated with the station entrance area complete with separate pedestrian and cycling routes to minimize conflicts in the station entrance zone. New pathway

connections to the residential community fronting onto Beechcliffe Street are proposed with further detail to be established during the detail design phase of the project. Connections to local bus routes will be via on-street curbside stops in the vicinity of the station.

Passenger pick-up and drop-off activity will be accommodated on-street, with short-term parking spaces designated in the vicinity of the station. Additional traffic measures including signage and physical measures will be considered during future design phases to address stakeholder concerns for spillover parking and neighbourhood traffic impacts.

Figure 7-3 Artistic Rendering of Proposed Knoxdale Station Looking Southeast

South from Knoxdale Station, the LRT alignment runs within the Woodroffe Avenue Right-of-Way for approximately 500m between Knoxdale Road and just north of West Hunt Club Road. The transition of the LRT alignment from the west side to the median of Woodroffe Avenue occurs immediately south of Knoxdale Road. The transition of the LRT alignment back to the west side of Woodroffe Avenue occurs north of West Hunt Club Road.

At West Hunt Club Road, the elevated LRT alignment remains on the west side of Woodroffe Avenue. A 20m wide Right-of-Way is required from the NCC-owned land to implement the LRT facility on the south side of West Hunt Club between West Hunt Club Road and the existing access road serving the NCC Greenbelt lands.

Modifications to Woodroffe Avenue

From approximately 200m north of the Knoxdale/Medhurst intersection to the Nepean Sportsplex south entrance, Woodroffe Avenue will require reconstruction to accommodate the elevated LRT alignment within the median. The functional design for roadway reconstruction reflects a reduction in total traffic lanes (from six to four) through this segment by reallocating the existing transit-only lanes to a wider median needed to support the elevated LRT. The roadway functional design also reflects current best practices and City design standards for Complete Streets (2015), with wider sidewalks and separated cycling facilities (cycle tracks). The reconstruction includes five protected signalized intersections (Knoxdale, Majestic, West Hunt Club, Sportsplex North, Sportsplex South) with Smart-channels for right-turns at some locations and a wide median to provide road safety barriers around piers.

7.2.1.4 Nepean Sportsplex Station

Nepean Sportsplex Station is located approximately 1km south of Knoxdale Station, on the west side of Woodroffe Avenue, just south of the main access road to the Nepean Sportsplex and NCC Greenbelt lands. The station will incorporate an enclosed pedestrian bridge allowing for safe passage over Woodroffe Avenue, connected by elevators and stairs on the west (station) side and stairs and ramps on the east (Sportsplex) side. Pedestrian and cycling connections will tie into the Station from the north and south. The NCC MUP from the south on east side and the City MUP from north on west side will tie into the protected intersections. Connections to local bus routes remaining on Woodroffe Avenue will be on-street.

South of the station, the LRT alignment will return to at-grade and run along the existing Southwest Transitway alignment, which will be converted from BRT to LRT. At the VIA Rail Smiths Falls Subdivision, a new overpass (LRT over rail) will be constructed. The overpass structure will be compatible with construction as either a BRT or LRT facility to allow flexibility in project phasing and implementation.

Figure 7-4 Artistic rendering of proposed Nepean Sportsplex Station Looking Southwest

7.2.1.5 Fallowfield Station

Fallowfield Station is located approximately 3.3km south of Nepean Sportsplex Station, southwest of the new grade-separation structures over the VIA Rail tracks. This station will support integration of multiple modes and will provide access to local transit, rapid transit, and inter-city travel.

After crossing over the VIA Rail tracks, the LRT alignment and station will remain elevated to allow for and maintain access to the existing VIA Rail Fallowfield Station, immediately to the north of the LRT. Although currently planned as two separate station facilities, as VIA Rail develops plans for its High Frequency Rail (HFR) project, the opportunity to develop a single, integrated station facility serving both VIA Rail and OC Transpo could be considered.

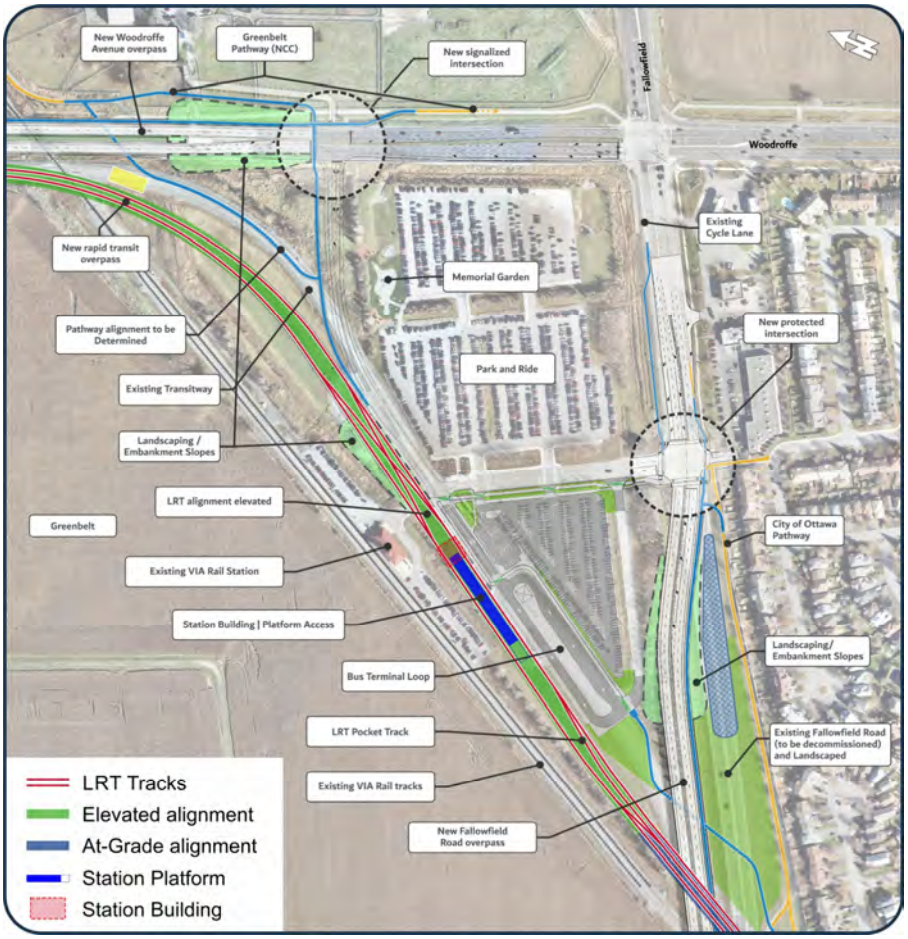
The LRT station will be integrated with the existing Park and Ride facility and designed to minimize impacts to the existing number of spaces. A new bus terminal will be constructed at ground level adjacent to the LRT station, with direct connections between the two facilities within a fare paid zone. A bus lay-up and operator facility will be provided.

A formal passenger pick-up and drop-off facility (PPUDO) will be provided close to the station entrance, adjacent to the bus terminal area.

A new signalized intersection on Woodroffe Avenue will provide a new entrance to the station and Park and Ride facility, which will ease pressure/congestion at the existing Fallowfield/Park and Ride access. It will also enable a safe crossing for pedestrians and cyclists, provide pathways on the east side of Woodroffe Avenue and support more direct access to the station for local bus routes on Woodroffe Avenue as well as rail replacement bus services, when required.

New or improved pathway connections will be provided to the station, including direct links from communities on the south side of Fallowfield Road and connections to an existing NCC Greenbelt pathway, which extends east from Woodroffe Avenue. Within the immediate station area, separate pedestrian and cycling facilities will be provided to improve safety by reducing conflicts between the pathway users.

Figure 7-5 Plan View of the Proposed Fallowfield Station



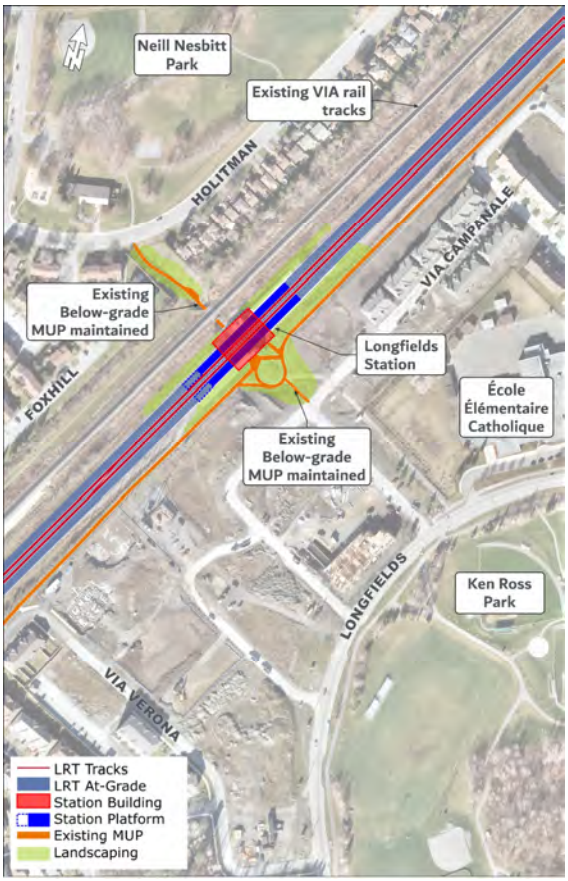
Southwest of Fallowfield Station, the elevated LRT alignment will transition back to at-grade to follow the existing BRT corridor while crossing under the new Fallowfield Road overpass which will span both the LRT and VIA Rail corridors. A pocket track will be provided in this area to support LRT operations by allowing for temporary train storage and reversing of trains at Fallowfield Station as an intermediate turnback point.

Southwest of Fallowfield Road, the alignment will continue at-grade along the existing BRT corridor which will be converted to LRT.

7.2.1.6 Longfields Station

Longfields Station is located approximately 1.7km southwest of Fallowfield Station and is an existing BRT station which will be converted to LRT station as part of this project. It remains a side platform configuration to make use of existing station's stairs and elevators. The lower level of the station will need to be enlarged to accommodate space for ticket vending machines, additional vertical circulation (e.g., redundant elevators), fare gates and service rooms. The existing MUP, which runs through the lower level of the station and provides connections from both the north and south sides of the rapid transit/VIA Rail corridor, will be maintained. Informal curbside passenger pick-up and drop-off activity will occur on adjacent streets. Additional traffic measures, including signage and physical measures will be considered during future design phases to address potential parking spill-over.

Figure 7-6 Plan View of the Proposed Longfields Station



Southwest from Longfields Station, the LRT alignment will continue within the existing transitway corridor. At a point east of Greenbank Road, the alignment will curve to the south, continuing to follow the existing transitway corridor.

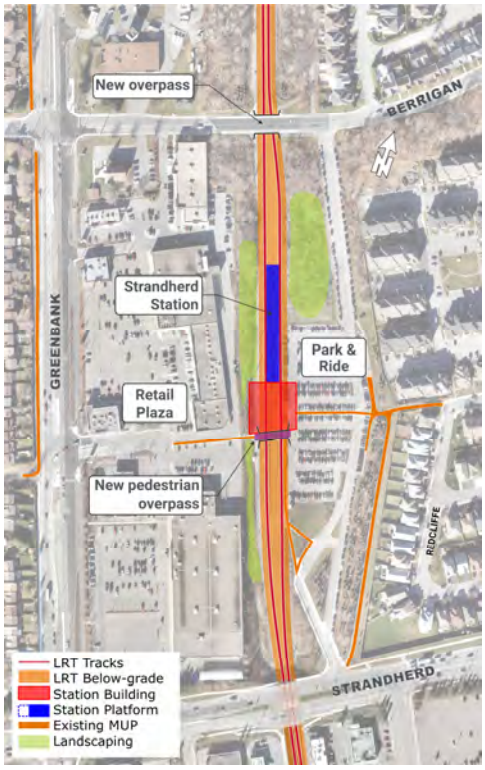
On the west side of the corridor, on lands bounded by Highbury Park Drive, Greenbank Road, the VIA Rail corridor and existing Southwest Transitway/future Barrhaven LRT corridor, a Train Storage and a Servicing Facility (TSSF) will be constructed to support LRT operations along the Barrhaven LRT extension.

South of the existing Highbury Park Drive underpass, the existing at-grade transitway corridor will be modified as part of the conversion to LRT to become a below-grade open trench. This will permit grade-separation at Berrigan Drive, with the LRT passing under the roadway before entering Strandherd Station.

7.2.1.7 Strandherd Station

Strandherd Station is located approximately 1.3km south and west of Longfields Station and is an existing BRT station which will be converted to LRT as part of this project. The below-grade open trench alignment will continue through the station area to match up with the existing underpass at Strandherd Drive, 250m south of the station. A centre platform configuration is proposed at this station, with vertical circulation (stairs, escalators, and elevators) providing platform access from a station house located at-grade and on a structure spanning over the tracks. This structure would also serve as a through link for pedestrian and cycling movement over the LRT, replacing the existing at-grade pedestrian crossing of the Transitway.

Figure 7-7 Plan View of Proposed Strandherd Station

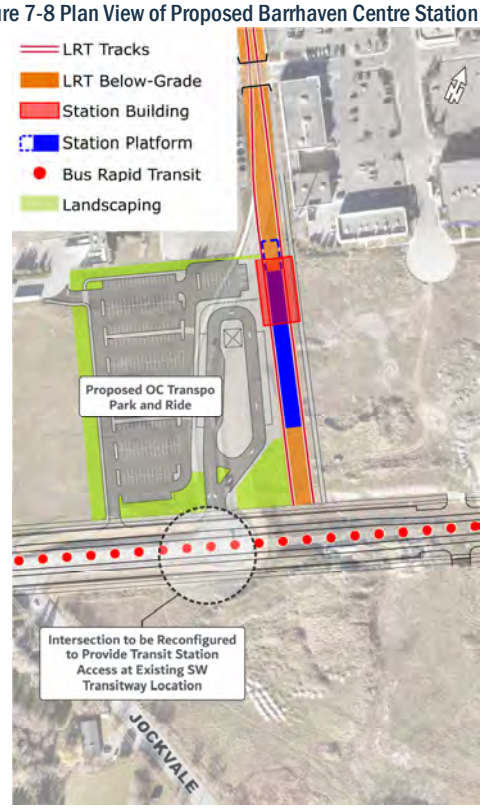


The existing Park and Ride lot, including the PPUDO facility will be integrated into the station, with only minor modifications needed to improve access for all modes. South of Strandherd Station, the LRT alignment will remain in a below-grade open trench, crossing under Strandherd Drive via the existing transitway underpass. The open trench will be extended further south to cross under Marketplace Avenue and through the existing Marketplace Station, which will be decommissioned as part of this project and replaced with a relocated and expanded Barrhaven Centre Station. The LRT will pass under the existing internal access road located approximately 100m south of Marketplace Avenue and proceed south into the proposed terminus at Barrhaven Centre Station.

7.2.1.8 Barrhaven Centre Station

Barrhaven Centre Station is located approximately 800m south from Strandherd Station and will be a below-grade station located in the general area of the existing Barrhaven Centre transitway Station. As part of the conversion from BRT to LRT, the rapid transit alignment will diverge from the existing transitway at a point approximately 200m south of Marketplace Avenue and continue in a straight alignment towards Chapman Mills Drive to provide sufficient tangent length for the LRT platforms and "run-off" length beyond. The station incorporates a new off-street bus terminal located west of the LRT alignment and station platforms on lands currently occupied by the transitway, with direct connections between bus and rail modes accommodated within a fare paid zone. This layout supports efficient transfers between future LRT, BRT and local bus routes within a single fare-paid area, providing for a better customer experience.

Figure 7-8 Plan View of Proposed Barrhaven Centre Station



The bus terminal will be accessed from a new signalized intersection on Chapman Mills Drive, located where the existing Southwest Transitway meets Chapman Mills Drive. The proposed layout supports the ability for buses terminating at this station to lay-up between runs and also provides space to support bus staging before and during peak hours, critical to supporting bus transit operations. The Study Team examined the ability to have all buses serving Barrhaven Centre Station use the future Chapman Mills median BRT, however this is not a feasible solution based on the following:

- There are existing bus routes that terminate at Barrhaven Centre station, which will continue to need a bus loop facility in this vicinity;
- The existing planned median bus platforms on Chapman Mills would likely not be capable of supporting the volume of buses and passengers anticipated, requiring longer/wider bus platforms and possibly bus by-pass lanes (i.e., a four-lane median Transitway through the station area);
- All bus services originating from the west and south of the station would need to run through the station and terminate elsewhere, incurring potentially significant operational cost for OC Transpo given it is expected most customers will be transferring to LRT or be destined to the Barrhaven Centre retail area. Similarly, all bus services originating from the north and east would also need to find an alternate location to terminate. There would be no ability to stage buses during peak periods;

- On-street bus platforms would require customers to cross a public roadway to transfer between buses and LRT, negating the ability to have transfers occur within a fare-paid zone and introducing passenger safety issues;
- In examining the ability to provide for a fare-paid zone between median bus stops on Chapman Mills Drive and the LRT platforms by adding vertical circulation elements to the median bus stops, the following issues were noted:
  - Lowering the LRT to provide a mezzanine (intermediate) level underground to allow for transition between a centre-platform LRT and side-platform BRT station areas would be required, or alternatively;
  - Two sets of stairs and four elevators on each BRT platform would be required to provide redundant access. A change to a side platform configuration for the LRT station would also be required, which is not efficient for a terminal station operation; and,
  - Both alternatives would increase the complexity and cost of Barrhaven Centre Station.
- In the shorter term, before LRT is built but after Chapman Mills Drive is extended between Longfields Drive and Greenbank Road, the existing Barrhaven Centre bus loop will be impacted by the extension of Chapman Mills Drive. Facility relocation would be required so that transit routes which terminate at this location can lay-up and turnaround to support efficient transit operations. Locating this facility on the north side of Chapman Mills is preferable and supports a phased approach to the future development of Barrhaven Centre Station by making use of the existing Southwest Transitway connection to Chapman Mills Drive;
- There is potential to examine alternative configurations for the bus terminal (e.g., stacking it over the LRT platforms) during detailed design, including the ability to have the LRT station and bus terminal integrated into future development, including the proposed Civic Building. The bus terminal location allows for development frontage along Chapman Mills Drive, potentially spanning over the future LRT trench to provide a continuous street frontage.

A new Park and Ride lot (250 spaces) is proposed with this station, initially on lands identified west of the existing Southwest Transitway. Ultimately, this facility may be integrated with a proposed Civic Complex to be located in the Town Centre area and incorporating the future Barrhaven Centre LRT Station. Configuration of the Civic Complex can be modified as part of negotiation with the affected landowner to provide development frontage along Chapman Mills Drive, if desired. The design for this facility will be undertaken in coordination with the adjacent landowner and the City's planning department regarding the potential for a future development block facing onto Chapman Mills Boulevard, while maintaining the requirement for 250 parking spaces. This document provides a conceptual layout for the purposes of determining impacts and property requirements. This EA provides the flexibility to modify the design for the Park and Ride including driveway location or road access, aisle arrangement or number of parking spaces without the need for an addendum. Further, the Park & Ride Lot could be removed from the plan/project at a later date by the City based on future circumstances, also without the need for an addendum to this EA. The Park and Ride lot will be designed to support phased implementation of rapid transit network in this area and potential implementation prior to the LRT project in the following sequence:

1. Existing BRT station (Southwest Transitway);
2. Implementation of Chapman Mills BRT, with reconfiguration of Barrhaven Centre Station to support increased bus operations; and,
3. Implementation of the Barrhaven LRT Extension.

7.2.2 SPECIAL TRACKWORK

Special trackwork is required along the LRT alignment to support reliable train operations during regular revenue service and reduced operating conditions. Special trackwork facilities and locations were determined based on conceptual LRT operational requirements and will be further refined during detailed design phase of the project. Initial special trackwork facilities identified include:

- Crossover tracks located south of Nepean Sportsplex Station to support single track working at reduced train frequencies;
- Crossover tracks located immediately north of Fallowfield Station to allow this station to operate as a temporary terminus or intermediate turnback point and/or support single track working at reduced train frequencies;
- A pocket track located south of Fallowfield Station to allow temporary storage of one train for operational flexibility;

- Crossover tracks located north and south of the proposed TSSF to allow trains to enter/exit the facility from either direction; and
- Crossover tracks located immediately north of Barrhaven Centre Station to support terminal operations.

7.2.3 TRACTION POWER SUBSTATIONS

A dedicated electrical supply is required to provide power to the trains that will run along the line, as well as for the operation of station facilities, communications and safety equipment and lighting. The connections between the Hydro Ottawa power distribution grid and the LRT system occur at regularly spaced electrical substations. Traction Power Substations (TPSS). These substations house the electrical machinery (transformer/rectifiers, switches, and circuit panels) needed to convert high voltage AC power supplies from the main electrical grid to support operation of the LRT system. TPSS are housed in single story buildings sized approximately 60m^2 and require service vehicle access. Substations will be provided at-grade and must be located close to the LRT line.

To meet power requirements, multiple TPSS are required along the line to distribute power in an efficient manner. The Confederation Line uses 1500 V DC power to power the trains. A maximum spacing of 1.5km to 2.0 km between electric substations is estimated. Based on the Recommended Plan, seven (7) TPSS are likely to be required, with locations identified as follows:

- Knoxdale Station;
- Pineland Avenue (approximate);
- North of Fallowfield Station;
- Oriska Way;
- Highbury Park Drive (approximate);
- Train Storage and Servicing Facility (dedicated TPSS for facility operations); and,
- Barrhaven Centre Station.

The final location and configuration of TPSS will be determined during subsequent phases of design and in collaboration with staff from Hydro Ottawa. Wherever possible, the co-location of substations with station facilities will be pursued. A technical memo providing further detail on TPSS is provided in **Appendix B**.

7.2.4 LIFE SAFETY

Provision of life safety features and systems will be governed predominately by standards developed through implementation of Stages 1 and 2 of Ottawa's LRT network, which reflect those developed by the National Fire Protection Association (NFPA, 2023). This includes fire detection and voice alarm systems, smoke control and ventilation systems, communications systems, firefighting equipment and fire-fighting facilities, emergency lighting, and construction materials. NFPA 130: Standard for Fixed Guideway Transit and Passenger Rail Systems (NFPA 130, 2023) provides fire and life safety requirements for passenger railway stations and guideways. Detailed requirements of these systems will be investigated at the preliminary design stage of the project. An overview of the major elements to be provided is detailed below.

