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

## 6.1 Evaluation Criteria and Methodology

An evaluation method reveals the rationale or reasons for decisions which assists 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 method of objectivity evaluating several alternatives against several 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 Selection

**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 by the subject matter experts of the Study Team 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<br>b) Maximizes opportunity for convenient and accessible LRT Stations<br>c) Supports enjoyable transit user experience, including ride comfort, riders' views, and integrated station opportunities<br>d) Maximizes opportunity to provide convenient and accessible connections to existing and future local and rapid transit via LRT<br>e) *Maximizes the tie-in compatibility and maintains access to Fallowfield Station<br>f) *Minimizes impacts to transit operations |
| 2 | ACTIVE TRANSPORTATION | a) Provides the opportunity to connect to pedestrian and cycling facilities within the Study Area<br>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<br>b) Provides/Supports Complete Streets design objective<br>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<br>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<br>b) Maximizes the opportunity to connect to utilities and infrastructure<br>c) Maximizes the opportunity to provide a safe and secure access to the facility from the surrounding road network<br>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<br>b) Minimizes stormwater management complexity and maintenance<br>c) Minimizes impact on surface water features including shoreline vegetation zones, or loss of or degradation of existing aquatic habitat<br>d) Minimizes or controls the spread of invasive plant species<br>e) Minimizes or reduces the amount of natural habitat loss, maximizes protection of urban trees<br>f) Minimizes the disruption to ecosystem connectivity and natural habitats<br>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<br>b) Minimizes risks associated with groundwater and/or sensitive soils<br>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<br>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<br>b) Minimizes impacts on existing farm infrastructure including buildings and tile drainage systems<br>c) Maximizes opportunity to maintain farmhouse access and farming access roads |
| 12 | GREENBELT ENVIRONMENT | a) Minimizes impacts to designated NCC Greenbelt lands<br>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<br>b) Minimizes impacts to existing land uses including existing buildings and residences |

| Criteria | | Indicators |
|---|---|---|
| | | c) Minimizes or avoids disruption to essential municipal services (utilities, potable water, and sanitary services)<br>d) Maximizes opportunities to improve community health and well-being through creation or access to recreation areas/facilities<br>e) Maximizes opportunities to improve the public realm<br>f) Maximizes opportunity to provide a safe facility and implement CPTED principles<br>g) Maximizes accessibility design standards<br>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<br>b) Avoids or minimizes impact on designated or potential built heritage resources<br>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<br>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<br>b) Minimizes the disruption or diversion for all modes (transit and vehicular traffic, sidewalks, cycling facilities, pathways etc.) during construction<br>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<br>b) Minimizes construction duration and complexity<br>c) Minimizes infrastructure maintenance and operation cost<br>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

To assist in understanding how the evaluation was conducted, Table 6-2 details the evaluation scale used. Each alternative was evaluated based on how it performs in meeting each individual indicator ranging from performing very well to failure assuming best management practices and standard mitigation measures would be applied. An accessible format is used. A big green happy face indicates the best performing alternative, whereas a sad red face indicates failure. Criteria that are not differentiating are also indicated 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