7.2.4.1 Emergency Access and Egress

Each LRT station will have two separate and independent means of egress from the platform to street level to permit evacuation of passengers during emergency events. These may be configured as regular access routes or emergency-only routes.

A walkway will be provided along the LRT alignment to allow for passenger egress along the line in the event of an emergency. This walkway will also allow maintenance workers to access the corridor without obstructing normal LRT operations. The ballast serves as the walkway away from structures along at-grade running way segments, while in stations and other structures, the walkway surface will be of a uniform, slip resistant design and constructed of non-combustible materials.

Intermediate access points will be provided along the LRT alignment in accordance with NFPA guidelines to allow for emergency and service vehicle access to the rapid transit corridor.

7.2.4.2 Communications

A centralized Operation Control Centre (OCC) will already be in place at the time of Barrhaven LRT extension implementation to support operation of the Confederation Line. The OCC will communicate with, supervise, and co-ordinate all personnel and trains operating on the system during normal operations. The OCC will be responsible for incident management in co-operation with Emergency Services personnel. Communications points will be provided on all trains and at multiple points within stations to allow passengers to contact operating staff in the event of an emergency. Emergency operating plans and contingencies will be developed as part of implementation of the system.

7.2.5 STATION ELEMENTS

7.2.5.1 Location and Spacing

There will be seven LRT stations included as part of the Barrhaven LRT extension.

- Tallwood (new station);
- Knoxdale (new station);
- Nepean Sportsplex (new station);
- Fallowfield (existing BRT station);
- Longfields (existing BRT station);
- Strandherd (existing BRT station); and,
- Barrhaven Centre (existing BRT station).

Station designs will have a common look and feel to those being built for the Confederation Line and will:

- Provide for safe, efficient and accessible access to rapid transit;
- Include convenient pedestrian and cycling connections to and from surrounding communities;
- Be consistent with City's bird-safe design guidelines;
- Integrate with the character of existing residential and green space areas; and,
- Fulfill AODA, Building Code and City of Ottawa Accessibility design standards including the implementation of redundant accessibility.

7.2.5.2 Entrances

Station entrances will be located to provide efficient access to stations from surrounding communities and streets. Access from a public Right-of-Way and through public lands and green spaces will be provided. Additional access through existing or future developments can be considered as part of project implementation to improve integration of LRT stations with the community.

7.2.5.3 Accessibility

All stations will be fully accessible and designed to meet universal design requirements, including elevator redundancy to provide a suitable alternate to be used in the event of an elevator breakdown, such as a second elevator or a suitable ramp structure. Depending on anticipated passenger volumes, installation of redundant accessibility features may be deferred in some stations, but all stations will be designed to accommodate eventual installation of redundant accessibility.

7.2.5.4 LRT Platform

At each station, platform facilities will be provided for passengers to board or alight from the trains. There are two possible configurations: side platforms or centre platform. Each station site has been evaluated to determine the configuration provides the best passenger service with minimal impacts to track geometry, existing and future structures, utilities, connectivity, and property. Platform configuration will be reviewed further during future design phases.

The platforms will provide a common set of passenger amenities including waiting areas, seating, sheltered areas for weather protection, passenger information (including signage and next train arrival messages), passenger security features (including designated waiting areas) and vertical circulation to concourse or station entry buildings.

7.2.5.5 Multi-modal Connections

Station Connectivity to surrounding communities is a key consideration in project planning. The main priority for station access is pedestrian and cycling activity this will include new/improved links to be identified/confirmed during detailed design. Parallel pathway facilities to be provided via a combination of existing and new linkages.

MUPs

Between the existing south access to Baseline Station and Norice Street, a MUP is planned along the west side of Woodroffe Avenue, with construction anticipated during 2021 (note this facility has since been constructed). This facility will remain in place and form part of the parallel pathway facility to be associated with the Barrhaven LRT. During detailed design, integration of this MUP facility with the elevated guideway, Tallwood Station and any intersection modifications required will be undertaken. During construction, the MUP may need to be closed at times to accommodate construction of Tallwood Station and the elevated guideway. Traffic management plans to be completed during detailed design will further assess the need for temporary closures or detours to accommodate pedestrians and cyclists.

Bicycle Facilities

Bicycle parking will be provided at all station locations. The number of spaces will be determined through detailed design and stakeholder input, however, space has been reserved at each station to provide the facilities. In addition to bicycle parking, other supporting facilities such as bicycle repair stands will be considered.

Future opportunities to provide space for bike-share facilities will be considered as part of detailed design.

Bus Connections

Bus connection activity will occur at most stations. Off-street bus terminals are provided at Fallowfield and Barrhaven Centre stations, where large volumes of passengers will be transferring and local services begin/end. In busier transfer stations, specifically the terminus stations, a fare paid area can be provided for multimodal connections to be made with ease. Where transfer volumes are low or where local services continue past the station (rather than terminating), on-street bus stops outside the fare paid area may be incorporated.

Passenger Pick-up and Drop-off (PPUDO)

Passenger pick-up and drop-off exists in a formal or informal way at the majority of existing rapid transit stations and is being planned for as part of the Barrhaven LRT Extension. Formal facilities will be provided at major stations to serve broader area needs, with off-street facilities integrated into the station site design. Informal, limited facilities will be accommodated at other stations to serve local needs and to spread activity and limit scale at any one location. These facilities may include designated curb space for time-limited parking or stopping on adjacent streets in the vicinity of an LRT station.

Life Safety Features

Providing a safe and secure system for passengers and others in the station areas is important. Stations have been designed using the CPTED (Crime Prevention Through Environmental Design) principles, which encourage designers to create spaces that are naturally safe, free of blind corners, dead ends, or areas where people can congregate without being seen. Stations should also provide for long sightlines so passengers can see their next destination and see if there are others on the route or at that destination. In addition to the physical layout of the station, stations will be equipped with features to assist persons in the event of emergency, including CCTV, communications, designated waiting areas and public telephones. Live connections to transit control staff will also be provided in the fare collection zone so that passengers experiencing difficulties with accessing the line can communicate directly with OC Transpo staff.

Fare Collection

Stations will be designed to accommodate fare collection equipment (fare gates, ticket vending machines, and help point). Stations will be unstaffed, with customer assistance provided remotely.

Community Integration

Stations function best when they are integrated in their adjacent communities. Stations should connect to local streets, pathways and sidewalks and entrances should be constructed in a way to help passengers orient themselves. Station facilities will be sized to meet the passenger needs and to be compatible with other buildings in the area. Lower volume community stations will be smaller than high volume stations with large bus transfer facilities.

Public Art

Public art is an important component of the project and will be accommodated within station and running way elements of the system. The City of Ottawa has policy requiring that an amount equal to 1% of an infrastructure project's hard costs be dedicated to the provision of public art. An allowance has therefore been included in project costing for public art. In addition to the provision of stand-alone pieces of artwork throughout the system, public art will be integrated into the architectural elements of stations and running ways.

7.2.6 RUNNING WAY ELEMENTS

The LRT running way will consist of new at-grade, elevated and below-grade segments.

7.2.6.1 Track

In at-grade segments, track will generally be laid on ties and ballast. In below-grade and elevated segments, track may be directly fixed to the concrete deck. Where vibration control is required, measures such as ballast mats and resilient track fasteners will be used. The study benefitted from consultation with the LRT Construction Office with respect to lessons learned from implementation of Stage 1 and Stage 2 regarding noise and vibration. The project will benefit from ongoing consultation and implementation of lessons learned. Discussion on this is provided in Section 7.6.3.

7.2.6.2 Service/Emergency Access

Access points to allow service or emergency vehicles to gain access to the LRT corridor will be provided at key points along the LRT corridor.

7.2.6.3 Overhead Power Supply

LRT trains will run on electrical power, delivered along the line from electrical substations via overhead wires commonly referred to as an Overhead Catenary System (OCS). LRVs obtain power from the OCS by means of a device called a pantograph, attached to the roof of the LRV.

The OCS will be mounted on support poles located between or to the side of the tracks. Exact location of support poles will be determined during detailed design of the alignment.

7.2.7 TRANSIT OPERATIONS

LRT service will operate as an extension of the Confederation Line. The design of the line will support frequent operation of trains. In practice, the splitting of service at Lincoln Fields between trains bound for Kanata and Barrhaven will limit service frequency on each branch, generally to half of the combined level of service which can be provided east of Lincoln Fields (e.g., 3 minute peak service on the combined section of line will result in 6 minute service on each branch). Given that the core of the line through downtown is designed to permit ultimate train operation as frequent as every 1 minute and 45 seconds, train frequencies as high as 3.5 minutes could be operated on each branch. This would result in a line capacity of 12,000 persons per hour per direction (pphpd) for the Barrhaven LRT Extension, which is more than sufficient to meet anticipated demand beyond the City's 2031 TMP horizon year.

Train frequencies in off-peaks and on weekends along the Barrhaven LRT extension will range from 10-15 minutes. Cross-over tracks will be provided at key locations along the line to permit turnback of trains or single track working during maintenance periods.

Bus routes (local and rapid transit) will connect to the LRT at key locations to facilitate passenger transfers and provide a seamless transit experience.

7.2.8 TRAIN STORAGE AND SERVICING FACILITY

To support rail operations along the Barrhaven LRT extension, a TSSF has been included to accommodate overnight storage and servicing of trains. This facility will assist in supporting efficient rail operations by reducing non-revenue train mileage given the long distance between Barrhaven Centre and the maintenance and storage facilities at Belfast Road and Moodie Drive. The TSSF will also provide the flexibility to scale service up or down at the beginning or end of the peak service times.

As outlined in Section 6.2.4, the TSSF will be located on the Greenbank Road site (1005 and 1045 Greenbank Road), adjacent to the existing Southwest Transitway, north of Highbury Park Drive.

The TSSF will accommodate up to eight trains (16 individual light rail vehicles) and provide for mid-day and overnight storage as well as servicing of trains (e.g., cleaning, inspection, minor "running" repairs).

Facility elements include:

- Covered storage tracks (6);
- Enclosed service building for train servicing (2 tracks);
- Hi-rail vehicle access point for inspection/maintenance of the LRT corridor;
- Dedicated TPSS;
- Administration building for staff;
- Access road and surface parking; and,
- Fencing, landscaping, noise barrier walls and stormwater management facility.

7.2.9 WATERMAIN PROTECTION STRATEGY

7.2.9.1 Under LRT Elevated Median Guideway

A 1200mm watermain runs along the west side of Woodroffe Avenue Right-of-Way south from Baseline Station. Between Knoxdale Road and West Hunt Club Road, it runs under the southbound lanes of Woodroffe Avenue. A large portion of this watermain (285m approx.) will require relocation due to multiple conflicts with proposed LRT piers and the proposed Knoxdale Station and in consideration of future maintenance and infrastructure lifespan. Other conflicts with local watermains, water services and hydrants are anticipated and will require modifications of the existing infrastructure. Depending on the timing of the project and in consideration of economies of scale, replacement and relocation of the watermain away from the pier impact zone would ultimately result in less disruption/risk in the future. In lieu of permanently relocating the watermain outside of the construction zone prior to construction of the elevated LRT structure, several recommended mitigation measures are described to minimize/eliminate potential impacts. These details and are provided in the Watermain Protection Memo found in Appendix B Annex 18.

Further detail of the impact to the watermain and mitigation measures are described in Section 7.8.2.

7.2.9.2 Rail Grade-Separations Location

The preferred alternative for rail grade-separation from the VIA Rail line for Woodroffe Avenue and the Southwest Transitway/LRT requires the relocation of a vital 1220mm feeder main (watermain). The construction of these structures and approach embankments, including the abutments and piers, requires the feeder main to be relocated outside of the footprint of these structures. Consultation with City Asset Management is recommended to coordinate

rehabilitation/replacement of portions of the feeder main with the construction of the grade-separation. The following describes rationale for relocation:

- The 1220mm feeder main is considered a major component in the City's watermain network as it supplies the majority of drinking water to Barrhaven, therefore, risk to its integrity and service disruptions must be avoided;
- At the VIA Rail crossing, the feeder main is approximately 4m deep to provide the required protection below the railway, Blacks Rapids Creek and local frost protection. Approximately 8m of backfill material would be added over the feeder main in order to construct the bridges. At a depth of 12m below the bridge embankment, maintenance of the feeder main would be extremely difficult;
- Construction of a feeder main through light weight fill embankments, concrete abutments, and/or piers is not recommended due to the potential for differential settlement based on the presence of poor soils and groundwater conditions through this area; and
- A watermain break below a bridge embankment would cause large structural issues to the bridges and lengthy roadway disturbances at the bridges.

To construct the new bridges with the proposed embankments, a widening of the existing Woodroffe Avenue Right-of-way is required. The lands adjacent to the Right-of-Way along this segment are currently owned by the NCC with tenants (Royale Equestrian Centre) operating. The proposed property widening along the east side of Woodroffe Avenue would provide the required clearance to minimize loading from the bridge onto the feeder main, would allow space for drainage and access for future maintenance. Regular maintenance activities would include bi-annual inspection of valve chambers (which would be accessible at the surface) by pick-up truck type vehicle. Activities necessitating excavation would only be due to an emergency event, not as part of regular maintenance. Based on this, it is recommended that the feeder main alignment be located within an easement with existing farm operations allowed on the surface following relocation.

A 10m wide allowance is required to provide sufficient space for future maintenance/repairs to the watermain via trenching without compromising the structural integrity of the bridges and components while minimizing potential disruptions to adjacent lands.

Relocating the feeder main to the west side of Woodroffe Avenue is not recommended based on the following:

- The feeder main cannot be located between Woodroffe and the Southwest Transitway bridges because there is not enough space between them;
- The feeder main diversion would need to be longer to be able to swing further to the west side of the Southwest Transitway;
- A west alignment would impact and require additional NCC Greenbelt lands;
- The feeder main would have to cross under the Southwest Transitway (future LRT) at two locations, which would require additional protection and increase the difficulty for future maintenance access; and,
- Providing access to the west for City staff to do routine maintenance inspections would be challenging due to LRT crossings.

To meet the above noted clearances, approximately 700m of the 1220mm feeder main will be relocated in an easement along the east side of Woodroffe Avenue. The relocation will start approximately 350m north of the VIA Rail line, near Blacks Rapids Creek. The location in plan-view is shown on functional design drawing sheets 21 and 22 provided in **Section 8**. The proposed profile for the relocated feeder main will be nearly identical to the existing 1220mm as shown on drawing sheets 9 and 10 (**Section 8**). The feeder main shall be designed and constructed to meet the latest versions of the City of Ottawa Design Guidelines – Water Distribution (City of Ottawa, 2010) and include but not limited to items such as, valve chambers, air relief chambers and steel casing Pipes. The feeder main crossing the VIA Rail line shall also meet requirements outlined under the Transport Canada – Standards Respecting Pipeline Crossings Under Railways (Transport Canada, 2000).

More details of the impact to the feeder main and mitigation measures are described in **Section 7.8.2**.

7.2.10 RAIL GRADE-SEPARATIONS

The proposed project includes three new rail grade-separations over the VIA Rail Smiths Falls Subdivision tracks in the vicinity of Fallowfield Station. Functional design of these grade-separations are provided in **Section 8**. These are located where the VIA Rail line currently crosses:

- Woodroffe Avenue;
- Southwest Transitway; and,
- Fallowfield Road.

As outlined in **Section 6**, all three rail grade-separations will be overpasses, and designed as open structures. The Woodroffe Avenue and Southwest Transitway overpasses incorporate eco-crossings (described further in **Section 7.4.4**) and all incorporate new MUP facilities as well as connections to existing/proposed NCC pathways. The structures have been planned to proceed as a separate project in advance of the Barrhaven LRT extension, based on available funding.

7.2.10.1 Woodroffe Avenue Rail Grade-Separation

This overpass will be a long multi-span bridge located within the existing Woodroffe Avenue Right-of-Way. The structure has been designed to accommodate for two VIA Rail tracks and will have two traffic lanes in each direction (**Figure 7-9**). Twin spans carrying the northbound and southbound traffic lanes are proposed. This will allow light to penetrate between the two spans down to ground level, to provide a sense of openness beneath the structure, where a new pathway connection will be provided between the existing NCC Greenbelt pathway and Fallowfield Station. The existing NCC MUP which runs parallel to Woodroffe Avenue on its east side will be relocated onto the east side of the new structure, with connections provided to the existing network.

7.2.10.2 Southwest Transitway Rail Grade-Separation

This overpass is located adjacent and to the west of the Woodroffe Avenue rail grade-separation, in the existing Southwest Transitway corridor (**Figure 7-9**). This rail grade-separation will be designed to allow construction as a BRT facility if the rail grade-separation proceeds in advance of the LRT implementation, with future conversion to LRT accommodated at a later date. The structure has been designed to accommodate two VIA Rail tracks.

Both the Woodroffe Avenue and Southwest Transitway bridges will be built at the same time and a temporary detour will be required while they are being built. This detour will be located west of existing Woodroffe Avenue, largely on NCC property. The detour will include a new temporary signalized at-grade crossing of the VIA Rail and will be six lanes wide (one exclusive bus-only lane and two general purpose lanes in each direction) and will accommodate the NCC MUP on the east side. Bus operations will transition into general traffic north of the crossing.

During construction, northbound and southbound bus queue-jumps will be built at the Slack Road intersection and between Vaan Drive and the Nepean Sportsplex where they will tie into the existing dedicated bus-only lanes to the north to minimize transit delays.

Figure 7-9 Artistic Renderings of the Woodroffe Avenue and Southwest Transitway/LRT Overpasses

It is anticipated that the existing 1220mm watermain will need to be protected during construction of the overpasses and may require realignment. Overhead utility lines will need to be relocated to accommodate the Woodroffe Avenue overpass structure.

The Woodroffe Avenue rail grade-separation will require reconstructing approximately 1km of Woodroffe Avenue and will include a new signalized intersection south of the VIA Rail line. This intersection will serve to provide additional roadway access to Fallowfield Station as well as to the NCC farmland (Royale Equestrian Centre) located on the east side of Woodroffe Avenue.

To accommodate required side slopes associated with the north and south overpass approach embankments, NCC property is required. This will impact existing farm operations on the east side of Woodroffe Avenue. Future design will consider means of reducing the footprint of the proposed rail grade-separation while balancing functional requirements and NCC land requirements.

7.2.10.3 Fallowfield Road Rail Grade-Separation

The Fallowfield Road overpass will cross over the VIA Rail and Barrhaven LRT tracks approximately 40m north of the current crossing and have two traffic lanes in each direction and will include a relocated MUP on the south side of the structure (**Figure 7-10**). The structure has been designed to accommodate two VIA Rail tracks. This relocation to the north creates greater separation from the existing neighborhood, reducing noise, vibration, and air quality impacts. It avoids building a temporary detour during construction, which would be complex to undertake given the skewed crossing of the VIA rail tracks and the existing Southwest Transitway.

The overpass has been designed as a long multi-span bridge with lower approach embankments that reduce the project footprint and associated impact on NCC lands. The abandoned roadbed will be rehabilitated and will provide space for landscaping, stormwater management and for potential community use. A new pathway connection linking to Fallowfield Station from the south will run below the overpass.

The existing intersections providing access to Fallowfield Station and the adjacent shopping plazas on the south side will be reconfigured to a protected intersection configuration.

Figure 7-10 Artistic Rendering of the Fallowfield Road Overpass

7.3 Corridor Drainage and Stormwater Management Approach

A detailed Corridor Drainage and Stormwater Management Plan shall be developed during the detailed design phase of the project. A high-level analysis during the EA process was conducted to confirm Right-of-Way requirements. During the detailed design stage, opportunities for employing current Low Impact Design (LID) and Best Management Practices (BMP) for stormwater management will be further considered. The objectives would be to manage stormwater within the Right-of-Way infrastructure to the extent possible. Potential low impact design measures may include:

- enhanced bioswales;
- open-bottom pipes; and
- bioswales.

Depending on the measures used and their effectiveness and given the localized subsurface conditions, the need for and size of proposed stormwater management facilities will be confirmed during detailed design.

All future stormwater management systems should provide an 'enhanced' level of stormwater quality protection as defined by the MECP in the *Stormwater Management Planning and Design Manual (2003)* or current BMP's depending on the time lapse to implementation. A more detailed understanding of the soil conditions and groundwater table, to be undertaken at detailed design, will assist in informing this approach.

Preliminary analyses and suggested approach to corridor drainage and stormwater management for the various sections of the Recommended Plan are described below. The full technical memo of analyses can be found in **Appendix B**.

7.3.1 BASELINE STATION

Water quantity control for Baseline Station and Southwest Transitway extension is being accommodated in the Baseline/Woodroffe Stormwater Management Retrofit Pond in lieu of underground storage. Quality control for the Southwest Transitway extension and upgraded Baseline Station has been provided on-site and the Baseline Transit tunnel has installed oil and grit separators. Further analysis of the existing oil and grit separator capacity is required during detailed design to confirm if additional oil and grit separators are required to meet quality requirements for this area.

7.3.2 BASELINE STATION TO NEPEAN SPORTSPLEX STATION

Figure 7-11 Enhanced Grass Swale with Check Dams (TRCA, 2016)

The elevated guideway is to be designed to prevent surface drainage from running off the edge of the deck or crossing over the rail. The depth of surface flow in a 100-year storm event should not exceed the elevation of the bottom of the rail at any location along the elevated guideway nor adversely affect the use of the guideway's emergency pathway. Flow is to be intercepted for the 100-year event. Preferably, drainage will be collected by a series of drains that ultimately outlet through the guideway's columns. Cleanouts are to be provided for downspout system in a manner as to provide access of the deck drainage system. Spread analysis should be undertaken during detailed design to confirm drain spacing.

The downspout system can be connected to the existing storm sewers within Woodroffe Avenue. However, there is an opportunity to incorporate LID into the drainage design by constructing an enhanced grass swale system in place of a traditional ditch system underneath the elevated structure. Enhanced grass swales are designed to not pond water for longer than 24 hours following a storm event and to not have standing water. They are vegetated open channels that convey, treat and attenuate stormwater runoff. The enhanced grass swale design decreases the velocity of the stormwater, allowing for sedimentation, filtration through the root zone and soil, evapotranspiration, and infiltration into the underlying soil. Incorporating grass swales into the landscaping design alongside the MUP can provide stormwater treatment while improving site aesthetic and irrigation. Check dams could

also be incorporated to temporarily pond water to further improve contaminant removal rates (TRCA, 2016). The enhanced grass swale system would ultimately drain to ditch inlets that drain to the existing storm network in Woodroffe Avenue.

To further enhance water balance and water quality benefits, dry swales could be a more appropriate alternative. A dry swale is a design variation of the enhanced grass swale that incorporates an engineered soil media bed and optional perforated pipe underdrain system (TRCA, 2016). Depending on the choice to outlet the elevated guideway to the swale, dry swales can provide additional water quality improvement and infiltration to reduce standing water over shorter periods of time. Choosing the most appropriate swale type will depend on soil conditions and swale design velocity.

For the reconstruction of Woodroffe Avenue, stormwater from the roadway will be captured utilizing the existing storm pipes, catch basins and catch basin lead infrastructure already implemented in the corridor. Relocation of existing storm infrastructure will be required for the section between Knoxdale Road to West Hunt Club Road to accommodate the reconstruction of Woodroffe Avenue.

7.3.3 NEPEAN SPORTSPLEX STATION TO VIA RAIL

It is recommended that the existing rural cross-section be maintained in this area. The existing grass swales will continue to reduce runoff volumes and reduce pollutant loads by filtrating stormwater through the grass vegetation and promoting infiltration into the native soil. The post-development drainage will match the existing drainage patterns and ultimately discharge to Black Rapids Creek. Changes to the existing peak flow patterns will be minor and are considered negligible, therefore no proposed quantity or quality additional treatment will be required.

7.3.4 WOODROFFE AVENUE AND SOUTHWEST TRANSITWAY/LRT OVERPASSES

Woodroffe Avenue and Southwest Transitway/LRT will overpass VIA Rail as two separate bridge structures. To accommodate the proposed embankment footprint, the existing box culvert at Black Rapids Creek tributary will be extended. The culvert will be retrofitted with a suspended platform to provide a new eco-crossing for small terrestrial wildlife.

By maintaining the existing rural cross-section, the existing grass swales will continue to reduce runoff volumes and reduce pollutant loads by filtrating stormwater through the grass vegetation and promoting infiltration into the native soil. The post-development drainage will match the existing drainage patterns and ultimately discharges to Black Rapids Creek.

The elevated guideway is to be designed to prevent surface drainage from running off the edge of the deck or crossing the rail. The depth of surface flow in a 100-year storm event will not exceed the elevation of the bottom of the rail at any location on the elevated guideway or adversely affect the use of the guideway's emergency pathway. Drains will ultimately outlet through the guideway's columns to the relocated or existing ditch system and continue draining towards Black Rapids Creek. Cleanouts are to be provided for downspout system in a manner as to provide access of the deck drainage system. Water quantity control should be incorporated within the ditch system using LID.

7.3.5 FALLOWFIELD STATION

The eastern portion of the park-and-ride will continue the use the existing sewer and ditch network that outlets to a dry pond in the northeastern corner of the site. Drainage from the new signalized intersection and MUPs just south of the parking lot area is to be routed to this system. To avoid retrofit of the existing dry pond, drainage from the western side of the park-and-ride should be relocated to the proposed Fallowfield stormwater ponds, detailed in the Realigned Fallowfield Road Overpass section (Section 7.3.6). Further water quantity control can be accommodated through roof storage, LID, and/or oversized pipes as needed. Additional water quality control can be enhanced by installing an oil and grit separator.

7.3.6 REALIGNED FALLOWFIELD ROAD OVERPASS

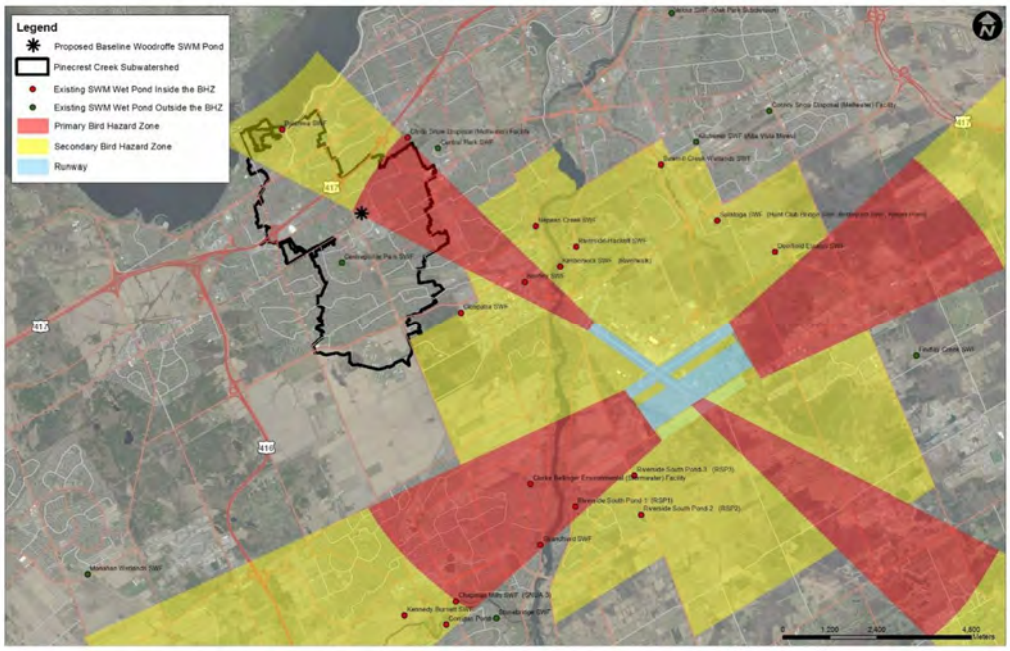
North of the current VIA Rail and Fallowfield Road crossing, the roadway is to be realigned as an overpass that will cross over the VIA Rail and proposed LRT corridor. The abandoned roadway will be rehabilitated to implement stormwater management features, landscaping, and potential community use. Existing sewer and ditch systems along Fallowfield Road and the western side of the Fallowfield park-and-ride facility are to be redirected to the new stormwater management features.

This area provides an opportunity to introduce an end-of-pipe stormwater management to treat stormwater runoff for the future configuration. An end-of-pipe stormwater management facilities receives stormwater from a conveyance system, such as a ditch or a sewer, and discharges the treated water to a receiving watercourse or water body. The purpose of end-of-pipe stormwater management practices is to control the impacts of urbanization which remain after lot level and conveyance controls have been applied. However, since the proposed area is located on the western side of the primary bird hazard zone of the Ottawa MacDonald Cartier International Airport (OMCIA) (**Figure 7-12**) as per 2010 Airport Zoning Regulations, activities or land use that attract birds within the limits of the bird hazard zone are not permitted. To ensure the stormwater management solutions remain in-line with these regulations, a dry pond is proposed along the old Fallowfield Right-of-Way. Creative design is suggested to incorporate with the landscaping and create a community space.

Discharges from the dry stormwater management ponds will ultimately outlet to the existing transitway ditch system, flowing towards the south.

Dry ponds can only achieve a basic level of protection (60% suspended solid removal rate). To achieve an enhanced protection level (80% suspended solid removal rate), a treatment train system could be incorporated into the stormwater management solution by additional features such as grass swale and/or an oil-grit separator prior to discharge into the receiving watercourse.

Figure 7-12 OMCIA Primary Bird Hazard Zone



7.3.7 CONSTRUCTION DETOUR

A temporary detour will be built west of the future structures (Woodroffe and Southwest Transitway/LRT) to accommodate general traffic, transitway buses, and the NCC MUP. The detour will require a temporary water passage system to ensure flow through Black Rapids Creek and its tributary are accommodated. The proposed temporary culverts are to be equivalent size to the existing Woodroffe Avenue crossings. Erosion and sediment control measures will be required to ensure water quality in the downstream water bodies is protected.

7.3.8 FALLOWFIELD TO HIGHBURY PARK

The post-development drainage along the transitway corridor is to match existing drainage patterns. Changes to the existing peak flow patterns along the transitway corridor will be minor and are considered negligible. Along the track, no proposed quantity or quality treatment will be required.

7.3.9 TRAIN STORAGE AND SERVICING FACILITY

Post-development runoff flows from the TSSF area requires the existing stormwater management facility be re-sized to accommodate both quantity and quality water control requirements from the site while accommodating its existing demands.

The proposed pond is located on the western side of the primary bird hazard zone of the Ottawa MacDonald Cartier International Airport. As per 2010 Airport Zoning Regulations, activities or land use that attract birds within the limits of the bird hazard zone are not permitted. To ensure the stormwater management solutions remain in-line with these regulations, the proposed pond shall remain a dry pond.

Based on MECP's Stormwater Management Planning and Design Manual (2003), only a basic removal rate of 60% can be achieved in a dry pond where the detention time is 24 hours. This could be improved with a detention time of 48 hours.

7.3.10 HIGHBURY PARK TO BARRHAVEN CENTRE STATION

The reuse of the existing transitway infrastructure will allow the post-drainage to match the existing drainage patterns. Changes to the existing peak flow patterns will be minor are considered negligible, therefore no proposed quantity or quality treatment will be required. The existing storm pipe infrastructure will need to be lowered to handle the new track elevation. The pipes will continue to outlet to Jock River.

7.3.11 BARRHAVEN CENTRE STATION

Underground storage chambers are recommended below the paved area of Barrhaven Centre Station to meet the required quantity storage requirements. An oil and grit separator would provide the required quality control prior to discharging into the 1650mm diameter pipe located along the future Chapman Mills. The large diameter pipes have been constructed to discharge stormwater from the Southwest Transitway Land and discharge into the Nepean South Stormwater Ponds.

It is recommended that underground chambers and an oil and grit separator be constructed below the new parking and roadways to meet the quantity and quality requirements.

7.4 Corridor Landscaping and Space Programming Strategy

The existing landscape context within the Study Area is complex and variable. The attributes shift rapidly along the corridor from the low density residential and commercial and institutional developments in Centrepointe, Crestview and Tanglewood, Craig Henry, Manordale, Merivale Gardens and Barrhaven, past the edges of the urban natural area of Tallwood Woods and Pinhey Forest and through active agrarian lands within the NCC Greenbelt. Vegetation along this route today serves to enhance, frame and screen these forms from existing infrastructure. A Corridor Landscaping and Space Programming Strategy is recommended for the Barrhaven LRT facility to guide the future design of landscape features at each station location and other contexts along the corridor. The strategy will assist in enhancing the transit rider experience, provide shelter for those using adjacent multi-use pathways and those accessing the corridor and provide a buffer for the adjacent land uses from the facility. The landscape strategy includes consideration of the contexts and approaches detailed below.

7.4.1 PARALLEL TO THE CORRIDOR ADJACENT TO EXISTING LAND USES

Landscaping elements to be provided to enhance existing elements along the corridor would serve to create a greener edge, buffer adjacent land uses as required, and provide shelter from the weather and extreme storm events. The development of future landscape plans in this context should consider the following:

- Minimizing removal of existing landscaping through compact footprints and choice of staging areas;
- Maximizing landscape corridor / edge conditions that may offer visual screening of the elevated guideway, shade for corridor users, and the added benefit of sound attenuation;
- Selecting landscape elements to provide functional and aesthetic value throughout the seasons;
- Including native tree and shrub species, use of non-invasive species, consideration of species that are urban, salt tolerant as well as context tolerant ()i.e., if planting under the guideway in the median; and,
- Including landscape elements that provide rest and seating areas that are designed to include soft landscape features to provide protection from the weather to the degree possible.

For the space under the elevated guideway through the Pinch Point, opportunities to green the median will be explored during the next phases of the project that are consistent with safety requirements and plantings tolerant of the constrained and shaded location.

7.4.2 TALLWOOD WOODS EDGE TREATMENT

Tallwood Woods is an approximately 5.4ha urban woodlot located between Tallwood Avenue (beyond the City Archives) to the CN Rail line. The woodlot is designated as an Urban Natural Feature in the City of Ottawa's Official Plan (2013) and hold both ecological and aesthetic value within the existing urban landscape and the community. An existing multi-use pathway connects Woodroffe Avenue to the community through this natural area. As a portion of the woodlot will require removal to implement the project, a new edge treatment will be required to protect the remainder of the area. The development of future landscape plans in this context should consider the following:

- Completion of a tree inventory prior to construction to determine species composition that can be further considered in development of a detailed landscape plan;
- Provision of planting lists to include non-invasive species that are native to Ottawa and will emulate natural characteristics consistent with the existing woodlot;
- Minimization of the removal of existing landscaping during construction through delineation of the "limit of site alteration" and markings in the field, using visual means so that construction teams can clearly see the limit of site alteration during the clearing and grubbing processes;
- Installation of new edge plantings as soon as possible following the site alteration processes to both protect the exposed woodlot edge and to mitigate the spread of invasive species;
- Consideration for greening of guideway piers that may serve as a gateway to the multi-use pathway connection to the community;
- Consideration for additional plantings within city boulevard to form a "green tunnel" appearance that the woodlot extends to street; and,
- Development of a monitoring plan to ensure that the newly planted materials survive and fulfils the intended function and to ensure that the inadvertent spread of invasive species is appropriately managed.

7.4.3 STATION LOCATIONS

The design of existing Confederation Line Stage 1 LRT stations have used similar architectural elements and stylings throughout and it is anticipated that the branding of individual stations will continue to roll out across the Stage 2 and Stage 3 locations, forming a recognizable entity at all points in the City. It is envisaged that each station will have a subtly or overtly recognizable treatment reflective of neighbourhood attributes or destination. In this way, landscape choices can build familiarity and confidence across the transit ridership or add individuality to reach location. The development of future landscape plans in this context should consider the following:

- Provision of landscape features should also include plantings & site furniture to respond and strengthen characteristics of the individual stations;
- Utilization of landscape design as wayfinding elements to assist and provide guidance to station entrances and connections to the adjacent pedestrian and cycling networks;
- Characterization of landscape design should be subordinate to station architectural design only assisting to articulate shape, form and providing functional elements such as nodes, shade, screening, define direction of travel and accentuate access/egress point; and,
- Consideration to the type and location of landscaping elements in proximity to the stations to minimize the attraction and risk to birds.

7.4.4 NCC GREENBELT INCLUDING AROUND THE GRADE SEPARATIONS

The Greenbelt is an iconic cultural landscape defining Ottawa as the Nation's capital. The area surrounding the Barrhaven LRT and the rail-grade separations around Woodroffe Avenue and Fallowfield Road is a pastoral context with active farm operations including horse riding, cultivated lands and research farms. The community facility of the Nepean Sportsplex and the Ottawa Sound Stage development located within the Greenbelt serve as additional destinations along the line. A landscape design in this context should consider the following:

- Landscape intervention should be subtle to maintain Greenbelt views of agricultural landscape and edge condition especially at Nepean Sportsplex Station, the northern edge of the Greenbelt;
- Greenbelt pathways edges should be re-naturalized and include shade trees at strategic respite locations. Consideration should be given to incorporating rest and seating areas;
- Slopes/embankments around the rail grade-separations should be minimized to the degree possible and naturalized with appropriate grass and shrub species to assist in slope stabilization/erosion control, and integration with surrounding rural landscape context; and,
- Identified creek culverts to be designed as eco-crossings for wildlife should be enhanced for terrestrial animals and aquatic species with native, non-invasive vegetation along the edges with natural substrates as much as possible. Fencing to guide approach and movements of wildlife to the eco-crossings should also be included.

7.4.5 SPACE PROGRAMMING UNDERNEATH THE ELEVATED GUIDEWAY

In consultation with various City departments, a number of opportunities were identified to animate the space that will be created below elevated portions of the facility between Baseline Station and Knoxdale Station. A range of space animation strategies should be considered during the detailed design of the project with the objective of creating welcoming spaces, softening the appearance of the elevated facility, and provide valuable community-servicing uses. Similar to the stations, these areas can be unique to their specific location and context. In addition to considering these areas for corridor landscaping, the range of opportunities to be examined could include:

- Location for Multi-Use Pathways;
- Recreational uses such as playgrounds, skate parks, and dog parks;
- Open Space Markets;
- Areas for festivals and community gatherings;
- Public Art installations; or,
- Community Gardens.

7.5 Description of Project Activities

7.5.1 PRECONSTRUCTION PHASE

A key requirement of the pre-construction phase will be the acquisition by the City of the required Right-of-Way within the project limits. The specific requirements are illustrated on the Recommended Plan (Section 8). The City will employ its

approved process of contacting landowners and working with them towards acquisition, using the standard methods that are available to the City.

This phase includes the completion of preliminary and detailed engineering and landscape designs and preparation of contract drawings and specifications. The phase also involves obtaining all necessary permits as well as approvals from regulatory agencies. Future consideration during the design phase should include but not be limited to:

- Confirmation of existing conditions through a detailed survey;
- Confirmation of project geometry, overpass, elevated LRT and station locations;
- Confirmation of approach to project procurement;
- Determination of intersection designs;
- Finalizing detours for all modes where applicable;
- Stormwater management design;
- Landscape materials and tree planting details;
- Confirming locations and design(s) of eco-crossings;
- Location/width of multi-use pathways;
- Lighting design, frequency and location of light poles;
- Traffic plant design;
- Station design;
- TSSF design;
- Final locations of TPSS;
- Submission of Property Management Proposal to Hydro One for approval;
- Completion of a separate EA following the Class EA for Minor Transmission Facilities for modifications/relocations of existing Hydro One infrastructure, as required (Section 9.5.2.7);
- Accessibility features;
- Strategy for management of impacted materials and excess soil requirements (as applicable);
- Obtaining approvals for construction access and working areas;
- Identification of all existing utilities in the area and preparing utility reconstruction/relocation plans;
- Detailed construction staging and phasing plans;
- Coordination with other projects in the vicinity of the corridor; and,
- Development of all mitigation plans and strategies.

7.5.2 CONSTRUCTION PHASE

This phase involves activities related to construction. Physical construction will consider construction timing considerations as described in Section 7.7.14. Physical construction activities for the modifications to Woodroffe Avenue intersections between Knoxdale Road and the Nepean Sportsplex, LRT, overpasses, stations, TSSF, MUPs and associated greenscaping and streetscaping will include but not be limited to:

- General activities applicable to all elements:
  - Installation of construction fencing and required protection measures for trees, wildlife and sediment / erosion control
  - Clearing and grubbing of trees or any vegetation within the grading limits for construction of the project;
  - Stripping of topsoil within the grading limits;
  - Management of impacted materials (if applicable);
  - Management of excess soil as per O. Reg. 406/19 On-Site and Excess Soils Regulation;
  - Relocation of utility and piped underground infrastructure;
  - Installation of storm catch basins and storm sewers as well as ditch drainage and other stormwater management features;
  - Implementation of traffic management measures. The work will be sequenced and timed to minimize impacts on the transit network, cycling routes, pedestrian pathways and adjacent local roads and access;
  - Installing landscaping features; and,

- Restoration and rehabilitation of any disturbed areas extending beyond the project limits.

- Activities applicable for the realignment and construction of the Fallowfield Road overpass:
  - Excavation of road surface;
  - Removal of existing asphalt, re-use where possible, and disposal at an approved facility;
  - Removal of Fallowfield rail crossing system and adjust adjacent crossing systems;
  - Removal of crossing ties and replace by track tie;
  - Grading and ditching work to allow proper drainage;
  - Any associated work on the railway line to accommodate the project;
  - Pouring concrete curbs; and,
  - Rehabilitation of existing Fallowfield Road alignment.

- Activities applicable for the construction of the Woodroffe Avenue and Southwest Transitway overpasses:
  - Construction of the detour;
  - Installing eco-crossings and exclusion fencing;
  - Modify track and signals to allow the construction of the temporary detour crossing;
  - Removal of Transitway and Woodroffe rail crossing systems and adjust adjacent crossing systems;
  - Removal of crossing ties and replace by track tie;
  - Grading and ditching work to allow proper drainage;
  - Removal of temporary detour crossing once overpass in function;
  - Any associated work on the railway line to accommodate the project;
  - Preparing base for LRT/overpasses including cutting and filling (potentially salvaging existing granular for re-use); and,
  - Rehabilitation of farmlands as part of decommissioning of the construction detour.

- Activities applicable to road works:
  - Preparing roadbed including cutting and filling (potentially salvaging existing granular for re-use);
  - Connection to existing storm catch basins and storm sewers as well as ditch drainage and other stormwater management features;
  - Laying granular and application of hot mix asphalt;
  - Pouring concrete curbs
  - Construction of Park and Ride at Barrhaven Town Centre (may proceed in advance of LRT);
  - Applying pavement markings and installing traffic signs; and,
  - Installing lighting and traffic signals.

- Activities applicable for LRT works:
  - Construction and conversion of existing transitway from BRT to LRT technology;
  - Elevated LRT components will be constructed in such a way as to minimize community disruption;
  - Elevated LRT segments will generally be constructed using a viaduct system rather than embankments;
  - At-grade sections will employ typical track on tie and ballast, with sub-grade to provide drainage;
  - From north of Berrigan Drive to south of Chapman Mills drive a below-grade LRT will be constructed. These sections will both be open cuts or trenched. Functionality of existing roadways and parking lots impacted will be maintained during construction using temporary decking, typically consisting of timber decking or precast concrete panels, supported by the excavation shoring system;
  - Raising hydro lines as required in partnership with Hydro One;
  - Constructing pier foundations to bedrock, installation of precast girders, concrete deck and rail tracks;
  - Transit priority measures on Woodroffe Avenue to reduce bus delays during construction;
  - Elevated stations will include at-grade station facilities (entrance buildings, service rooms) with stairs, escalators and elevators providing vertical circulation between the station entrance and elevated platform at track level. Fully enclosed platform canopies spanning over the platforms and tracks will be provided;

- For stations converted to accommodate LRT, they will remain largely in their current configuration, existing platforms will be lengthened and widened. Station amenities will need to be upgraded;
- New station construction (Tallwood, Knoxdale and Nepean Sportsplex, Barrhaven Centre);
- Decommissioning of Marketplace Station;
- Ancillary works including construction of special trackwork (pocket track, crossovers) and TPSS; and,
- Construction of the TSSF
  - Site excavation and grading, installation of overhead electrical supply, track laying, construction of maintenance and storage structures/buildings, associated road access and parking lot, installation of security features, lighting and communication systems, transportation and storage of construction materials and equipment, installation of landscaping elements.