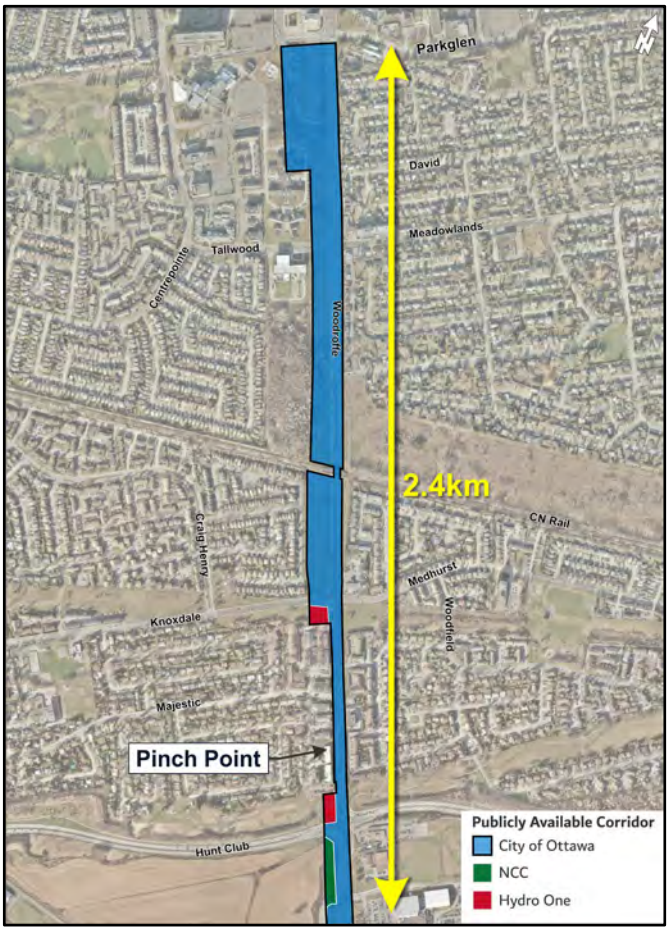
The 1997 Southwest Transitway EA was reviewed as a starting point in the development of alternative designs for this focussed evaluation. As described in **Section 2.2.1.1** of this report, the Recommended Plan consisted of an exclusive BRT facility described as follows:

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 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 above-noted 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 in this segment of the corridor. This is referred to as the “Pinch Point” throughout the following evaluation and it is shown in **Figure 6-1** along with the previously protected Right-of-Way corridors to the north and south of it.

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




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

- Geotechnical conditions;
- Limited right-of-way available at the pinch point;
- Adjacent community impacts; and,
- Transportation operations during and post construction.

As mentioned previously, 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.

The Study Team examined and screened out early two alternative designs:

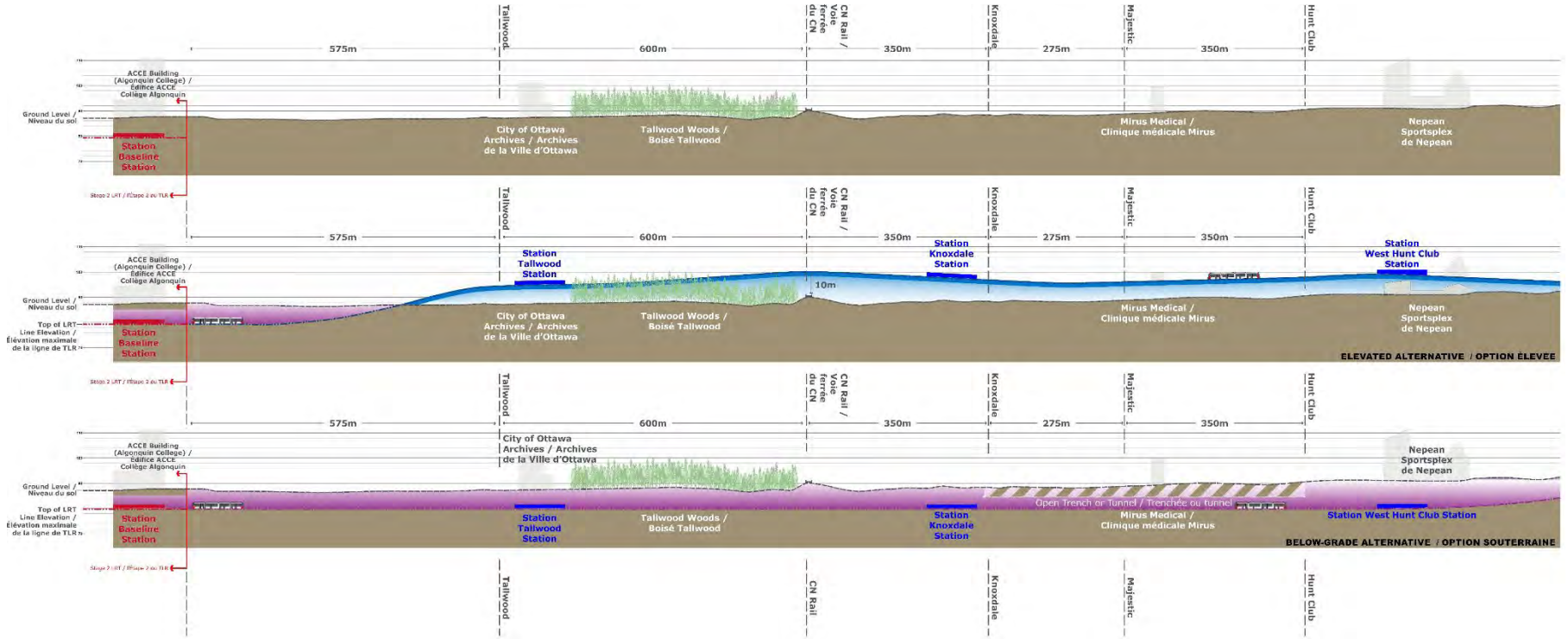
- LRT alignment at-grade; and,
- LRT alignment in either a shallow or deep bored tunnel.