7.5.3 OPERATIONAL PHASE

This phase begins with the first day of corridor operation and covers the general operational activities such as maintenance and monitoring, on an as-required basis. Once construction is complete, monitoring of the project, as it will be completed in phases, will be initiated as part of the normal City practices. In addition, warranty reviews (such as landscape health) will be completed.

Light Rail Operation

Activities associated with the operation of the Barrhaven LRT Extension include general operation of trains along the alignment which will occur in accordance with the operating standards developed and agreed to between the City and contractor selected to maintain the LRT system. Operations will generally be from early morning to late evening, 365 days a year. Service levels will vary through the day to reflect demand, with more trains during weekday peak periods and fewer during off-peak, late evening and weekend time periods.

A detailed operating plan will be developed prior to opening of the line for revenue service and adjusted as ridership patterns develop and are established. Operating plans will address LRT operations under a variety of different scenarios (normal, emergency, special events) and will be consistent with those developed for the Confederation Line.

Bus Operation

The Barrhaven LRT Extension will be fully integrated with the City's existing transit network. Existing bus routes which currently operate along the Southwest Transitway between Baseline Station and Barrhaven Town Centre will largely be replaced by the new LRT. Some routes will need to be adjusted to connect with the LRT at Fallowfield or Barrhaven Centre Stations.

While the final bus route configuration cannot be planned in detail at this time, as the exact arrangement of routes and service frequencies are dependent on the level and types of services being operated when the system becomes operational, preliminary planning at each station has identified the need for bus connection facilities. Each of the stations has sufficient space to meet the expected demand for connecting bus routes.

Near the end of the construction period, OC Transpo, as part of on-going service planning processes, will finalize the BRT and local bus routings to provide connections with the new LRT line, reflect the new operating philosophy, respond to ridership growth and changes in ridership patterns and meet the operating budget requirements in place at the time. After construction ends and the LRT is in service changes to the bus network will be part of OC Transpo's annual service planning process.

Corridor Maintenance

Maintenance activities, in accordance with current City standards, will include:

- Spring sweeping of the roads and pathways;
- Maintenance of stations;
- General maintenance to ensure public safety (changing lights, security checkups);
- Maintenance of rails, LRT infrastructure and overhead electrical system;

- Routine vehicle cleaning and light maintenance;
- Ditch cleanouts;
- Snow and ice removal in winter;
- Winter maintenance will include snow clearance and salting/sanding pedestrian areas;
- Routine vehicle cleaning, inspection and minor repairs and vehicle storage (TSSF);
- Landscaping maintenance including grass cutting, tree pruning (optimally in Fall or Winter); and,
- Replacement of any landscape materials.

7.5.4 PROJECT PHASING AND PRIORITIZATION

The extension of LRT to Barrhaven is identified in the 2013 TMP for implementation post 2031. The project is not part of the City's affordable network but is identified as part of the ultimate rapid transit network. The rail grade-separation of Woodroffe Avenue, Southwest Transitway and Fallowfield Road is not identified with a timeline for implementation in the 2013 TMP. No funding has been committed from senior levels of government to implement the project. Notwithstanding, there may be opportunities to build sections of the project in two phases. These phases are:

Phase 1: Extension of LRT from Baseline Station to Fallowfield Station including the three rail grade-separations of Woodroffe Avenue, the Southwest Transitway and Fallowfield Road over the VIA Rail line. Recommended for construction first to address the critical safety issue in the Barrhaven area and more critical travel demand.

Phase 2: Extension of LRT from Fallowfield Station to Barrhaven Centre Station including construction of the TSSF. Based on availability of funding and future demand:

The City could elect to proceed with the three grade-separated crossings over VIA Rail tracks, independent of the Barrhaven LRT Extension project. The Recommended Plan for the overpass of the Southwest Transitway has been designed to support initial implementation as a BRT facility with later conversion to LRT technology.

Although this Study identifies a proposed two-phased approach, the actual implementation strategy will be determined by the City as part of its ongoing TMP and infrastructure planning practices.

7.5.5 CONSTRUCTION STAGING

Primary tasks associated with construction of the project have been identified above. The varying conditions along the corridor will require that several different construction methods be used to complete the project, including excavation for below-grade segments and foundations for elevated LRT segments and the rail grade-separations. Temporary staging areas will be required at multiple locations to support stockpiling of materials and equipment needed to construct the project in an efficient manner.

Construction of the Barrhaven LRT Extension is likely to follow the same process as the current Confederation Line, which has a private sector partner responsible for the final design, construction, and maintenance of the project, while OC Transpo operates the service. The contractor selected by the City will be responsible for developing construction plans and designs which meet contractual requirements, including defining the means and methods of construction.

More details pertaining to construction of the elevated median LRT guideway are provided in Appendix B.

7.6 Built-in Mitigation Measures

For this project, "built-in mitigation" is defined as actions and design features incorporated in the pre-construction, construction, and operational phases, which have the specific objective of lessening the significance or severity of environmental effects which may be caused by the project. This includes standard construction practices and best management practices (BMPs).

The Project will be designed and implemented with the benefit of contemporary planning, engineering, and environmental management practices including governing legislation, policies, regulations, guidelines, and best practices relevant at time of construction. Where possible, mitigation measures will be prescribed in construction contracts and specifications.

Examples of practices that should be employed, based on current standards, are described below. These measures can be considered "built into" the preferred design for the roadway. They will be updated and refined as early as possible during the pre-construction, construction, and operation phases of the project.

7.6.1 EROSION AND SEDIMENT CONTROL PLAN

A detailed plan will be prepared by the Contractor, to manage and mitigate the flow of sediment into storm sewers and watercourses resulting from project construction including excavation. This plan will include preventative measures (e.g., covering excavated soils) to deter opportunistic species such as Bank Swallow from nesting on stockpiled materials within construction areas. The plan shall include drawings, standard notes and reports depicting and describing the site conditions (e.g., grades, locations of natural features, soil stockpiles) during a particular phase of construction and based on BMPs. Individual ESC plans should be generated for each phase of construction to manage and mitigate the flow of sediment into storm sewers and watercourses resulting from project construction. The plan should have regard for the sensitive nature of the lands north of West Hunt Club Road to Baseline Station which are located within an IPZ-2 area.

This plan may include the following elements:

- Preserve existing vegetation and mark clearing limits;
- Establish construction access;
- Control flow rates;
- Install sediment controls specific to the site topography;
- Stabilize soils;
- Protect slopes;
- Protect drain inlets;
- Stabilize channels and outlets;
- Control pollutants;
- Control de-watering; and
- Maintain best management practices.

7.6.2 ENVIRONMENTAL PROTECTION PLAN

The contractor is required to ensure that no contamination, waste or other substances which may be detrimental to aquatic life or water quality, will enter a watercourse as either a direct or indirect result of construction or site preparation. In this regard, any floating debris resulting from construction which accumulates on watercourse banks is to be immediately cleaned up and disposed of. Any spills or contamination, waste or other substances which may be detrimental to aquatic life or water quality will also be immediately cleaned up. Spills Response and Reporting is described in Section 7.6.5.

Any work which will cause or be the cause of discharge to watercourses is to be prohibited. At all times, construction activities are to be controlled in a manner that will prevent entry of deleterious materials to watercourses. In particular, construction materials, excess materials, construction debris and empty containers are to be stored away from watercourses, the banks of watercourses and steep slopes.

Any required staging areas should avoid sensitive areas such as Black Rapids Creek or Tallwood Woods, to the extent possible and be located as far away as possible.

7.6.3 AIR QUALITY, NOISE AND VIBRATION

A detailed air quality, noise and vibration assessment as well as an addendum to capture the modification to the preferred design to align the LRT in the median of Woodroffe Avenue was conducted for the Recommended Plan. These full reports can be found in Appendix B. Analysis found noise levels throughout the Study Area are dominated by area road traffic. Established ambient noise levels in the Study Area are more than 60 dBA. Implementation of the project will marginally increase noise levels above existing conditions. Should there be changes in guidelines and best management practices in the future or changes in LRT design, further noise analysis may be required at detailed design. If future residential

developments are proposed within proximity to the project, the requirement for noise attenuation measures will be evaluated at that time and any necessary mitigation will be included as a condition of development approval.

Construction activities throughout the corridor are expected to create isolated and short-term noise, air quality and vibration impacts on the environment. The construction manager will be required to develop a strategy for mitigating the effects according to BMPs intended to satisfy, as feasible, the fugitive dust limits specified in O. Reg. 419, the noise limits specified in MECP NPC-115 and City of Ottawa By-laws for Noise; and MECP NPC -119 for ground vibrations or the regulating standards of the time. A list of common mitigation strategies adapted to the current project includes, but is not limited to, the following:

Air emissions BMPs:

- Monitor wind conditions, and plan operations to take advantage of calm wind periods;
- Minimize site storage of granular material in height and extent;
- Locate storage piles in sheltered areas that can be covered;
- Provide movable wind breaks;
- Use water spray and suppression techniques to control fugitive dust; and,
- Cover haul trucks and keep access routes to the construction site clean of debris.

Noise and vibration BMPs:

- Limit speeds of heavy vehicles within and approaching the site;
- Provide compacted smooth surfaces, avoiding abrupt steps and ditches;
- Install movable noise barriers or temporary enclosures, around blast sites for instance;
- Keep equipment properly maintained and functioning as intended by the manufacturer; and,
- If required, implement a blast design program prepared by a blast design engineer.

The study benefitted from consultation with the LRT Construction Office. Lessons learned from implementation of Stage 1 and Stage 2 were shared and ongoing consultation during the next phases of the project will also serve to minimize impacts related to air quality, noise and vibration.

7.6.4 EMERGENCY RESPONSE PLAN

The preparation of an Emergency Response Plan to be used by the contractor will be needed to allow full emergency service access at all times during the construction period, such that there is a method to access all residential, commercial and other land uses in the event of an emergency. Additionally, the Emergency Response Plan should include provisions for providing temporary services to end users in the event of a construction related service outage or other service disruption.

7.6.5 SPILLS RESPONSE AND REPORTING PLAN

A Spills Response and Reporting Plan will be prepared and adhered to by the contractor. A response plan is to be implemented immediately in the event of a sediment release or spill of a deleterious substance and include keeping emergency spill kits on site (and in heavy machinery) in case of emergency.

The Contractor must also ensure that:

- Materials such as paint, primers, rust solvents, degreasers, grout, poured concrete or other chemicals do not enter the watercourse.
- Ensure that building material used in a watercourse has been handled and treated in a manner to prevent the release or leaching of substances into the water that may be deleterious to fish.

All spills shall be reported to the Ministry of Environment (MOE) Spills Action Centre (1-800-268-6060). Management of Contaminated Materials.

Studies will be completed to confirm the potential for the project to interact with contaminated soil or groundwater, where existing conditions are not known. Where the potential has been confirmed, a plan to remediate the environment to the applicable standards will be prepared. The MECP and Construction Project Manager would be notified immediately upon discovery of any contaminated material encountered within the construction area. If contaminated material or contaminated groundwater is encountered within the construction limits, these are to be removed and disposed of in accordance with all applicable Acts and Regulations and reported to applicable authorities. Treatment and discharge of contaminated groundwater are to also be in accordance with applicable legislation and regulations.

7.6.6 LIGHTING TREATMENT PLAN

A Lighting Plan in accordance with City of Ottawa Right-of-Way Lighting Policy (2016) will be prepared as part of the detailed design. The Lighting Plan will include lighting fixtures and illumination along the corridor. Within the Greenbelt, consultation with the NCC to develop context sensitive lighting solutions will be undertaken.

7.6.7 CONSTRUCTION WASTE MANAGEMENT PLAN

During construction there will be excess materials requiring disposal off the project site. These materials may include concrete rubble, asphalt, waste steel/metal structural components, earth, and road Right-of-Way appurtenances such as signs, lighting and utility poles. During the detailed design stage, a Construction Waste Management Plan will be developed to ensure that surplus material is recycled wherever practical and to describe the methods to be used by the Contractor for disposal of all other surplus material in accordance with provincial or local municipal practices and guidelines. MECP's guideline *Management of Excess Soil – A Guide for Best Management Practices* (MOECC, 2014) should be referenced once this management plan is prepared. A site-specific approach to address excess soils is discussed in Section 7.7.9.

7.6.8 ARCHAEOLOGICAL RESOURCES

During the course of construction, if unexpected archaeological resources are discovered, the site should be protected from further disturbance until a licensed archaeologist has completed the assessment and any necessary mitigation has been completed. Applicable authorities should be notified according to the guidelines and land ownership at the time.

7.7 Site Specific Mitigation Measures

Once potential effects were predicted as part of this EA study, mitigation measures were identified. Often these mitigation measures were sufficient to reduce potential negative effects to an insignificant or negligible status. Mitigation included environment rehabilitation and replacement. Localized site-specific mitigation measures are summarized below.

7.7.1 PROPERTY ASSESSMENT AND ACQUISITION PROCESS

The EA study resulted in a Class C cost estimate for project implementation that followed the City of Ottawa's Project Delivery Review and Cost Estimating procedure. Costs associated with acquiring property and property rights on which to build or provide construction easements for the construction of the project will need to be estimated. These will include, in addition to actual property value, the cost of Right-of-Way preparation, legal and appraisal services and land survey.

7.7.2 PUBLIC COMMUNICATIONS PLAN

A Public Communications Plan is required need to keep the public informed about the work in progress and the impacts of ongoing or upcoming construction activities. Businesses, institutions, residents, tenants and other stakeholders including emergency service providers must be aware of scheduled road closings and other disruptions to normal service ahead of time in order that their activities can be planned with minimum disruption. The Public Communications Plan will follow the standard established by the City including detail on how to communicate the information to the public, information to be disseminated, and at what project stage the communication should take place.

7.7.3 ARCHAEOLOGICAL ASSESSMENT

Areas within and adjacent to the corridor identified as having archaeological potential will be subject to subsequent (Stage 2/3/4) Archaeological Assessment prior to construction should these lands be required to be disturbed through implementation of the Recommended Plan. Subsequent stages of archaeological assessment should be completed as early as possible in the detailed design phase as the results may impact design details and schedules. Indigenous Communities will be involved as required based on best practices and governing municipal, provincial and federal legislation and policies.

7.7.4 CONSTRUCTION AND TRAFFIC MANAGEMENT PLAN

A Construction and Traffic Management Plan will be developed to manage the transportation function for all travel modes including equipment and material deliveries at various times during the construction period. The objective will be to maintain clear walking routes and to maintain as much functionality for traffic as possible. The plan will also outline the road signage program.

7.7.4.1 Traffic and Transit Diversions during Construction

During construction of the LRT system and modifications to Woodroffe Avenue, traffic diversions will need to be implemented to permit construction work to occur on various project elements based on proposed staging. The duration and extent of traffic diversions will vary from location to location and include lane closures and temporary detours. Complete closure of existing roadways is not anticipated based on the current level of design; however, the Southwest Transitway between Nepean Sportsplex and Barrhaven Centre Station will need to be closed to permit conversion to LRT.

During the detailed design phase, the final detour plans will be closely coordinated with construction staging. Routes for any diversions will be determined in consultation with the City of Ottawa and the contractor completing the works and be communicated to the public in advance of implementation (e.g., through consultation or mobility management plans).

7.7.4.2 Confederation Line Operations during Construction

The operation of the Confederation Line should not be impacted by construction of the LRT extension, although there may be a need for some limited service disruptions during testing and commissioning activities, when the entire line will need to be tested to ensure integration of systems with the existing Confederation Line.

7.7.4.3 Railway Operation During Construction

All efforts shall be taken to avoid impacting railway operations during the course of the project. Prior approval from the railway operator, including arrangements for permits and flag person protection, will be required for any and all works within or adjacent to the railway Right-of-Way. These approvals will include but not be limited to any potential track and signal modifications, construction of adjacent or overhead structures, drainage modifications, utility installations, modifications to existing or new at-grade crossings or crossing protection systems, or any other works that may impact railway safety or operations.

7.7.5 CORRIDOR DRAINAGE AND STORMWATER MANAGEMENT PLAN

The purpose of developing and implementing stormwater management strategies is to provide adequate systems for the Recommended Plan. The purpose of the Corridor Drainage and Stormwater Management Plan is two-fold; it identifies the rate and volume of anticipated stormwater runoff and the means to accommodate it, and the means of achieving Ministry guidelines for water quality of stormwater runoff.

This includes the identification, in the detailed design phase, of the overall stormwater management system requirements, methods of retention, detention and infiltration, and any control mechanisms necessary to achieve runoff quantity and quality targets, while continuing to provide the required flows to downstream areas. Drainage systems and their components are sized and designed in conjunction with the overall project, and retention or detention systems are then incorporated into the design to achieve Ministry guidelines for runoff quantity and quality control. When prepared

during the detailed design phase, this plan will consider the opportunity to treat stormwater runoff within the identified Right-of-Way prior to further off-site (i.e., outside the Right-of-Way) treatment following those measures outlined in the Corridor Drainage and Stormwater Management Approach outlined in this EPR (Section 7.3).

7.7.6 HYDRO ONE INFRASTRUCTURE CONFLICT RESOLUTION

Through consultation with Hydro One, mitigation is required for work in and around the two main Hydro One lines that intersect with the Recommended Plan. Should the Project trigger the requirement for a separate EA as described under the Class EA for Minor Transmission Facilities (Hydro One, 2016) costs associated with modification or relocation of Hydro One facilities will be the proponent's responsibility. This EA process will require a minimum of 6 months to be completed for a Class EA Screening (and up to 18 months if a Full Class EA is required). As such, the following commitments are to be carried out to mitigate the impacts to the Hydro One infrastructure during the pre-construction planning and design and project construction phases of the project. The below was provided verbatim from Hydro One for inclusion.

- Submit a Property Management Proposal to Hydro One for approval.
- Hydro One has advised that during the next phases of the project, a feasibility-level study will need to be completed in order to determine the modifications required for both circuits in order to achieve the adequate clearances. The City will be required to provide AutoCAD versions of the drawings for review.
- Confirm required modifications/relocations to existing Hydro One infrastructure and associated studies, permits and approvals (i.e., EA, archaeology).
- Survey to determine if the 15m buffer zones around the tower legs will be encroached by placement of permanent infrastructure. If the supporting structures from the elevated LRT facility are within 15m to the towers, the impact to the towers/foundations may need further investigation.
- Hydro One requires 15m of clearance on all sides around its transmission structures as measured from the tower legs in order to carry out maintenance operations. This clearance must be maintained at all times, no storage or staging activities should occur within this area during construction.
- A 3m radius around Hydro One structures must be left unpaved for tower access.
- Construction equipment and personnel working underneath the Hydro One conductors must satisfy OSHA clearance requirements.
- All proposed plantings in the vicinity of the Hydro One lines must be reviewed and approved by the Forestry Technician and Land Use Agent.
- No grading/excavation work is to be carried out using heavy machinery within 10m of the tower footings. Hydro One may permit grading/excavation work within 10m of the tower footings provided this work is carried out by hand or by using a vacuum truck system.
- Access to Hydro One facilities must not be obstructed at any time during construction, or after the proposed facilities are in service. The site must be kept free of all debris and equipment which could prohibit access to Hydro One facilities.
- Hydro One requires a minimum of 6m wide route longitudinally along the corridor to access each transmission structure. The access route should not have a slope greater than 10%. If the proponent fails to maintain the required access route, they will be liable for any costs incurred by Hydro One in regaining access to perform maintenance or repairs.
- No fill material must be placed on the Hydro One corridor, except with prior approval from Hydro One.
- If the proponent performs any construction activity within 10m of any transmission structures, they must install temporary orange snow fence erected 3m around tower footprint. This fence must be maintained in an upright position for the duration of construction.
- All underground utilities have to be designed to allow for vehicular traffic to pass over. Type of vehicles to be accommodated includes large utility vehicles and cranes.
- The proposal shall not interfere with the natural drainage patterns or result in standing water anywhere on the affected stretch of the Hydro One corridor.
- The proponent will be held liable for any damage to Hydro One facilities, as a result of flooding or standing water caused by the proposal.

- Any proposed catch basins on the Hydro One corridor must be located within a paved roadway.
- The proponent is responsible for maintaining security of the site and for the safety of the people working within the corridor.
- In the case of Hydro One emergency work, the proponent may be required to suspend their operations without notice until Hydro One crews have completed the emergency work.
- Hydro One is not responsible for any damages or injuries resulting from the effect of adverse weather conditions. This would include any damages or injuries from ice falling from structures or conductors as a result of an ice storm.
- Hydro One may, at its sole discretion, interrupt the proponent's occupation of the transmission corridor at any time during construction or post construction, to perform maintenance or emergency repairs. Hydro One will not be liable for any damages suffered by the proponent due to this interruption.

7.7.7 GEOTECHNICAL INVESTIGATIONS

A detailed geotechnical and hydrogeological program should be completed during detailed design to advise on groundwater and subsurface conditions and potential impacts that will need to be considered in the detailed design of the project. Geotechnical investigations will confirm specific construction methodologies, techniques, and processes in consideration of subsurface findings. The residents reliant on private water wells and septic services at 2069, 2086, 2191 Woodroffe Avenue and the Grenfell Glen community have expressed concern for impacts with respect to their water quality and quantity during project construction. Preliminary investigations did not anticipate impacts, however, during detailed design this should be considered as part of the detailed geotechnical investigations.

7.7.8 PHASE TWO ENVIRONMENTAL SITE ASSESSMENT

A Phase One ESA was completed to assist with the evaluation of alternatives and potential impacts that will need to be further considered in the detailed design of this project. The Phase One ESA identified several areas that have some level of risk for contamination. Additional ESA work (e.g., Phase Two ESA) may be required to assess the soil and groundwater quality associated with these areas and to assist in the planning and scoping of the construction phase of the project with regard to the cost and approach to the management of materials (soil and/or groundwater during construction).

7.7.9 EXCESS SOIL MANAGEMENT PLAN

An Excess Soil Management Plan is required as it is expected that construction of the project will generate excess soil and, as such, will need to be managed in compliance with O.Reg. 406/19, as amended under the direction of a Qualified Person. The purpose of this new Regulation is to promote the beneficial reuse of excavated soil and to ensure contaminated soil doesn't end up on clean sites. The supporting excess soil document, *Rules for Soil Management and Excess Soil Quality Standards (2014),* sets out the reporting requirements and applicable excess soil testing and excess soil quality standards requirements to comply with the Regulation. The reporting requirements include the completion of the following excess soil planning reuse reports: Assessment of Past Uses (APU); Sampling and Analysis Plan (SAP); and Soil Characterization Report (SCR) and Excess Soil Destination Assessment Report (ESDAR). In addition to these reports, the Site (defined as the Project Area during detailed design) will require the registration of the Project on the Excess Soil Site Registry and tracking of all excess soil movement generated from the Project and disposed of at an off-site beneficial reuse site and/or waste transfer or waste disposal site. The Regulation does include regulatory exemptions which may not trigger the need to complete the reporting, site registry and tracking requirements. During any proposed construction project involving the management of excess soil, the above-noted regulatory requirements must be completed prior to any site registry and off-site movement of excess soil. Ideally, all of the reporting requirements should be completed during detailed design and construction tendering of the Project to ensure that these documents can support the construction contract tender for competitive bidding purposes.

7.7.10 LANDSCAPE PLAN

The Landscape Plan will generally be in-keeping with the Corridor Landscape Approach outlined in Section 7.4 of this EPR. A detailed Landscape Plan will be prepared to guide the species selection, location and planting details for all

proposed plantings and other streetscape elements throughout the corridor. The plan will be prepared by a professional landscape architect in consultation with the NCC for planting on Greenbelt lands and lands owned/located adjacent to it. For lands adjacent to Black Rapids Creek, RVCA may need to be consulted.

All proposed plantings must be reviewed and approved by the Hydro One Forestry Technician and Land Use Agent in the vicinity of the Hydro One lines.

Hydro Ottawa should be consulted should any tree trimming be anticipated within 3m of Hydro Ottawa's overhead lines. Landscaping should not encroach any existing or proposed Hydro Ottawa overhead or underground assets or easement. Planting trees in proximity of existing power lines shall be done so in consultation with Hydro Ottawa's *Tree Planting Advice* document.

Landscaping opportunities for the median space under the elevated guideway should be considered in consultation with relevant City departments. Proposed elements should be evaluated for safety (including sightlines) and shade tolerance.

7.7.11 AGRICULTURE MANAGEMENT PLAN

The agriculture management plan is a unique plan specific to the project as it extends through highly valued NCC Greenbelt lands that are primarily used for agricultural purposes. To mitigate the impacts from the project, ongoing consultation with the NCC will be essential during the next phases of the project to achieve consensus of the preferred approach to mitigation. The project works has the potential to cause impacts to agricultural soils, tile drainage, farm infrastructure, the interior road network as well as loss of use of agricultural lands. Both temporary and permanent impacts are expected. During the pre-construction planning phase of the project, impacts to all agriculture-related infrastructure (including soils) should be minimized or avoided to the extent possible.

With respect to soils, a Soil Management and Rehabilitation Plan is recommended to be undertaken by qualified professionals in consultation with the NCC during the next phases of the project. This report will identify mitigation required to restore soils to agricultural use and same level of agricultural productivity impacted by temporary and permanent project infrastructure. As part of this plan, baseline conditions for the soils in the area subject to disturbance by construction should be assessed prior to construction. The plan should include recommendations for stripping, handling, storing during construction and replacing soil resources following construction, as well as monitoring to assess conditions and practices during and post-construction.

For tile drains, it is recommended that outlets and headers should be located prior to work and a plan developed to ensure minimization of disruption to the tile drainage system This should also include maintaining outlets and roadside ditches to convey surface waters away from agricultural lands and to avoid temporary ponding of the surrounding agricultural fields. As part of the Agriculture Management Plan, any disrupted tile drainage infrastructure should be restored in consultation with the NCC following completion of project construction.

There are two retired farms and associated infrastructure that may be impacted by the project. The Recommended Plan has been designed to limit impacts to these farms. Continued avoidance should be exercised. Additional mitigation should be explored through the drafting of the Agriculture Management Plan.

The interior road network is essential to maintaining agriculture operations. Impacts to access should be avoided. Main entry/exit points and access to key properties should be established in the Agriculture Management Plan and in consultation with the NCC.

During construction, the lands required for the construction detour will result in a temporary loss of use. Agricultural activities will have to be suspended for a set amount of time to construct the rail grade-separations. The extent to which lands will be impacted and the compensation for tenants as well as the NCC will need to be negotiated during the next phases of the project.

7.7.12 ECOLOGICAL SITE ASSESSMENT

Various potential natural heritage features were identified in the Study Area under present day conditions. An Ecological Site Assessment should be carried out during detailed design and prior to construction to more thoroughly determine the presence, extent or provide an update of natural heritage features including: SAR, and habitat suitable for SAR, Significant Wildlife Habitat, wildland fire risk, significant woodlands and headwater drainage features located along the Recommended Plan corridor. Protection afforded to any identified species shall be in accordance with appropriate provincial and federal jurisdiction.

Breeding bird surveys are recommended as per the Marsh Monitoring program (Bird Studies Canada, 2001) which will also help to identify presence of SAR birds. As per the protocol, a set of at least 3 breeding bird surveys to assess should be conducted between the last week of May and the first week of July and separated by a week or more from previous surveys.

The SAR in Ontario List (O.Reg. 230/08 under the ESA, 2007) and Schedule 1 of the SARA are updated periodically to add newly listed species or revise species status. Prior to construction, these lists should be reviewed and an update of the potential species present and their associated habitat should be completed. A SAR determination should be included in an Ecological Site Assessment for any affected areas. If a SAR is observed during the works within the construction zone, the MECP and/or ECCC are to be immediately contacted and operations modified to avoid any negative impacts to the species or their habitat until they leave the area, or until further direction is provided by the MECP/ECCC. If necessary, permits and/or authorizations will be obtained under the ESA/SARA.

A Wildland Fire Risk Assessment as per Wildland Fire Risk Assessment and Mitigation Reference Manual (MNRF, 2017) should be conducted to determine potential risk of wildland fire particularly in areas of the Study Area that have been identified to contain coniferous forest types. The Tree Conservation Report will also assist with the completion of this report.

During the EA, an assessment was conducted to determine if there were additional qualifying areas within the Study Area that meet the criteria for significant woodlands. In particular, Tallwood Woods was identified as a significant woodland based on criteria contemporary at the time. During the next phase of the project, it should be confirmed if Tallwood Woods or additional woodlots meet the criteria as significant woodlands or those that occur within 120m of the project in rural areas and 30m in urban areas, based on the evaluation criteria at the time of detailed design. Consultation with MNRF and City of Ottawa Natural Systems and Forestry Services staff to confirm buffer width and any other additional requirements is also recommended. Undertaking the Tree Conservation Report will also support this work.

Headwater drainage features should be re-confirmed and assessed during the planning phases of detailed design. Any alteration or interference with a headwater drainage feature or other surface water feature may require a permit from RVCA and restrictions may apply.

The Ecological Site Assessment will also inform or provide guidance on the location, type and size of engineered eco-crossings as well as the location of associated exclusionary fencing.

7.7.13 TREE CONSERVATION REPORT

The purpose of the Tree Conservation Report is to retain as much natural vegetation as possible, including mature trees, stands of trees, and hedgerows. The Tree Conservation Report will identify and describe the vegetative cover on the site prior to construction and will provide a professional opinion as to the priority that should be given to the conservation of the treed areas that are beyond the grading limit. This report will also provide an assessment of trees identified for removal. Additional surveys to mark distinctive mature trees may be required. The City's Tree Protection By-law (No. 2020-340) establishes minimum standards for tree protection, as well as compensation requirements for trees authorized for removal. For trees within Greenbelt lands, the NCC should be consulted as their criteria and methodology for tree conservation reports differs from the City of Ottawa's.

Together the Landscape Plan and the Tree Conservation Report will help ensure that trees will be retained where feasible and that new trees will be planted to contribute to the City's forest cover target and to address net tree loss of a project

site and the tree protection measures required. The Tree Conservation Report will be prepared during detailed design prior to construction and in accordance with the City of Ottawa Guidelines.

7.7.14 CONSTRUCTION TIMING CONSIDERATIONS

All activities related to construction should avoid certain timing windows dependent on the wildlife that is present. Following SAR review and more in-depth surveys conducted prior to detailed design, there may be additional timing restrictions in addition to those listed below to protect sensitive species and/or habitats.

7.7.14.1 Breeding Birds

In order to remain in compliance with the *Migratory Bird Convention Act*, 1994 and *Fish and Wildlife Conservation Act*, 1997, it is recommended that any vegetation removal that may be required take place outside of the breeding bird season for this region (April 1st to August 31st).

In most cases nest searches during the nesting season (April 1st to August 31st) are not recommended within complex habitats, such as those occurring along the project corridor, as the ability to detect nests is low while the risk of disturbance to active nests is high. Disturbance increases the risk of nest predation and abandonment by adults. Therefore, nest searches are not recommended unless nests are known to be easy to locate without disturbing them. Nests searches may be completed during the nesting period (April 1st to August 31st) by a qualified biologist within 'simple habitats' (Canadian Wildlife Service, 2014). Simple habitats refer to habitats that contain few likely nesting spots or a small community of migratory birds.

Examples of simple habitats include the following:

- an urban park consisting mostly of lawns with a few isolated trees;
- a vacant lot with few possible nest sites;
- a previously cleared area where there is a lag between clearing and construction activities (and where ground nesters may have been attracted to nest in cleared areas or in stockpiles of soil, for instance); or,
- a structure such as a bridge, a beacon, a tower or a building (often chosen as a nesting spot by robins, swallows, phoebes, Common Nighthawks, gulls and others)" (Canadian Wildlife Service, 2014)

Similarly, nest searches can also be considered when investigating the following:

- conspicuous nest structures (such as nests of Great Blue Herons, Bank Swallows, Chimney Swifts);
- cavity nesters in snags (such as woodpeckers, goldeneyes, nuthatches); or,
- colonial-breeding species that can often be located from a distance (such as a colony of terns or gulls)" (CWS 2014).

MBCA Regulations, 2022

Updated regulations to the Act, adopted in 2022, include provisions for the year-round protection of nests of 18 species of migratory birds, identified on Schedule 1 of the Act, which reuse nests (Canada 2023a). Removal of the inactive nests of these species requires that either notification be provided to ECCC through the Abandoned Nest Registry, or a species-specific waiting period of 18-36 months be respected in order to establish a nest as abandoned. In the Ottawa Area, potential Schedule 1 species include pileated woodpecker as well as herons and egrets. These new regulations should be reviewed and considered during the next phases of the project.

7.7.14.2 Fisheries Resources

Should there be in-water works confirmation of current in-water construction timing windows with MNRF is necessary prior to any construction works. For potential fish relocation work, a License to Collect Fish for Scientific Purposes is required from the MNRF. To protect fish spawning activity, there are specific in–water works timing window restrictions. Consultation with MNRF is recommended to provide updated information on the timing restrictions at the time of design.

Changes to the federal *Fisheries Act* implemented in 2019 focused on restoring lost protections and incorporating modern safeguards for fish and fish habitat. The intent was also to provide enhanced compliance and protection tools to

enable cross-agency partnerships and better protection of fisheries in Canada (DFO 2018). The updated *Fisheries Act* includes a prohibition against causing the death of fish or the harmful alteration, disruption, or destruction of fish habitat (Section 35 of the Act). Changes resulting from the previous update to the Act in 2012 the *Fisheries Act* still apply. This includes the proponent-based process and requirement for self-assessment for any in-water works. From the self-assessment process, the proposed in-water works are weighed against criteria set out by the DFO. By using these criteria, it can be determined if works can avoid serious harm to fish. If works cannot avoid serious harm to fish and/or works are not included in the criteria listed on the DFO's website, a "Request for Review" will be submitted to DFO. DFO will make a determination regarding serious harm to fish and will outline, if required, approval/authorizations to be obtained from the DFO. Opportunities for habitat enhancements to watercourses should be considered.

7.7.14.3 Turtles

Turtles are actively nesting in June and early July and may be attracted to existing road shoulders or to construction zones with areas of exposed soils or stockpiles of fill. Caution should be taken during the active season (April 1 – October 30) of any given year by thoroughly sweeping the area before works begin to help encourage any turtles within the area to move away. Exclusion fencing will be installed to prevent turtle access to the work area where appropriate (e.g., near water or wetlands). Additional consultation with the MECP may also provide species-specific mitigation, if required. ECCC should also be consulted regarding the potential requirement for a SARA permit or species-specific mitigation should measures be required to protect turtles listed on Schedule 1 of SARA on federal lands.

7.7.14.4 Bats

There are four (4) Species at Risk (SAR) Bats found in Ontario and are present in the City of Ottawa. These species are protected under the ESA as well as their habitats are included in Significant Wildlife Habitat with protection afforded under the PPS. Critical and valuable habitats include hibernacula for overwintering and maternity roost habitat when females are with young. If a hibernacula is determined to be present, avoidance using timing windows can by applied where no work should occur from October 1 to April 30 of any given year. Maternity roost habitats can be varied, ranging from hollow trees and snags, houses, buildings to rocky outcroppings and mature forest. Maternity roosting periods can be avoided from May 1 to July 15 of any given year. If avoidance is not feasible, mitigations such as exclusionary netting can be applied and additional consultation with MECP if required.

7.7.15 AIR QUALITY DISPERSION STUDY

The results of analysis determined the need for a dispersion study around each LRT station to be conducted during detailed design to analyze the potential local air quality impacts in greater detail.

7.7.16 DETAILED STATIONARY NOISE ANALYSIS

Preliminary qualitative assessment indicates that noise from the TSSF may be potentially up to 60 dBA during the daytime period at a distance of 100m, representative of the nearest noise-sensitive property. Because noise levels have the potential to exceed the ENCG criteria for stationary noise, a Detailed Stationary Noise Analysis should be undertaken during the design phase to confirm the need for mitigation. If noise levels are confirmed to exceed the ENCG criteria, the TSSF may require noise mitigation strategies in conformance with the MECP and City of Ottawa guidelines.

7.8 Assessment of the Recommended Plan

7.8.1 ASSESSMENT METHODOLOGY

The preliminary impact analysis of alternatives served to determine which alternative was preferred for the Study Area. If the resulting effects for a particular criterion were the same for each alternative, or no residual effects were predicted, the results were not used to compare alternatives. This section describes the comprehensive analysis/assessment of all the identified impacts of implementing the preferred solution.

The values and conditions identified in the documentation of existing conditions were used as the basis for assessing the effects of the preferred alternative on the transportation, social, physical and biological environments. The impact analysis involved applying the steps, as presented in **Table 7-1**.

Table 7-1 Impact Assessment Approach

Step 1	Identify and analyze activities where the project, as detailed in **Section 7** interact with existing environmental conditions as detailed in **Section 3** and **5**.
Step 2	Acknowledge predetermined project activities that act as *built-in mitigation* measures as well as *site specific mitigation measures*. Both identified by the use of italicized text in **Table 7-2**.
Step 3	Identify the residual environmental effects, if any.
Step 4	Identify opportunities for further mitigation of residual effects, if possible/practical including monitoring.
Step 5	Determine the significance of the residual environmental effects, after further mitigation.

As described in the methodology, an environmental effect assessment requires consideration of the interaction of the project (i.e., project activities) with the environment. Pre-construction, construction and operational activities as described above were assessed.

Professional judgement and experience formed the basis for identifying environmental effects and mitigation measures. The analysis was based primarily on comparing the existing environment with the anticipated future environment, during and after construction. Consideration was given to:

- the magnitude, spatial extent, and duration of effects;
- the proportion of a species population or the number of people affected;
- the direct or indirect effects; and,
- the degree to which the effect responds to mitigation.

In this assessment, 'residual' environmental effects are defined as changes to the environment caused by the project, and vice versa, when compared to existing conditions and taking into account all mitigation measures. Potential residual environmental effects are assessed as to their significance, including spatial and temporal considerations, and are categorized according to the following definitions:

'Positive" refers to an effect that exhibits a beneficial outcome.

'Negligible' refers to an effect that may exhibit one or more of the following characteristics:

- no effect or hardly discernible effect; or
- affecting a population or a specific group of individuals at a localized area and/or over a short period.

"Insignificant' refers to an effect that may exhibit one or more of the following characteristics:

- not widespread;
- temporary or short-term duration (i.e., only during construction phase);
- recurring effect lasting for short periods of time during or after project implementation;
- affecting a specific group of individuals in a population or community at a localized area or over a short period; or,
- not permanent, so that after the stimulus (i.e., project activity) is removed, the integrity of the environmental component would be resumed.

'Significant' refers to an effect that may exhibit one or more of the following characteristics:

- widespread
- permanent transcendence or contravention of legislation, standards, or environmental guidelines or objectives;
- permanent reduction in species diversity or population of a species;

- permanent alteration to groundwater flow direction or available groundwater quantity and quality;
- permanent loss of critical/productive habitat;
- permanent loss of important community archaeological/heritage resources; or,
- permanent alteration to community characteristics or services, or established land use patterns, which is severe and undesirable to the community as a whole.

Study boundaries serve to focus the scope of the assessment such that a meaningful analysis of potential impacts arising from the proposed project can be made. Project boundaries are defined by the spatial and temporal limits of the proposed project activities, and their zones of influence.

Once the potential effects were predicted, additional mitigation measures were identified. Often, these mitigation measures were sufficient to reduce negative effects to an insignificant or negligible status.

Monitoring is important to verify the accuracy of effects predictions. Monitoring measures were recommended to determine what effects actually occurred with project implementation and may result in the modification of mitigation measures to improve their effectiveness.

7.8.2 ASSESSMENT RESULTS

Table 7-2 describes the potential effects, mitigation, residual effects and their significance, and monitoring recommendations for the Recommended Plan.

Project phases are identified as follows: P - Pre-construction/Design; C - Construction; O - Operation

Table 7-2 Impact Assessment Results

Environmental Value	Project Activity	Project Phase			Location	Analysis of Potential Environmental Effect	Mitigation Measures Built-In Mitigation Measures	Potential Residual Effect	Level of Significance after Mitigation	Monitoring Recommendation
		P	C	O						
Social Environment										
Planning Policies	Pre-construction planning and design; Project Implementation.	•			Throughout corridor	Inconsistency in Secondary Plan policies.	Amendment to the Barrhaven Downtown Secondary Plan, Schedule A - Land Use Plan, Parks Designation that may be required to accommodate the facilities at Barrhaven Town Centre.	None anticipated.	Positive	None required.
Planning Policies	Pre-construction planning and design; Project Implementation.	•			Throughout corridor	The project has been developed in accordance with relevant provincial, federal and municipal guiding documents.	Review project in the context of new or updated policies as required and any changes to be incorporated into the preliminary and detailed design for the Recommended Plan.	None anticipated.	Positive	None required.
Existing Land Use	Pre-construction planning and design; Project Implementation.	•			Throughout corridor.	The project will provide an enhanced level of service and thereby access to a diversity of commercial, institutional, mixed-use residential areas and other major destinations such as: • College Square • Algonquin College • Nepean Sportsplex • NCC Greenbelt • VIA Rail Fallowfield Station • Barrhaven Town Centre	None required.	None anticipated.	Positive	None required.
Future Land Use	Pre-construction planning and design; Project Implementation.	•			Throughout corridor.	The project provides opportunities for intensification and new development along the corridor and around stations.	Completion of a Transit-Oriented Development Plan or similar to study corridor specific opportunities and locations for additional land use types and densities.	None anticipated	Positive	Period reviews of plans in accordance with established review cycles.
Indigenous Land Claims	Pre-construction planning and design; Project Implementation.	•			Throughout corridor.	A large portion of northeastern Ontario is subject to an unresolved land claim with the Algonquins. The Agreement-in-Principle (2016) does not identify any lands within the Study Area as subject to these consultations.	Continued engagement and consultation with Indigenous Communities in subsequent project phases.	None anticipated.	Negligible	None required.
Property Requirements	Acquire temporary access to public and private properties to undertake pre-construction surveys and studies.	•			Throughout corridor	Permission to enter onto private and public property will be required prior to construction to obtain/update additional information on: topographical mapping, geotechnical conditions, environmental conditions, and the natural environment to assist in detailed design and inform permitting/approval requirements.	*Public Communications Plan* Consent to Enter Agreements and permissions as required prior to undertaking work. Coordinate investigation schedule with affected property owners to minimize disturbance.	Temporary inconvenience to property owners during surveys and studies.	Insignificant	As per *Public Communications Plan* and requirements negotiated through Consent to Enter Agreements as required.

Environmental Value	Project Activity	Project Phase			Location	Analysis of Potential Environmental Effect	Mitigation Measures Built-In Mitigation Measures	Potential Residual Effect	Level of Significance after Mitigation	Monitoring Recommendation
		P	C	O						
Property Requirements	Acquire necessary properties for the project.	•			Throughout corridor	The project requires permanent property acquisitions from federal, private and public landowners as well as potential easements.	Acquire property as per City of Ottawa Real Property Acquisition policy and according to future land transfers and land leases. Cost, cost-sharing and requirement for compensation to be determined in negotiation with affected landowners. As per *Property Assessment and Acquisition Process.*	Remaining land could be redeveloped/repurposed.	Insignificant	As per *Property Assessment and Acquisition Process.*
Property Requirements	Pre-construction planning and design.	•	•		VIA Rail corridor (Smiths Falls Subdivision)	Permission to enter onto private property will be required to support the design during pre-construction planning and construction phases. Notification to Transport Canada that the existing at-grade crossing is to be replaced with an overpass.	A Board Order may be required. Further consultation with VIA Rail/Transport Canada to determine if the removal of at-grade crossing requires any changes to formalize matters of maintenance, inspection, etc. as it relates to the new bridges.	None anticipated.	Negligible	As per Board Order and City and VIA Rail agreements.
Property Requirements	Acquire necessary permission to access/undertake work on adjacent properties owned by others.	•	•		CN Rail line (Beachburg Rail Corridor)	Permission to enter onto private property will be required to support the design during pre-construction planning and construction phases.	Property requirements will be respected. Plans or work methods on CN Rail's property or affecting CN Rail's structures/safety must be reviewed and approved by CN Rail prior to work. If a temporary or permanent retaining wall is required, CN Rail and its consultants/contractor will design and construct it at a cost to be negotiated with and approved by the City at a timing requested by the City. Early notifications are required to access property, flagman must be present to permit entry to CN property. Locates must be completed prior to any excavation. *Public Communications Plan* to identify any other requirements of CN Rail.	None anticipated	Negligible	As per *Public Communications Plan* and requirements negotiated through Consent to Enter Agreements as required.
Property Requirements	Acquire necessary properties and easements for the project.	•			Nepean Sportsplex property, Greenbelt lands (agriculture properties and private residences), Royale Equestrian Farm. Realignment of Fallowfield Road, lands around rail grade-separation at Woodroffe Avenue and the Southwest Transitway.	Permanent and temporary Federal property requirements will require Federal approvals.	Early consultation and coordination with NCC and any other applicable Federal agencies at the time of project pre-planning. *Property Assessment and Acquisition Process* to acquire property as per City of Ottawa policy and according to future land transfers and land leases. Cost, cost-sharing and requirement for compensation to be determined in negotiation with affected landowners. Completion of a FLUDTA as set out in Sections 12 and 12.1 of the *National Capital Act.* Sale of National Interest Land Mass (NILM) property necessitates a Level 3 FLUDTA required. Completion of requirements consistent with the *Impact Assessment Act* of Canada.	Loss of lands.	Insignificant	As per *Property Assessment and Acquisition Process* and consultation with NCC.