The at-grade alternative was screened out on the basis that this project will be an extension of the City's O-Train Confederation Line LRT system. Therefore, this project must use the same design standards for an exclusive segregated corridor with the same operational and safety requirements as the rest of the network as established in the Stage 1 and Stage 2 LRT projects which requires grade-separations at all major road and rail crossings.

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, the high 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 stations that come at a high cost and with reduced LRT access. A shallow bored tunnel (above the bedrock level) was screened out as the challenging subsurface conditions would significantly limit its feasibility. Further it would require specialized tunneling techniques and carries significant risk of ground collapse (i.e. sinkholes). The geotechnical challenges that add construction complexity and risk along with a very high cost for either bored-tunnel alternative resulted in this option being screened out.

An early study finding was that the close spacing between the streets, and the CN Rail line that cross this section of the corridor, along with the allowable LRT grades and clearances needed to cross either over or under them, do not provide the opportunity to combine under- and over-passes for grade-separating this section of the line. 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 (**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', meant 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.

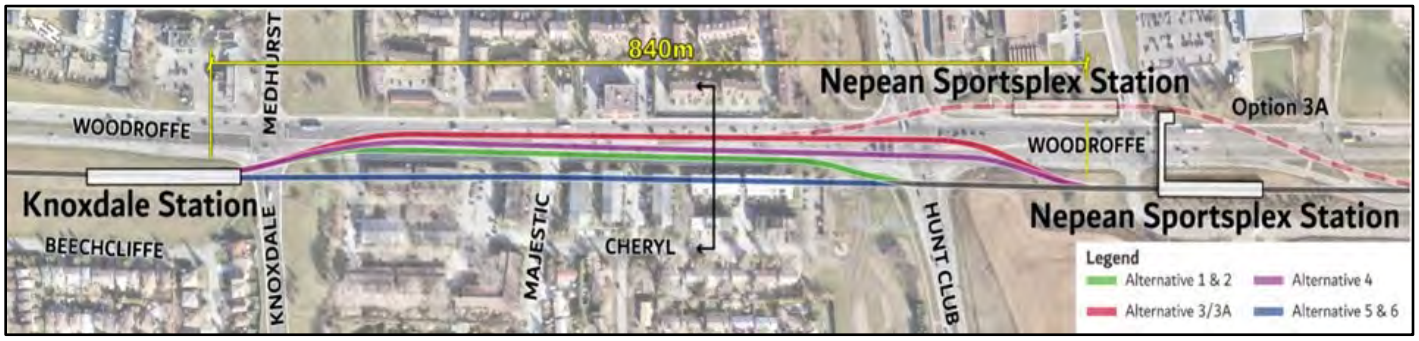
Accordingly, six (6) design alternatives through the Pinch Point were developed for a focussed evaluation. Alternatives were not developed north of the pinch point, as the city has already protected land for the transitway to the west of the Woodroffe Avenue corridor. Also, alignments along the east 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, requiring a significant diversion of the line to the east resulting in a facility located very close to the existing buildings along this stretch of the corridor. Furthermore, they would require relocating major utilities running beneath Woodroffe Avenue and would impact above-ground utilities such as Hydro Ottawa's distribution line (**Figure 6-3**) and require significant modifications to Hydro One infrastructure (more impacts to an east side alignment than alternatives located on the west side).

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

The six design alternatives included both below-grade and elevated alignments, located within or west of the Woodroffe Avenue Right-of-Way (**Figure 6-4**). These are:

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

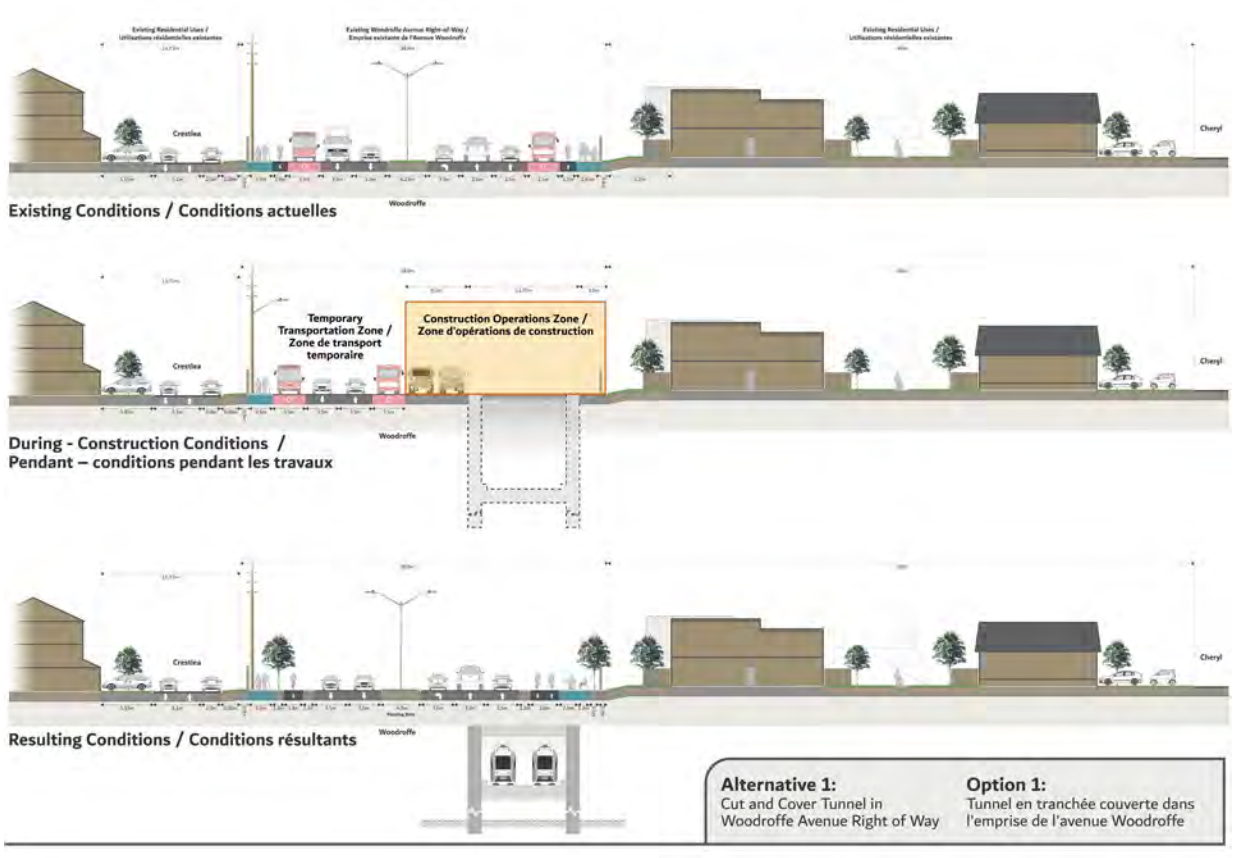

#### Alternative 1: Cut and Cover Tunnel in Woodroffe Avenue Right-of-Way

This alternative is consistent with the 1997 Southwest Transitway EA Recommended Plan. It locates the LRT facility in a shallow tunnel underneath the existing southbound lanes on Woodroffe Avenue. **Figure 6-6** illustrates this alternative in cross-section through three scenarios: existing conditions, during construction and post-construction. The tunnel would be constructed using "cut and cover" methods where the tunnel is first excavated and then decked over 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 transit would be relocated in the cut and cover tunnel.