Environmental Value	Project Activity	Project Phase			Location	Analysis of Potential Environmental Effect	Mitigation Measures Built-In Mitigation Measures	Potential Residual Effect	Level of Significance after Mitigation	Monitoring Recommendation
		P	C	O						
Landscape and Visual Environment	Pre-construction planning and design; detailed design for roadway and associated landscape design.	•		•	Throughout corridor. Greenbelt lands. Woodroffe Avenue and Fallowfield Road.	Detailed design for corridor landscaping will need to consider the various corridor contexts. Improve vistas through design and context-sensitive landscaping. Woodroffe Avenue is a scenic route in the Greenbelt Master Plan. The elevated LRT facility (Baseline Station to Fallowfield Station) will create new views and vistas of the City. Rail grade-separation overpasses will create new views and vistas of the Greenbelt lands.	*Landscape Plan* to be completed during detailed design in consideration of landscaping strategy as outlined in **Section 7.4** Corridor Landscaping Consultation with adjacent landowners, RVCA and NCC through the Greenbelt lands and Black Rapids Creek. Opportunities to green the median should be considered consistent with safety requirements (TAC Standards) as well as with species tolerant of constrained/shaded and height-limited contexts. Areas where property is required to construct protected intersections should be considered for additional landscaping enhancements.	Temporary disruptions to the existing views. *Landscape Plan* should result in an overall improvement to existing landscape landscaping and views.	Positive	As per *Landscape Plan.*
Landscape and Visual Environment	Pre-construction planning and design; Project Implementation.	•			Lands adjacent to rail grade-separation overpasses of Woodroffe Avenue, Southwest Transitway and Fallowfield Road.	Although the overpasses will provide new views and vistas in particular, those of a greater distance, the views and vistas of the immediate adjacent farms and other land uses may become less visible.	Improving the safety for all modes by providing segregation to the VIA Rail line is paramount. Wherever possible, the *Landscape Plan* will aim to maintain or improve views and vistas in consideration of their context.	Change in the views and vistas of properties immediately adjacent to rail grade-separations.	Insignificant	As per *Landscape Plan.*
Privacy to adjacent land uses	Pre-construction planning and design; Project Implementation.	•			Lands adjacent to the elevated LRT, Baseline Station to West Hunt Club Road.	The elevated LRT facility (Baseline Station to Fallowfield Station) has the potential to impact the privacy to nearby homes.	A parapet wall and screening fence will be incorporated into the elevated guideway design to mitigate noise and protect nearby residents' privacy. During the next phases of the project the current land use conditions should be revisited to confirm if impacts to privacy exist and provide contemporary mitigation at that time. Any redevelopment adjacent to the corridor (Baseline Station to West Hunt Club Road) should also consider potential impacts to privacy during site planning process. Where possible, *Landscape Plan* to screen nearby land uses.	None anticipated.	Insignificant	As per *Landscape Plan.*
Loss of Affordable Housing Site	Pre-construction planning and design; Project Implementation.	•			1005-1045 Greenbank Road	Train Storage and Servicing Facility to displace an identified potential site for affordable housing.	Staff to remove the 1005--1045 Greenbank Road site earmarked for affordable housing by Council on April 10, 2019 (Report ACS2019-PIE-GEN-001) from the list of affordable housing development sites; and, Direct the Interdepartmental Task Force on Affordable Housing to undertake a comprehensive review of the planned Stage 3 LRT corridors to identify short-term alternative locations for future affordable housing development to replace the 1005-1045 Greenbank Road site.	None anticipated	Insignificant	None required.

Environmental Value	Project Activity	Project Phase			Location	Analysis of Potential Environmental Effect	Mitigation Measures Built-In Mitigation Measures	Potential Residual Effect	Level of Significance after Mitigation	Monitoring Recommendation
		P	C	O						
Archaeological Resources	Pre-construction planning and design; project construction, grading and excavation for all associated infrastructure.	•	•		Areas identified as having archaeological potential.	Construction in undisturbed areas identified as having archaeological potential may disturb intact archaeological resources.	For City/Provincial lands: Conduct subsequent *Archaeological Assessment* (Stage 2, 3, 4) in identified areas in conformance with MCM Standards and Guidelines for Consultant Archaeologists (2011). Archaeological Assessment must be undertaken by a licensed archaeologist. These subsequent assessments should be completed as early as possible in the detailed design process so that study recommendations can be incorporated into the project details. In consultation with Indigenous Communities. Reports will be circulated to MCM and interested Indigenous Communities. If archaeological resources are accidentally uncovered during construction activities, the site should be protected from further disturbances until a licensed archaeologist has completed an assessment. For Federal NCC lands: Conduct subsequent *Archaeological Assessment* (Stage 2, 3, 4) in identified areas as required following direction of NCC Archaeologist.	None anticipated.	Insignificant	Additional work, if needed, as per *Archaeological Assessment* recommendations. As per consultation with Indigenous Communities.
Cultural Heritage Resources (including Built Heritage Resources and Cultural Heritage Landscapes (CHL)	Pre-construction planning and design; project construction, grading and excavation for all associated infrastructure.	•	•		NCC Greenbelt agricultural lands. Temporary detour for Woodroffe Avenue and the Southwest Transitway.	While the grade-separated overpasses are constructed, a temporary detour will be required. The construction of the temporary detour will alter portions of the agricultural fields at the edges of the Greenbelt, recognized by the NCC as a CHL. The detour will result in a temporary and reversible impact to the land use and agricultural character. Construction is proposed more than 50m from the nearest structure. As such, no impacts related to vibration are anticipated.	It is recommended that detailed design of the detour consider its reversibility and detour lands should, to the extent possible, be reverted to their prior form and use following decommissioning of the detour. As per *Agriculture Management Plan.*	None anticipated.	Insignificant	As per *Agriculture Management Plan.*
Cultural Heritage Resources (including Built Heritage Resources and Cultural Heritage Landscapes (CHL)	Pre-construction planning and design; project construction, grading and excavation for all associated infrastructure.	•	•		NCC Greenbelt agricultural lands. Overpass of the VIA Rail line for Woodroffe Avenue and the Southwest Transitway.	The rail grade-separation of Woodroffe Avenue and the Southwest Transitway to the VIA Rail line via overpasses will permanently alter portions of the agricultural fields at the edges of the Greenbelt, recognized by the NCC as a Cultural Heritage Landscape. Construction is proposed more than 50m from the nearest cultural heritage structure. As such, no impacts related to vibration to the cultural heritage landscape are anticipated.	Given that the Southwest Transitway and Woodroffe Avenue currently run adjacent to the Greenbelt, the overpasses are planned in their current alignment and the area is characterised by the rail corridor and station the cultural heritage value is not anticipated to be greatly altered. No significant adverse visual impacts are anticipated.	None anticipated.	Insignificant	None required.

Environmental Value	Project Activity	Project Phase			Location	Analysis of Potential Environmental Effect	Mitigation Measures Built-In Mitigation Measures	Potential Residual Effect	Level of Significance after Mitigation	Monitoring Recommendation
		P	C	O						
Cultural Heritage Resources (including Built Heritage Resources and Cultural Heritage Landscapes)	Pre-construction planning and design; project construction, grading and excavation for all associated infrastructure.	•	•		NCC Greenbelt agricultural lands. 3641 Fallowfield Road.	The realignment and rail grade-separation of Fallowfield Road to the VIA Rail line and Southwest Transitway (future LRT) will result in a permanent loss of a small portion of agricultural lands at the edges of the Greenbelt, recognized by the NCC as a CHL. Construction is proposed more than 400m from the nearest cultural heritage structure. As such, no impacts related to vibration are anticipated.	Given that Fallowfield Road currently runs adjacent to the Greenbelt, the overpass is more than 400m from 3641 Fallowfield Road, the area is characterised by the rail corridor and station and no built features associated with the cultural heritage value of the Greenbelt are located in the vicinity of the proposed overpass the cultural heritage value for either cultural heritage resource (Greenbelt or listed property) is not anticipated to be greatly altered. No significant adverse visual impacts are anticipated.	None anticipated.	Insignificant	None required.
Cultural Heritage Resources (including Built Heritage Resources and Cultural Heritage Landscapes)	Pre-construction planning and design; project construction, grading and excavation for all associated infrastructure.	•	•		NCC Greenbelt. Royale Equestrian Centre - 2191 Woodroffe Avenue.	The entrance to the property will be realigned following construction of the overpass for Woodroffe Avenue. A small portion of land will be permanently lost at the property edge to construct the overpass. Construction is proposed more than 50m from the nearest structure. As such, no impacts related to vibration are anticipated.	Given that the property is currently adjacent to a transportation corridor and rail corridor and no built features associated with the cultural heritage value of the Greenbelt or property are located in the vicinity of the proposed overpass the cultural heritage value for either cultural heritage resource is not anticipated to be greatly altered. No significant adverse visual impacts are anticipated.	None anticipated.	Insignificant	None required.
Cultural Heritage Resources (including Built Heritage Resources and Cultural Heritage Landscapes)	Pre-construction planning and design; project construction, grading and excavation for all associated infrastructure.	•	•		1081 Greenbank Road.	The LRT alignment and TSSF are more than 90m away from the church as such, no impacts are anticipated. Potential loss of or change to cultural heritage value.	None required.	None anticipated.	Insignificant	None required.
Air quality	Project construction, grading and excavation for all associated infrastructure.		•		Throughout corridor	Dust and equipment exhausts will diminish air quality during the construction period.	As per *Public Communications Plan* to inform residents of planned construction works. Contractor to implement air quality BMPs and will be responsible for implementing a mitigation strategy with the intent on satisfying the requirements for Ontario Regulation 419. These can include: • Dust suppressants will be applied as warranted. • Haul routes and nearby streets will be cleaned as per existing municipal standards. • Minimize site storage of granular material in height and context. • Locate storage piles in sheltered areas if feasible. • Provide moveable windbreaks if feasible. • Equipment to be kept in good working order and will not unnecessarily idle.	Dust may be an irritant to adjacent residents, business owners and pedestrians particularly nearby residential areas.	Insignificant	As per *Public Communications Plan.*

Environmental Value	Project Activity	Project Phase			Location	Analysis of Potential Environmental Effect	Mitigation Measures Built-In Mitigation Measures	Potential Residual Effect	Level of Significance after Mitigation	Monitoring Recommendation
		P	C	O						
Air quality	Project operation.			•	Throughout corridor	Products of combustion are anticipated to fall below the MECP's Ambient Air Quality Criteria (AAQC). Over time, pollutant concentrations are expected to improve with vehicle environmental controls and newer engine technologies. Overall, the project undertaking will allow for a higher modal split of transit, thus reducing the emissions and reliance on single occupant vehicles and city buses which operate on fossil fuels, unlike the electrified LRT. Emissions are not anticipated to increase as a result of the rail grade-separations as the same number of travel lanes will replace the existing conditions as an overpass.	None Required.	Pollutant concentrations predicted below AAQC.	Positive	None required.
Air Quality	Operation of LRT.			•	Throughout corridor	Conversion from diesel to electrified LRT technology will reduce in reduced emissions and reliance on single occupant vehicles and city buses which operate on fossil fuels.	None required.	Lowered emissions throughout corridor.	Positive	None required.
Air Quality	Operation of LRT stations and TSSF.			•	Throughout corridor, at stations.	Implementation of LRT will result in expanded activities at transit stations which may result in increased idling to coordinate LRT and bus transit service. The project undertaking will allow for a higher modal split of transit, thus reducing the emissions and reliance on single occupant vehicles and city buses which operate on fossil fuels, unlike the electrified LRT. Passenger pick-up and drop-off areas for cars are not expected to see extended idling and are considered insignificant compared to diesel buses in the area. Only light maintenance and storage is anticipated at the TSSF, significant emissions are not expected.	An *Air Quality Dispersion Study* around each station should be conducted during detailed design to assess potential local impacts.	Potential for reduced air quality around stations and TSSF.	Insignificant	As per *Air Quality Dispersion Study.*
Noise	Project construction, grading and excavation for all associated infrastructure.		•		Throughout corridor	Noise levels produced by stationary and moving construction equipment will be occasionally disruptive to adjacent landowners.	As per *Public Communications Plan* to inform residents of planned construction works. Contractor to adhere to the City By-laws (2017-255). Noise BMPs may include: • Keeping equipment well maintained, moving parts lubricated and restricting unnecessary idling. • Compliance with MECP NPC-115 and NPC-118. • Contractor to have construction noise complaint process detailed, and action plan to address noise related complaints where warranted.	Temporary increase in noise from construction.	Insignificant	As per *Public Communications Plan*. Monitor complaints during construction.

Environmental Value	Project Activity	Project Phase			Location	Analysis of Potential Environmental Effect	Mitigation Measures Built-In Mitigation Measures	Potential Residual Effect	Level of Significance after Mitigation	Monitoring Recommendation
		P	C	O						
Noise	Project Construction	•	•		Royale Equestrian Centre - 2191 Woodroffe Avenue.	Construction equipment noise and activities near active farm may impact animal behavior and operations/programming.	As per *Public Communications Plan* to inform residents and tenants of planned construction works. Installation of additional noise-diminishing mitigation measures should be determined in advance of project construction and in consultation with landowners and tenants i.e., installation of temporary noise barriers, additional insultation of selected buildings. Timing of construction works in consultation and coordination with property owners and tenants.	Temporary increase in noise from construction.	Insignificant	As per *Public Communications Plan*. Monitor complaints during construction.
Noise	Project operation.			•	Throughout corridor	The proposed Fallowfield Road realignment will move the road away from nearby receptors, reducing noise levels. Noise levels along the alignment are dominated by area road traffic. Established ambient noise levels in the Study Area are more than 60 dBA. Implementation of the project will marginally increase noise levels above existing conditions.	Noise levels fall below the City's Environmental Noise Control Guideline for provision of mitigation measures. Should there be changes in guidelines and best management practices in the future or changes in LRT design, further noise analysis may be required at detailed design. A parapet wall and screening fence will be incorporated into the elevated guideway design to mitigate noise and protect nearby residents' privacy. If future residential developments are proposed, the requirement for noise attenuation measures will be evaluated at that time and any necessary mitigation will be included as a condition of development approval. Continued discussions of lessons learned with Stage 1/2 Office are recommended.	None anticipated	None	Ongoing discussions with Stage 1/2 Office.
Noise	Operation of the TSSF			•	TSSF location	Preliminary qualitative assessment indicates that noise from the TSSF may be potentially up to 60 dBA during the daytime period at a distance of 100m, representative of the nearest noise-sensitive property.	Because noise levels have the potential to exceed the ENCG criteria for stationary noise, a *Detailed Stationary Noise Analysis* should be undertaken during the detailed design phase to confirm the need for mitigation. If noise levels are confirmed to exceed the ENCG criteria, in conformance with the MECP and City of Ottawa the TSSF may require noise mitigation strategies that could include equipment silencers, noise walls or berm around the perimeter of the property.	None anticipated	Negligible	As per findings of *Detailed Stationary Noise Analysis*.
Noise and Vibration	Operation of LRT	•	•	•	Traction power substation locations (TPSS)	Noise and vibration generated by TPSS may impact nearby sensitive receivers.	During preliminary and detailed design, once analysis has been completed to more accurately determine the locations of the TPSS, a noise and vibration analysis may be required to determine if there are noise and vibration impacts and mitigation will be required.	None anticipated	Negligible	As per findings of future noise and vibration studies.
Vibration	Project construction, grading and excavation for all associated infrastructure.		•		Throughout corridor	Construction activities may cause noticeable vibrations.	As per *Public Communications Plan* to inform nearby residents/businesses/institutions of planned construction works. Vibration BMPs to be implemented by contractor. Compliance with MECP NPC-119. Construction vibration complaint process is detailed with an action plan to address vibration-related complaints where warranted.	Temporary vibrations from construction activities may be noticeable.	Insignificant	As per *Public Communications Plan*. Monitor complaints during construction.

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Vibration	Project construction, grading and excavation for all associated infrastructure.		•		Royale Equestrian Centre - 2191 Woodroffe Avenue.	Construction activities may cause noticeable vibrations that may impact animal behavior.	As per *Public Communications Plan* to inform nearby residents/businesses/tenants/institutions of planned construction works. Installation of additional noise-diminishing mitigation measures should be determined in advance of project construction and in consultation with landowners and tenants i.e., installation of temporary noise barriers, additional insultation of selected buildings. Timing of construction works in consultation and coordination with property owners and tenants	Temporary vibrations from construction activities may be noticeable	Insignificant	As per *Public Communications Plan*. Monitor complaints during construction.
Vibration	Project operation			•	Throughout corridor	Predicted future vibration level conditions are anticipated below perceptible thresholds.	Continued discussions of lessons learned with Stage 1/2 Office are recommended.	Vibration levels below recommended perceptible threshold.	Negligible	Ongoing discussions with Stage 1/2 Office.
Climate Change: Extreme weather events	Pre-construction planning and design.	•			Throughout corridor.	Increasing variability in temperature extremes. Increasing frequency of high-intensity and duration of weather extremes (i.e., wet weather, dry periods, windstorms).	Actions as detailed in the City of Ottawa's Climate Change Master Plan (2020) or as updated. *Corridor Drainage and Stormwater Management Plan* to consider accommodation of flash storm events and regard for Wet Weather Infrastructure Management Plan or best practices at the time of construction. *Landscape Plan* to consider possible mitigating use of trees for moderating temperatures and provide wind break.	Potential for short-term flooding. Disruptions to corridor for additional maintenance, as required.	Insignificant	As per *Corridor Drainage and Stormwater Management Plan,* and *Landscape Plan.*
Climate Change: Corridor user safety and comfort	Pre-construction planning and design.	•			Throughout corridor.	Increased risk to public safety for corridor users during extreme storm events. Reduced corridor user comfort during periods of extreme temperature.	Actions as detailed in the City of Ottawa's Climate Change Master Plan (2020) or as updated. *Landscape Plan* to consider possible mitigating effects to improve corridor user comfort through application of additional sheltering elements. Corridor to include adequate rest areas.	Temporary discomfort to corridor user.	Insignificant	As per *Landscape Plan.*
Climate Change: Waste Management	Pre-construction planning and design. Project construction, grading and excavation for all associated infrastructure.	•	•		Throughout corridor	Construction of the project has the potential to produce a large amount of waste.	Design to consider opportunities to employ waste-reduction methods, where possible. Contractor to develop *Waste Management Plan* to the extent possible, reuse material on-site prior to the consideration for new materials or shipment off-site.	Generation of excess waste materials for disposal off-site.	Insignificant	As per *Waste Management Plan.*
Climate Change: Green LRT Station Design	Pre-construction planning and design.	•			At LRT Stations	Opportunity to reduce carbon footprint and build in resiliency by employing contemporary "green' design standards.	During detailed design, to consider green building design principles in the planning and design of LRT stations, drop-off and pick-up areas, and connections to/from stations including adoption of a green design standard, such as LEED or similar standard, and consideration be given to green building design elements such as green roofs, low impact design for stormwater management, low maintenance and native tree plantings and consideration for tree canopy cover, and other climate mitigation and adaptation strategies.	None.	Insignificant	As per City policies and procedures.

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Climate Change: Extreme weather events	Project operation.			•	Throughout corridor.	Increased frequency of high intensity and duration of wind and storm events may result in greater frequency of disruptions to service (i.e., temporary closure for maintenance, loss of power at traffic signals).	City to follow *Emergency Response Plan* policies and procedures. Maintenance plan to consider reducing risks to infrastructure.	Temporary disruptions to corridor function during and immediately following extreme weather events.	Insignificant	As per *Emergency Response Plan.*
Climate Change: Extreme snow and ice events	Project operation.			•	Throughout corridor.	Increased frequency and duration of extreme snow and ice events may increase risk to corridor users (i.e., pedestrians and cyclists). Increased requirement for application of de-icing agents.	City to consider pre-application techniques to prevent ice build-up and requirement for further applications as per City operating policies and processes and best practices at the time of operation.	Iced surfaces may result in accidents to corridor users.	Insignificant	As per City policies and procedures.
Transportation Network										
Pedestrian and Cycling Network	Project construction		•		Throughout corridor. Grenfell Glen community.	Construction will require detours for pedestrians and cyclists. Potential for decreased safety for pedestrians and cyclists in the community resulting from cut-through traffic/speeding/congestion during construction. The Grenfell Glen community does not have sidewalks so must share the road with vehicles.	Key pedestrian and cycling routes should be maintained. Accessibility Design Standards (City of Ottawa, 2015) must be applied. Contractor to implement a *Construction and Traffic Management Plan* to minimize the effects on traffic flow and to ensure roadway safety for all users. Detours through the Grenfell Glen community to be avoided if possible. If not possible, signage and additional traffic slowing/calming measures should be implemented to protect pedestrians and cyclists sharing the road in this community. A *Public Communications Plan* should be developed in consultation with OC Transpo to inform residents of construction schedule and changes. Construction fencing to demarcate the work area for safety.	Temporary inconvenience to pedestrians and cyclists.	Insignificant	As per *Public Communications Plan* and *Construction and Traffic Management Plans* including *Transit Operations*. Monitor complaints during construction.
Pedestrian and Cycling Network	Pre-construction planning and design. Project Operation	•		•	Throughout corridor	Improved/enhanced pedestrian and cycling connections. Opportunity to implement missing links and continuous facilities. Rail grade-separation to the VIA Rail line improving level of safety for the facilities.	BMPs during preliminary and detailed design phase. Regard for contemporary pathway design and protected intersection design. Accessibility Design Standards will be applied. Consultation with NCC for pathway design in Greenbelt lands. A *Landscape Plan* will be implemented to include pedestrian and cycling amenities. Modifications to the multi-use pathway located through the Greenbelt located on NCC lands should be completed at the cost of the City and continued to be maintained by the City as is currently the agreement.	Pedestrians and cyclists will be provided a safer, multi-modal, more accessible transportation environment.	Positive	None required.
Road and Transit Network	Pre-construction planning and design. Project construction.	•	•		Temporary detour route, rail grade-separation to the VIA Rail line.	The temporary detour route has been planned to ensure it meets the requirements under a crossing safety review to ensure the detour configuration is acceptable.	It is recommended that during preliminary and detailed design that the detour configuration be re-confirmed to meet safety requirements. Continued consultation with VIA Rail during pre-construction planning and design as well as construction phases of the project.	None anticipated.	Negligible	As per detour crossing safety review and in consultation with VIA Rail.