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

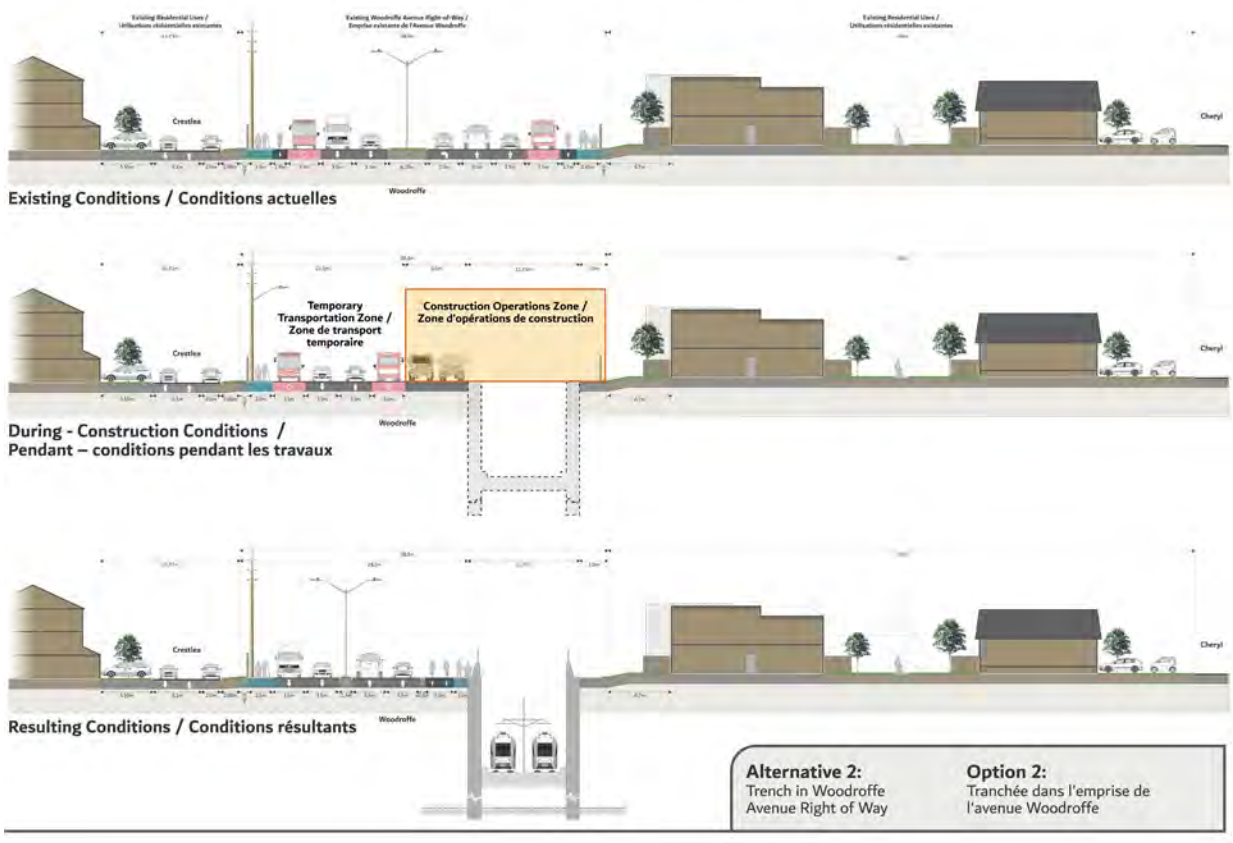


### Alternative 2: Trench in Woodroffe Avenue Right-of-Way

This alternative locates the LRT in an open trench within the Woodroffe Avenue Right-of-Way adjacent to the west side (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 almost the same fashion as described in 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 transit 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.

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



Alternatives 3 and 4 are elevated, located within the Woodroffe Avenue Right-of-Way (**Figure 6-8**).