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Road and Transit Network	Project construction.		•		Throughout corridor. North of Knoxdale Road to Hunt Club Road.	Disruption to transit and traffic services. Construction will require transit and vehicle detours during construction. Traffic may become congested, cut-through traffic may be experienced on Knoxdale Road.	A *Public Communications Plan* should be developed to inform residents and businesses of construction schedule and changes. A public notification program should be implemented by the City and OC Transpo for any detoured transit routes/stops. *Traffic Management Plan including Transit Operations* in consultation with OC Transpo (for Transit modifications) Maintain crossroad traffic during construction of median elevated LRT. Avoid closure of crossroads as much as possible. In consultation with OC Transpo, maintain transit lane on Woodroffe Avenue until such time as the LRT is operational before removing transit lane. Enforcement of lane allocations during construction. Off-peak daytime closures or reductions are to be avoided as much as possible. Contractor to ensure road safety for all corridor users. *Emergency Response Plan*. To limit increased cut-through traffic along Knoxdale Road it is recommended that traffic calming measures along Knoxdale Road be considered prior to construction.	Increased traffic on alternate routes during construction. Possible delays in travel time in peak hours during construction. Possible isolated delays in emergency response	Insignificant	As per *Public Communications Plan* and *Construction and Traffic Management Plans including Transit Operations.* Monitor complaints during construction.
Road and Transit Network	Project operation.			•	Throughout corridor.	Implementation of a higher-order facility will improve transit service throughout the corridor and increase modal-share. Improved transit user experience. Implementation of the rail grade-separations to the VIA Rail line will improve safety for all modes.	BMPs during detailed design phase. Regard for contemporary design standards. Accessibility Design Standards will be applied. *Landscape Plan* will be implemented to include pedestrian and cycling amenities.	Increased transit ridership. Improved local and regional traffic movements. Improved connections between communities.	Positive	None required.
Road and Transit Network	Project operation.			•	Throughout corridor.	Maintenance activities may result in temporary disruption to service and require detours.	*Traffic Management Plan* including Transit Operations for maintenance work requiring substantial delays. *Public Communications Plan* to notify users of potential delays/changes to service.	Temporary disruption to transit service during maintenance activities.	Negligible	*Traffic Management Plan* including Transit Operations and as per *Public Communications Plan*
Transit Network	Pre-construction planning and design.	•			North of Knoxdale to West Hunt Club Road	The distance between local bus stops on Woodroffe Avenue and intersections adds travel time for transit users.	Opportunities to shorten travel distance i.e., shifting bus stop locations should be optimized during the next phases of the project, ensuring consistency with TAC. Ongoing consultation with OC Transpo will be required.	Slightly longer transfer distance than optimal.	Insignificant	As per consultation with OC Transpo.

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Transit Network	Pre-construction planning and design. project construction and operation.	•	•	•	North of Knoxdale to West Hunt Club Road. Key corridors in the area as needed.	The reconstruction of Woodroffe Avenue and subsequent narrowing of the corridor may result in increased congestion and may affect transit operation and impact network-wide operation during construction.	Opportunities to implement transit priority measures should be considered during the next phases of the project to help maintain transit operation in the area. Should be considered during all next phases of the project on an ongoing basis. *Traffic Management Plan including Transit Operations* Ongoing consultation with OC Transpo will be required.	Increase to transit times during operation.	Insignificant	As per consultation with OC Transpo.
Transit Network: Access	Project operation			•	Knoxdale Station	The distance between the Knoxdale LRT station and north and southbound bus stops is greater than desired.	Opportunities to shorten travel distance between the Knoxdale LRT station and north and southbound bus stops should be considered during the next phases of the project. Station layout could provide opportunity to shorten travel as well i.e., by locating an entrance at the south end of the station. Opportunities to weather protect travel between station and stops should also be considered further i.e., covered walkway. Ongoing consultation with OC Transpo will be required.	Slightly longer transfer distance than optimal.	Insignificant	As per consultation with OC Transpo.
Road Network: Access	Project construction.		•		Road access to Greenbelt Research Farm, Royale Equestrian Farm (2191 Woodroffe Avenue), residences located on Greenbelt lands.	Project activities may disrupt access in the vicinity of identified properties.	Access during and post construction must be maintained at noted locations. Best efforts during construction staging to ensure the REC's operations can continue (e.g., timing the driveway and paddock relocation. A *Public Communications Plan* should be developed to inform residents/tenants/businesses of construction schedule and changes. *Traffic Management Plan including Transit Operations* in consultation with OC Transpo (for Transit modifications) Contractor to ensure road safety for all corridor users. Ongoing consultation with the NCC required during preliminary and detailed design is required.	None anticipated.	Negligible	As per *Public Communications Plan* and *Construction and Traffic Management Plans including Transit Operations.* Monitor complaints during construction. Ongoing consultation with NCC.
Road Network: Design	Project operation.	•		•	Royale Equestrian Farm 2191 Woodroffe Avenue.	Modified entrance to the Royale Equestrian Farm must maintain access/egress for large agricultural vehicles to the site.	The Recommended Plan includes a new signalized entrance to the Royale Equestrian Centre that accommodates large agricultural vehicles to access the site in similar manner to existing conditions. Additional consultation and design review during preliminary and detailed design with the NCC and tenants (REC) shall be undertaken. Best efforts during construction staging to ensure the REC's operations can continue (e.g., timing the driveway and paddock relocation.	A permanent small loss of land adjacent to the rail grade-separations.	Negligible	As per consultation with NCC and tenants.
Transportation Network: Safety	Project operation.			•	New signalized intersection with Fallowfield Park and Ride and Royale Equestrian Centre on Woodroffe Avenue.	The new signalized intersection provides enhanced safety for all users.	None required.	Improved safety for users.	Positive	None required.

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Transportation Network: Safety	Pre-construction planning and design. Project operation.	•		•	Woodroffe Avenue reconstruction, north of Knoxdale to the Nepean Sportsplex.	Roadway reconstruction will require modification to corridor lighting to avoid conflict with the elevated median LRT guideway. Shadows from the elevated median LRT guideway may diminish sightlines/visibility. High visual demands in the area resulting from the median elevated LRT guideway may diminish sightlines/visibility.	Further discussions with relevant City Departments will be required. *Lighting Treatment Plan.* Additional study to assess hazard areas during detailed design phase will be required. Mounting traffic signals directly on the elevated guideway, use of modified traffic signal design should be considered during the detailed design phase.	None anticipated.	Negligible	As per ongoing discussions with City departments.
Transportation Network	Pre-construction planning and design. Project operation.	•		•	Woodroffe Avenue reconstruction, north of Knoxdale to the Nepean Sportsplex.	The implementation of the protected intersections will impact existing signals timing.	Signal timing modifications to be reviewed during the next phases of the project. Ongoing consultation with relevant City Departments will be required.	None anticipated.	Negligible	As per ongoing discussions with City departments.
Rail Network	Construction of the Project.		•		At the VIA Rail crossing.	Potential disruption to VIA Rail's train schedule and operations.	All efforts shall be taken to not impact Railway operations during the course of the project. As per **Section 7.7.4.3**. Consultation with VIA Rail to determine what/if any restrictions to construction must be completed in consideration of VIA Rail train operations.	Potential for short-term and/or unintentional service disruptions.	Insignificant	As per consultation with VIA Rail.
Heavy Rail Network	Pre-construction planning and design. Project construction.	•	•		CN Rail line	Construction in the vicinity of the CN Rail line may require special coordination with rail activity. Protection of fibre optic line(s).	Any plans or work methods on CN Rail's property or affecting CN Rail's structure/safety must be reviewed and approved by CN Rail prior to work. CN will judge if the work is to be done in between trains with a flagman or if a workblock is needed with a flagman/supervisor. As per **Section 7.7.4.3**. Detailed design in accordance with CN Rail standards and applicable permitting requirements.	Temporary disruption to CN railway operations.	Insignificant	As per consultation with CN Rail.
Biological Environment										
Vegetation	Pre-construction planning and design.	•			Coniferous hedgerow located west of the Southwest Transitway and just south of Vaan Drive.	This coniferous forest community has been identified as having moderate wildlife fire risk.	*Ecological Site Assessment* including Wildland Fire Risk Assessment as per Wildland Fire Risk Assessment and Mitigation Reference Manual (MNRF, 2017) *Tree Conservation Report and Landscape Plan.*	Reduced wildland fire risk.	Positive	As per *Ecological Site Assessment, Tree Conservation Report and Landscape Plan.*
Vegetation	Pre-construction planning and design. Project construction, grading and excavation for all associated infrastructure.	•	•		Throughout corridor including Tallwood Woods, Black Rapids Creek, Fallowfield Station.	Clearing and grubbing activities will remove/alter vegetation. Loss of terrestrial/wetland vegetation due to construction activities may cause fragmentation of habitats and corridors. Accidental spills to the terrestrial environment.	*Ecological Site Assessment* prior to construction to identify existing wildlife corridors and habitats. Protection of identified features and individual specimens with exclusion fencing. *Tree Conservation Report and Landscape Plan.* Minimize vegetation clearing to the extent possible. Replacements to be with native varieties and/or salt tolerant species as appropriate. *Spills Response and Reporting Plan.* *Erosion and Sediment Control Plan* to be implemented prior to vegetation removal.	Localized loss of terrestrial/wetland vegetation.	Insignificant	As per *Ecological Site Assessment, Tree Conservation Report, Landscape Plan* and *Erosion* and *Sediment Control Plan.*

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Vegetation	Project operation.			•	At-grade portions of the LRT facility.	Application of herbicides to maintain LRT track. Spread of invasive species along rail lines.	*Spills Response and Reporting Plan.*	Localized increased susceptibility to invasive species and lowered LRT operation safety issue.	Insignificant	As per *Spills Response and Reporting Plan.*
Wildlife	Pre-construction planning and design; project operation.	•		•	LRT station locations	Wildlife collisions with stations.	Follow City of Ottawa guidelines for bird-safe design. The guidelines were documented in compliance with the CSA A460:19 and approved by City Council on November 25, 2020.	Accidental avian injury/mortality.	Insignificant	As per *City of Ottawa guidelines for bird-safe design guidelines*
Wildlife	Pre-construction planning and design; project operation.	•		•	Throughout corridor including Pinhey Forest and Black Rapids Creek and Tributary.	New illumination throughout the corridor may influence wildlife circadian rhythms. Increase in high frequency noises may influence wildlife behaviour including foraging and communication.	*Ecological Site Assessment* to understand wildlife populations and specific mitigation to reduce illumination effects. *Lighting Treatment Plan* based on contemporary BMPs, research and consultation with NCC for Greenbelt areas. Best practices through design to ensure a balance of maintaining road safety (from wildlife collisions) while not over-illuminating adjacent natural areas.	Change to wildlife behaviour.	Insignificant	As per detailed design recommendations.
Wildlife	Pre-construction planning and design. Project construction, grading and excavation for all associated infrastructure.	•	•		Throughout corridor, including Tallwood woods, Pinhey Forest, Black Rapids Creek and Tributary.	Impact to wildlife movement due to construction activities. Temporary localized disruption of wildlife habitat. General construction activities may disturb migratory birds or their habitat.	*Ecological Site Assessment* including targeted surveys to be conducted prior to construction. Delineation of construction area to limit disturbance. As per the City's Protocol for Wildlife Protection during Construction (2015). To reduce the possibility of contravention of the MBCA, vegetation removal should be scheduled to occur outside of the overall bird nesting season of April 1 to August 31. If a nest of a migratory bird is found within the active construction area at any time, vegetation removal and construction activities must cease until the young have fledged from the nest and the area is cleared by a qualified Biologist. If vegetation must be removed during the overall bird nesting season nest sweeps must be completed prior to works and cleared by a qualified Biologist. Caution should be taken during the turtle nesting season in June and early July as turtles use embankments and other terrestrial sites for nesting. During the active season MNRF recommends a thorough sweep of the area before works begin to encourage any turtles using the site to move away and the use of exclusion fencing as a best management practice. Fencing must be installed in the spring, prior to the turtle nesting season, be maintained throughout works, and checked on a daily basis.	Minor short-term localized avoidance of the area by migratory birds and transient wildlife.	Insignificant	As per City's Protocol for Wildlife Protection during Construction, and *Ecological Site Assessment*. Daily sweeps of the construction areas.

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Wildlife Movement	Pre-construction planning and design. Project construction, grading and excavation for all associated infrastructure. Project operation.	•	•	•	North of VIA Rail corridor including Black Rapids Creek Tributary.	New Eco-Crossings will allow for safer and increased wildlife mobility across transportation corridor(s), and fewer collisions. New Eco-Crossings help protect a natural link between natural areas on either side of corridor. New Eco-Crossings will be designed to address the needs of small animals and large mammals.	The location of eco-crossings will be re-confirmed at the detailed design stage. It is possible that additional eco-crossings may be recommended at that time, and/or that the recommended locations may change, based on new information that may be available while having regard for funding and approval requirements and limitations. The detailed design of the eco-crossings to be confirmed through *Ecological Site Assessment* work. Wildlife exclusion fencing to be integrated with the eco-crossings as determined through *Ecological Site Assessment* work. Implementation of wildlife warning signs and other traffic signs as part of the wildlife collision prevention program and detection systems, if appropriate. Landscape strategy to consider field of views of animals that may use the corridor.	Fewer vehicle-wildlife collisions. Increased habitat connectivity for small and large animals.	Positive	As per detailed design recommendations. This is to include monitoring of the wildlife collision prevention measures and making adjustments as necessary.
Species at Risk: Butternut	Pre-construction planning and design. Project construction, grading and excavation for all associated infrastructure.	•	•		Black Rapids Creek, west of Woodroffe Avenue and north and south of Berrigan Drive near existing Southwest Transitway corridor.	Butternut trees may be impacted by the construction of the project.	*Ecological Site Assessment* prior to construction to identify existing Butternut trees. Butternut Health Assessment should be completed as part of *Ecological Site Assessment* to determine requirements for permitting, protection, and compensation. *Tree Conservation Report, and Landscape Plan.* Protection of identified features and individual specimens with exclusion fencing. Minimize vegetation clearing to the extent possible. Compensation Butternut plantings. *Spills Response and Reporting Plan.* *Erosion and Sediment Control Plan* to be implemented prior to vegetation removal. Authorization may be required or the project may qualify for an exemption under O. Reg. 830/21. Consultation with MECP to identify any permits/approvals required. If necessary, permits to be obtained under the ESA. Butternut is also listed as an Endangered species on Schedule 1 of SARA, consideration should be given to whether SARA permits may be required from ECCC should direct or indirect impacts be anticipated to Butternut individuals.	Potential for loss of Butternut trees.	Insignificant	As per *Ecological Site Assessment, Landscape Plan, and Tree Conservation Report* and in consultation with agencies.

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Species at Risk - Confirmed	Pre-construction planning and design. Project construction, grading and excavation for all associated infrastructure.	•	•		Throughout corridor and within 120m (for rural areas) and 30m (in the urban area) including Tallwood Woods, Pinhey Forest, Black Rapids Creek and Black Rapids Creek Tributary	Three threatened/endangered species under the ESA and/or SARA were confirmed present within the Study Area. These include: Bobolink and Eastern Meadowlark. Species at Risk habitat may be affected during construction.	Conduct an *Ecological Site Assessment* to re-confirm presence of SAR identified. Avoidance of habitats of identified SAR where possible. Targeted surveys may be required. Protection afforded to any identified SAR or SAR habitat shall be in accordance with appropriate federal/provincial jurisdiction. Construction Timing Considerations - mitigation measures outlining timing window restrictions on construction will also help protect SAR. Authorization may be required or the project may qualify for an exemption under O. Reg. 830/21. Consultation with MECP, CWS and ECCC, to identify any permits/approvals required. If necessary, permits or authorizations to be obtained under the ESA. Additional considerations to avoid contravention of the MBCA will also need to be considered. All on-site staff should undergo environmental awareness training to be able to identify the potential SAR that could be encountered. If SAR are observed during construction, the MECP is to be immediately contacted and operations modified to avoid any negative impacts to the species or their habitat until further direction is provided by the MECP.	Potential for short-term localized disturbance to SAR.	Insignificant	*Ecological Site Assessment* and in consultation with agencies.
Species at Risk – Potential Species/habitat	Pre-construction planning and design. Project construction, grading and excavation for all associated infrastructure.	•	•		Throughout corridor and within 120m (for rural areas) and 30m (in the urban area) including Tallwood Woods, Pinhey Forest, Black Rapids Creek and Black Rapids Creek Tributary	Seven threatened/endangered species under the ESA and/or SARA have the potential to occur within the Study Area. These include: Bank Swallow, Chimney Swift, Common Nighthawk, Wood Thrush, Little Brown Myotis, Northern Myotis, and Tricolored Bat. Species at Risk habitat may be affected during construction.	Conduct an *Ecological Site Assessment* to confirm presence of SAR identified. Avoidance of habitats of identified SAR where possible. Targeted surveys may be required. Protection afforded to any identified SAR or SAR habitat shall be in accordance with appropriate federal/provincial jurisdiction. Construction Timing Considerations - mitigation measures outlining timing window restrictions on construction will also help protect SAR. Preventative measures (e.g., covering excavated soils) should be employed to deter opportunistic species such as Bank Swallow and Common Nighthawk from nesting on stockpiled materials within construction areas. Consultation with MECP SAR branch, CWS and ECCC, to identify any permits/approvals required. If necessary, permits or authorizations to be obtained under the ESA. Additional considerations to avoid contravention of the MBCA will also need to be considered. All on-site staff should undergo environmental awareness training to be able to identify the potential SAR that could be encountered. If SAR are observed during construction, the MECP is to be immediately contacted and operations modified to avoid any negative impacts to the species or their habitat until further direction is provided by the MECP.	Potential for short-term localized disturbance to SAR.	Insignificant	*Ecological Site Assessment* and in consultation with agencies.

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Significant Wildlife Habitat (SWH) - Confirmed	Pre-construction planning and design. Project construction, grading and excavation for all associated infrastructure.	•	•		Locations identified and within 30m of confirmed SWH including Pinhey Forest.	Potential loss and/or edge disturbance of confirmed SWH.	During detailed design phase of the project consultation with MNRF and an *Ecological Site Assessment* should be completed to re-confirm SWH (sand barren, woodland raptor nesting habitat and special concern and rare wildlife species habitat). Confirmed SWH within 30m of the project may require mitigation measures. Mitigation measures should follow the advice provided in the Significant Wildlife Habitat Mitigation Support Tool (SWHMist) (MNRF, 2014). *Tree Conservation Report and Landscape Plan.* Minimize vegetation clearing to the extent possible. Replacements to be with native varieties and/or salt tolerant species as appropriate.	None anticipated.	Insignificant	As per *Ecological Site Assessment, Tree Conservation Report and Landscape Plan.* Advice in the SWHMist (MNRF 2014) and consultation with MNRF.
Significant Wildlife Habitat (SWH) - Candidate	Pre-construction planning and design. Project construction, grading and excavation for all associated infrastructure.	•	•		Locations identified and within 120m (for rural areas) and 30m (in the urban area) of candidate SWH, including Tallwood Woods, Pinhey Forest, and Black Rapids Creek.	Potential loss and/or edge disturbance of candidate SWH.	During detailed design phase of the project consultation with MNRF/ECCC/NCC and an *Ecological Site Assessment* should be completed to confirm candidate SWH (waterfowl stopover and staging areas, amphibian breeding habitat, and bat maternity colonies). Candidate SWH within 120m (for rural areas) and 30m (in the urban area) of the project may require mitigation measures. Mitigation measures should follow the advice provided in the Significant Wildlife Habitat Mitigation Support Tool (SWHMist) (MNRF, 2014). *Tree Conservation Report and Landscape Plan.* Minimize vegetation clearing to the extent possible. Replacements to be with native varieties and/or salt tolerant species as appropriate.	Loss or change to SWH.	Insignificant	As per *Ecological Site Assessment, Tree Conservation Report and Landscape Plan.* Advice in the SWHMist (MNRF 2014) and consultation with MNRF.

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Aquatic Habitat	Pre-construction planning and design. Project construction, grading and excavation for all associated infrastructure.	●	●		Black Rapids Creek and Black Rapids Creek Tributary. All other watercourse crossings including agricultural drains.	Increased sedimentation during construction could impact fish habitat. Input of deleterious substances and water quality: via spills/leaks during construction and operational phase	Consult with regulatory agencies such as DFO, MNRF and RVCA regarding details of construction methodology and proposed mitigation measures. Mitigation measures proposed to reduce/eliminate potential effects to surface water resources, will also help reduce/eliminate potential effects to aquatic habitat such as: • Store all stockpiled material away from watercourses. • Remove all stockpiled material following construction. • Construction fencing at work areas near watercourses to limit the area of disturbance from encroaching on watercourses. • Minimize vegetation clearing around watercourses as much as possible, necessary to accommodate construction. • Preference for construction during low-flow periods. • Ensure machinery is in good working condition, free of fluid leaks. Inspections should be conducted daily to ensure this. • Refueling of equipment should be conducted away from slopes and at least 30m away from any surface water. Designated refueling area should be implemented for the site. Contractor to complete an *Erosion and Sediment Control Plan*, *Emergency Response Plan* and *Environmental Protection Plan*. Complete Fisheries Self-Assessment prior to undertaking in-water work. Follow current in-water construction timing restrictions provided by MNRF. Avoid in-water work to the extent possible. Headwater drainage features should be re-confirmed and assessed through *Ecological Site Assessment* during the planning phases of detailed design. Not all features were identified during the EA due to access restrictions. Any alteration or interference with a headwater drainage feature or other surface water feature may require a permit from RVCA and restrictions may apply.	Potential localized and temporary reduction in water quality and aquatic environment.	Negligible	As per *Erosion and Sediment Control Plan, Emergency Response Plan, Environmental Protection Plan* and results of *Ecological Site Assessment.*
Aquatic Environment – Water Quality	Project construction and operation.		●	●	Black Rapids Creek and Black Rapids Creek Tributary. All other watercourse crossings including agricultural drains.	Salt, spray and drainage.	The implementation of Low Impact Design stormwater management techniques will be determined during detailed design. These techniques will assist with the management of water quality and quantity prior to infiltration to the surrounding environment. Road drainage near the Black Rapids Creek and Black Rapids Creek Tributary crossing should be directed away from the creek to allow for infiltration and improve water quality. When snow is removed during operation, the creek should be protected/the snow should be directed into drainage swales, not directly into the creek.	Potential localized and temporary reduction in water quality and aquatic habitat.	Insignificant	None required.

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Surface Water Features	Pre-construction planning and design. Project construction, grading and excavation for all associated infrastructure.	●	●		Black Rapids Creek and Black Rapids Creek Tributary. All other watercourse crossings including agricultural drains and wetlands.	The rail grade-separations and construction detour may cause potential impacts to surface water features in the Study Area.	*Erosion and Sediment Control Plan.* Consultation with RVCA through detailed design of the project. Permit requirement under Section 28 of the *Conservation Authorities Act* known as Development, Interference with Wetlands and Alterations to Shorelines and Watercourses Regulation (Ontario Regulation 174/06). Further consultation with RVCA and the NCC during preliminary and detailed design to ensure protection of the recent NCC wetland restoration project.	Potential impacts to surface water features.	Insignificant	As per Permit requirement, *Erosion and Sediment Control Plan.*
Significant Woodlands	Pre-construction planning and design. Project construction, grading and excavation for all associated infrastructure.	●	●		Several qualifying Significant Woodlands have been identified throughout the Study Area associated with the following areas: Tallwood woods, Pinhey Forest, Black Rapids Creek, Highbury Park Drive.	Potential localized loss and/or edge disturbance of Significant Woodlands in the Study Area including 2 in the urban area, and 7 in the rural area.	*Landscape Plan and Ecological Site Assessment* to confirm areas of significant woodlands that occur within 120 m of the project in rural areas and 30 m in urban areas, based on the evaluation criteria at the time of detailed design. *Tree Conservation Report* to determine replacement of trees identified for removal based on municipal policy that would apply. Additional surveys to mark distinctive mature trees may be required. The Natural Heritage Reference Manual (MNR, 2010) should be consulted to determine these buffer widths. Consultation with MNRF and City of Ottawa Natural Systems and Forestry Services staff to confirm buffer width and any other additional requirements. Minimize footprint of disturbance to significant woodlands during construction. Contractor to complete an *Environmental Protection Plan* and follow direction provided in the *Landscape Plan* to minimize disturbance.	Limited loss of significant woodland.	Insignificant	As per consultation with MNRF and City of Ottawa Natural Systems and Forestry Services staff. *Landscape Plan, Ecological Site Assessment, Tree Conservation Report* and *Environmental Protection Plan.*
Physical Environment										
Geotechnical Conditions	Pre-construction surveys and investigations.	●			Throughout corridor	More detailed geotechnical and hydrogeological information is required in order to confirm engineering methods and requirements.	*Geotechnical Investigations* to be completed during detailed design to specify construction specifications.	None anticipated.	Negligible	As per detailed *Geotechnical Investigations.*
Geotechnical Conditions	Pre-construction surveys and investigations.	●			Throughout corridor	Potential sulphate attack on buried concrete or potential corrosion of exposed buried steel elements. Preliminary geotechnical results indicate the potential for corrosion following sampling of soil from a borehole located adjacent to Woodroffe Avenue. This may be indicative of conditions throughout or in portions of the Study Area.	Detailed *Geotechnical Investigations* should be completed during detailed design to identify any additional requirements.	None anticipated.	Negligible	As per detailed *Geotechnical Investigations.*
Groundwater	Pre-construction planning and design; project construction and project operation.	●	●	●	Locations of identified private water wells i.e., 2069, 2086, 2191 Woodroffe Avenue and the Grenfell Glen community.	Construction of the project may impact private drinking water quality and quantity for nearby residents.	During detailed design, recommendations will be made for monitoring during *Geotechnical Investigations.* Ongoing consultation with NCC and Grenfell Glen Community during preliminary and detailed design.	None anticipated.	Negligible	As per *Geotechnical Investigations* and consultation with NCC and the Grenfell Glen Community.

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Geotechnical Conditions: Hydrogeology and Groundwater	Pre-construction planning and design. Project construction.	•	•		Throughout corridor.	Shallow groundwater table throughout corridor. Excavations will likely extend below the groundwater table. Groundwater levels are expected to fluctuate seasonally.	Detailed Geotechnical/hydrogeology assessment to be completed during detailed design which will identify subgrade specifications, foundations details and dewatering techniques. A Permit-To-Take-Water from the MECP is required for rates of groundwater inflow in excess of 400,000 L/day. All water to be removed from excavations shall be treated prior to disposal. No sediment laden water is permitted to enter any watercourse. Discharge in accordance with laws, regulations and By-laws. *Erosion and Sediment Control Plan, Wastewater Management Plan, Geotechnical Investigations.*	Minor groundwater inflow is anticipated to be manageable.	Insignificant	As per PTTW (if required) As per *Erosion and Sediment Control Plan* and *Wastewater Management Plan*, and *Geotechnical Investigations*.
Source Protection	Pre-construction planning and design; project construction and operation.	•	•	•	Portions of the Study Area identified as IPZ-2 scored 8.1: Woodroffe Avenue area between Baseline Station to just south of Vaan Drive.	Surface waters in areas with an IPZ of 2 scored 8.1 are more vulnerable to contamination. Activities listed as *drinking water threats* in O. Reg 287/07 under the *Clean Water Act, 2006* undertaken may impact sources of drinking water. Storage of road salt and/or fuels is expected to be small and temporary in nature isolated to the construction phase of the project.	Drinking water threats as listed in O. Reg 287/07 should be avoided in portions of the Study Area with an IPZ-2. Specifically, policy SALT-2-LB-S57 applies. Section 57 Prohibition. Future storage of road salt and storage or snow are prohibited under Section 57 of the *Clean Water Act* in areas where the threat would be significant, in this case applies to areas identified as IPZ 2 scored 8.1. During construction, avoid application and storage of road salt in areas identified as IPZ 2 scored 8.1. Also, policies FUEL-1-LB-S58, FUEL-6-LB-S57 and FUEL-6-LB-S58 apply and mitigation below is consistent with the prohibitions in these polices. Construction dewatering must be discharged at least 30m from sensitive areas identified as IPZ. *Environmental Protection Plan* *Erosion and Sediment Control Plan* *Emergency Response Plan* *Spills Response and Reporting Plan* Construction staging areas including fuel storage, should be located outside of portions of the Study Area with an IPZ-2. Review and ensure conformance with any other applicable Source Protection Plan policies at preliminary/detailed design. Additional mitigation measures may be prescribed in consultation with MECP and RVCA.	None anticipated.	Insignificant	As per O.Reg 287/07 and consultation with MECP and RVCA.

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Source Protection	Project construction and operation.		•	•	Portions of the Study Area identified as part of areas with highly vulnerable aquifers.	Areas identified as containing highly vulnerable aquifers are more vulnerable to the application and storage of road salt which may be used during the construction and/or operation phases of the project. Construction dewatering has the potential to impact areas identified as containing highly vulnerable aquifers. Subsurface works have the potential to impact areas identified as containing highly vulnerable aquifers. Storage of road salt and/or fuels is expected to be small and temporary in nature isolated to the construction phase of the project.	Adhere to applicable Source Protection Plan policies, including those encouraged: SALT-5-NLB, SALT-6-NLB. Avoid application and storage of road salt in areas identified as containing highly vulnerable aquifers. Construction dewatering must be discharged at least 30m from sensitive areas identified as highly vulnerable aquifers. *Environmental Protection Plan* *Erosion and Sediment Control Plan* *Emergency Response Plan* *Spills Response and Reporting Plan* Review and ensure conformance with any other applicable Source Protection Plan policies at preliminary/detailed design. Additional mitigation measures may be prescribed in consultation with MECP and RVCA.	None anticipated.	Insignificant	As per O.Reg 287/07 and consultation with MECP and RVCA.
Potentially Contaminated Land	Pre-construction planning and design; project construction, grading and excavation for all associated infrastructure.	•	•		Potentially contaminated areas (PCAs) within the project construction footprint.	Construction activities may disturb subsurface contaminants in identified PCAs.	Conduct a *Phase Two Environmental Site Assessment* during detailed design, as early as possible to better define PCAs and assist in the planning and scoping of construction and approach to the management of materials (soil and/or groundwater) during construction.	Management and removal of contaminated materials, if required.	Insignificant	As per *Phase Two Environmental Site Assessment.*
Potentially Contaminated Land	Pre-construction planning and design; project construction, grading and excavation for all associated infrastructure.	•	•		Existing roadways and transitways.	Years of historical salt application on existing roadways may have caused shallow impacts to soil adjacent to the roadways.	Impacts should be considered in areas of deep excavation if along existing roadways/transitways. Conduct a *Phase II Environmental Site Assessment* during the next phases of the project.	None anticipated.	Negligible	As per *Phase Two Environmental Site Assessment.*
Excess Soils	Pre-construction planning and design; project construction, grading and excavation for all associated infrastructure.	•	•		Throughout corridor.	Past regulations regarding excess soil management have been made contemporary and responsible re-use/disposal of excess soils will be required and are subject to new rules.	The project should be carried out in accordance with O. Reg. 406/19 regarding excess soils and the MECP's current guidance document titled "*Management of Excess Soil – A Guide for Best Management Practices*" (2014). *Excess Soil Management Plan, Erosion and Sediment Control Plan, Phase Two Environmental Site Assessment.* Consideration for re-use of soils on-site for bridge approaches, landscape berms, etc. to consider reuse of corridor soils ahead of non-native soils.	None anticipated.	Negligible	As per *Erosion and Sediment Control Plan* and *Phase Two Environmental Site Assessment.*
Agricultural Resources: soils	Pre-construction planning and design.	•	•		Greenbelt lands in the vicinity of the temporary rail grade-separation detour.	Temporary impacts to prime and non-prime agriculture lands for the Woodroffe Avenue and Southwest Transitway (LRT) overpasses. The overpasses address a critical safety issue.	As per *Agriculture Management Plan*, the completion of a Soil Management and Rehabilitation Plan specific to agricultural soils will be required to mitigate impacts to soil resources.	Potential for change or loss of prime and non-prime agriculture lands.	Insignificant	As per *Agriculture Management Plan.*

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Agricultural Resources: soils	Pre-construction planning and design; project construction.	•	•		Greenbelt lands in the vicinity of the Fallowfield Road realignment and rail grade-separation overpass to the VIA Rail line.	Permanent loss of prime and non-prime agriculture lands for Fallowfield Road realignment. The construction and implementation of the Fallowfield Road overpass will result in a permanent loss of lands identified as having prime agriculture value. The overpass address a critical safety issue. The realignment of Fallowfield road provides the opportunity to rehabilitate the existing Fallowfield Road alignment and repurpose as greenspace and stormwater management which is of benefit to the community. Realigning the road also moves it further away from the residents located to the south of benefit to the noise and privacy environments. The realignment also eliminates the need for a detour during construction.	Where possible, impacts should be minimized during detailed design as per *Agriculture Management Plan.* Ongoing consultation with the NCC during preliminary and detailed design.	Permanent loss of prime agriculture lands.	Insignificant	As per *Agriculture Management Plan* and consultation with NCC.
Agricultural Resources: tile drainage	Pre-construction planning and design; project construction.	•	•		Greenbelt lands	Construction may cause disruption to the tile drainage system. If disrupted, ponding of the surrounding agricultural fields may occur. If tile drainage tile is damaged it is important that it is repaired as soon as possible.	Pre-construction investigations to locate and mitigate disruption to tile drainage infrastructure. *Agriculture Management Plan* to minimize impacts. *Erosion and Sediment Control Plan* to minimize impacts from potential ponding.	Temporary disruption to tile drainage infrastructure.	Insignificant	As per *Agriculture Management Plan, Erosion and Sediment Control Plan* and consultation with NCC.
Agricultural Resources: interior road network	Pre-construction planning and design; project construction.	•	•		Greenbelt lands	Main access to the interior agriculture road network appears to come from Greenbank Road and therefore should not be impacted during construction.	*Public Communications Plan* to inform and coordinate with farm operations and tenants to allow as much notice and best scheduling as possible. Ongoing consultation with NCC during preliminary and detailed design.	Potential for short-term disruptions to access.	Negligible	As per consultation with NCC. *Agriculture Management Plan* and *Public Communications Plan.*
Agricultural Resources: loss of use	Pre-construction planning and design; Construction of the temporary construction detour.	•	•		Greenbelt lands	Temporary loss of use of some lands that are under active cultivation and crop production within the detour area.	*Agriculture Management Plan* to minimize to the extent possible the area impacted during construction to reduce impact to tenant farmers of the loss of a portion of their land use. Negotiations and compensation with NCC.	Temporary loss of use.	Insignificant	As per *Agriculture Management Plan* and consultation with NCC.

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Stormwater Management	Pre-construction planning and design; project construction, grading and excavation for all associated infrastructure.	•	•		Throughout corridor	*Corridor Drainage and Stormwater Management Plan* to identify overall system requirements, methods of retention, detention, and infiltration and any control methods necessary to achieve runoff quality and quantity targets.	The *Corridor Drainage and Stormwater Management Plan* will consider low impact design alternatives and the opportunity to treat stormwater runoff within the identified Right-of-Way prior to outside of the Right-of-Way treatment in accordance with the *Corridor Drainage and Stormwater Management Approach* outlined in this EPR. As outlined in the strategy, consideration shall be made for design in proximity to the Ottawa International Airport and in-line with Airport Zoning Regulations in relation to guidelines established for Primary and Secondary Bird Hazard Zones. Secondary Bird Hazard areas in the Study Area include: east of Woodroffe Avenue between approximately Vaan Drive to south of Fallowfield Road and the Southwest Transitway from approximately Strandherd Drive to the southern limit of the Study Area. Primary Bird Hazard areas in the Study Area include: Fallowfield Road and south to Strandherd Drive. Consideration shall also be made for the impact of climate change on the associated infrastructure and specifically, extreme storm events. Environmental Compliance Approval (ECA) for new stormwater management system, if required.	Improved/new SWM infrastructure.	Insignificant	*As per Corridor Drainage and Stormwater Management Plan.*
Stormwater Management	Operation of stormwater management infrastructure.			•	Throughout corridor	Project implementation will result in an increase in the impervious surface area and increase in need to accommodate stormwater including during high storm events.	A *Corridor Drainage and Stormwater Management Plan* and requirements of Environmental Compliance Approval (ECA) as required.	New SWM infrastructure.	Insignificant	Maintenance requirements as per ECA.
Utilities: Watermain	Pre-construction planning and design.	•			Rail grade-separations for Woodroffe Avenue and the Southwest Transitway.	Watermain to be relocated outside of the footprint for the overpass structures. Relocation to NCC Lands.	Footprint of the watermain in the vicinity of the rail grade-separations relocation to be minimized to extent possible. Coordination with NCC and relevant City departments regarding the relocation and any additional rehabilitation works of the backbone watermain. Depending on land ownership decisions, Federal Land Use and Design Transaction Approval (FLUDTA) required. Utility locates completed prior to excavations. *Spills Response and Reporting Plan.* *Emergency Response Plan.* *Construction Waste Management Plan.*	Potential for short-term and/or unintentional service disruptions.	Insignificant	Monitor complaints during construction. As per FLUDTA.

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Utilities: Watermain	Pre-construction planning and design.	•	•		1200mm watermain located along the west side of Woodroffe Avenue and specifically in the vicinity of the elevated guideway in the median of Woodroffe Avenue from approximately Knoxdale Road to West Hunt Club Road.	The construction of the elevated guideway to the west of Woodroffe Avenue as well as in the median will impact the 1200mm watermain. Approximately 285m of this watermain needs to be relocated due to many conflicts with the proposed LRT piers and the proposed Knoxdale LRT Station and in consideration of future maintenance and infrastructure lifespan. Other conflicts with local watermains, water services and hydrants are anticipated and will require modifications of the existing infrastructure.	Utility locates completed prior to excavations. *Spills Response and Reporting Plan.* *Emergency Response Plan.* *Construction Waste Management Plan.* Construction methodology to be reviewed at detailed design: Construction using drilled caissons should maintain a minimum offset of 3 caisson diameters from the side of the pipe for all utilities at the elevation of or below the underside of caisson cap to reduce the magnitude of stresses imposed onto the watermain by the foundations in resisting lateral loads.is maintained. Adhering to the City's guidelines on vibration limits due to construction –dictate a sliding scale limit of 5-20mm/sec based frequency or whatever is current guidelines at the time of construction. Settlement and vibration monitoring for construction is recommended. Construction limitations should be outlined in tender specifications. Heavy equipment must be kept off of the watermain. Where this isn't possible there are methods to bridge over it to reduce the load. For the embedment of the caissons into the underlying bedrock, rock hammers or vibro-hammers are to be prohibited. Measures need to be taken to prevent the drawdown of the water table and any possible subsidence/settling of the sands under the watermain during caisson drilling operations through the running sands layer. With respect to the median guideway alignment: Depending on the timing of the project and in consideration of economies of scale replacement and relocation of the watermain away from the pier impact zone would ultimately result in less disruption/risk in the future. Ongoing consultation with relevant City departments is required.	Potential for short-term and/or unintentional service disruptions.	Insignificant	As per *Emergency Response Plan*. Monitoring determined necessary during preliminary/detailed design. Ongoing consultation with relevant City departments.

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Utilities: Storm sewer	Pre-construction planning and design.	•	•		Knoxdale/Woodroffe intersection.	An existing storm structure located within the Knoxdale/Woodroffe intersection will require relocation to allow the construction of a pier for the LRT on the south-west corner of the intersection. The relocation is complicated due to storm and sanitary sewer inverts being nearly identical (therefore must remain parallel), the number of pipes affected, and the numerous other utilities located in this intersection.	Storm pipes, catch basins and catch basin leads will require relocations and/or protections. Utility locates completed prior to excavations. *Spills Response and Reporting Plan.* *Emergency Response Plan.* *Construction Waste Management Plan.*	Potential for short-term and/or unintentional service disruptions.	Insignificant	As per *Emergency Response Plan*. Monitoring determined necessary during preliminary/detailed design. Ongoing consultation with relevant City departments.
Utilities	Pre-construction planning and design.	•	•		Knoxdale to West Hunt Club.	Some small diameter sanitary sewers or sanitary services are conflicting with the proposed pier placement for the median LRT. Various telecommunications wires are in conflict of the piers/placement of the elevated LRT guideway in the median.	Utility locates completed prior to excavations. *Spills Response and Reporting Plan.* *Emergency Response Plan.* *Construction Waste Management Plan.* Ongoing consultation with relevant City departments and agencies to determine requirements for protection, removal or relocation for each utility conflict will be required.	None anticipated.	Negligible	As per *Emergency Response Plan*. Monitoring determined necessary during preliminary/detailed design. Ongoing consultation with relevant City departments.
Utilities: Hydro One Lines	Pre-construction planning and design.	•			South side of Knoxdale Road.	Relocate/raise the 115kV circuit C7BM twin wood pole line to get clearance for the elevated LRT guideway running parallel with Woodroffe Ave.	As per consultation with Hydro One and *Hydro One Infrastructure Conflict Resolution.* Hydro One has advised that during the next phases of the project, a feasibility-level study will need to be completed in order to determine the modifications required for both circuits in order to achieve the adequate clearances. The City will be required to provide AutoCAD versions of the drawings for review. Changes to Hydro One infrastructure may require the completion of a separate EA following the Class EA for Minor Transmission Facilities. It is recognized that the design information required to confidently confirm this will not be available until the preliminary and detailed design for the project is undertaken. At that time, the City will coordinate with Hydro One and determine if there are any additional EA requirements. If an EA is required, mitigation will be determined through the EA process. Any changes to the design will require review and approval by Hydro One prior to construction.	None anticipated.	To be determined.	To be determined.
Utilities: Hydro One Lines	Pre-construction planning and design.	•			230kV circuit M32S on south side of Knoxdale Road. Hydro One corridor on north side of West Hunt Club Road.	Elevated infrastructure potential to fall within minimum clearance requirements and/or affect location of steel transmission towers.	Potential impacts to transmission infrastructure to be evaluated. As per consultation with Hydro One and *Hydro One Infrastructure Conflict Resolution.* Any changes to the design will require review and approval by Hydro One prior to construction.	None anticipated.	To be determined.	To be determined.

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Utilities: Hydro Ottawa Lines	Pre-construction planning and design.	•			Hydro Ottawa lines throughout Study Area.	The Recommended Plan will require the relocation of some Hydro Ottawa lines.	Consultation with Hydro Ottawa regarding engineering designs to ensure compliance with Conditions of Service. Proposed structures as part of the project will not hinder Hydro Ottawa's ability to access electricity meters or other distribution assets. Hydro One has advised that during the next phases of the project, a feasibility-level study will need to be completed in order to determine the modifications required for both circuits in order to achieve the adequate clearances. The City will be required to provide AutoCAD versions of the drawings for review. Hydro Ottawa specifically requests to be consulted on the design of the proposed overpasses and bridges for rail grade-separation. Utility locates completed prior to excavations. Any modification in proximity to the CN Rail Line will require further consultation, review and approval from CN to ensure that the design does not interfere with the CN tracks or signals.	Potential for short-term and/or unintentional service disruptions.	Insignificant	As per consultation with Hydro Ottawa.
Fibre Optic Cables	Pre-construction planning and design; project construction.	•	•		Fibre optic lines located north and south of the VIA Rail tracks Smiths Falls Subdivision and the CN Rail Beachburg Subdivision.	Construction of the Recommended Plan may impact existing fibre optic cables.	Consultation with property owners, CN Rail, VIA Rail. Proposed structures and design considers the presence of fibre optic cables. Construction activities to avoid accidental disruption to cables. Utility locates completed prior to excavations. All work near CN fibre optics has to be reviewed and approved by CN. In general, excavation must be a minimum of 2m away from the fibre optics. The relocation of the fibre optics is to be avoided.	Potential for short-term and/or unintentional service disruptions.	Insignificant	As per consultation with CN Rail/VIA Rail.