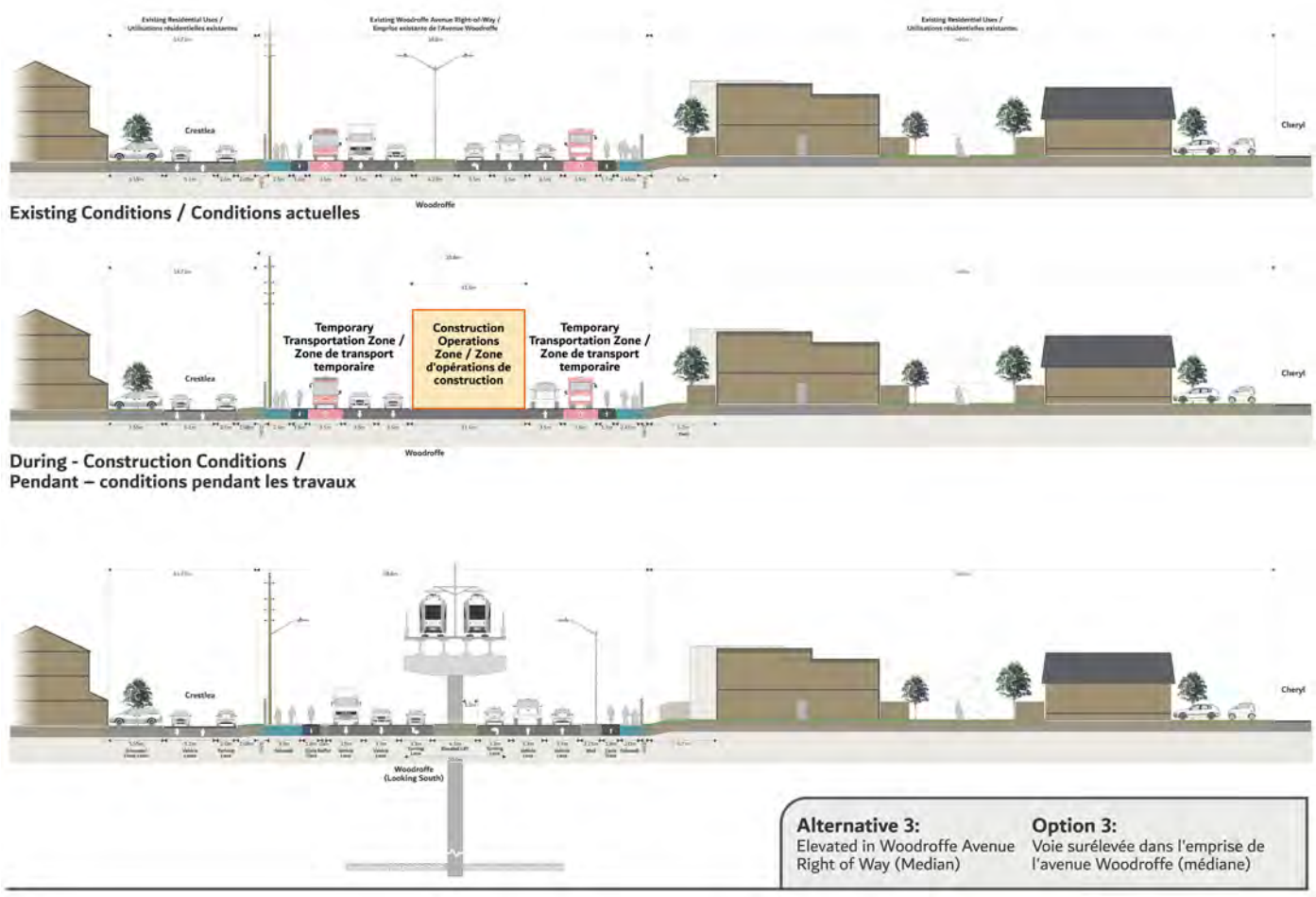
Figure 6-8 Alignment of Alternatives 3 and 4 in the Woodroffe Avenue Right-of-Way


### 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.

The resulting conditions would allow for renewal of Woodroffe Avenue as the LRT facility would be elevated within the Woodroffe Avenue corridor. The Right-of-Way width available for complete street renewal would be dependent on design guidelines for offset to the piers etc. for the median elevated LRT facility. This is the only alternative that 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)

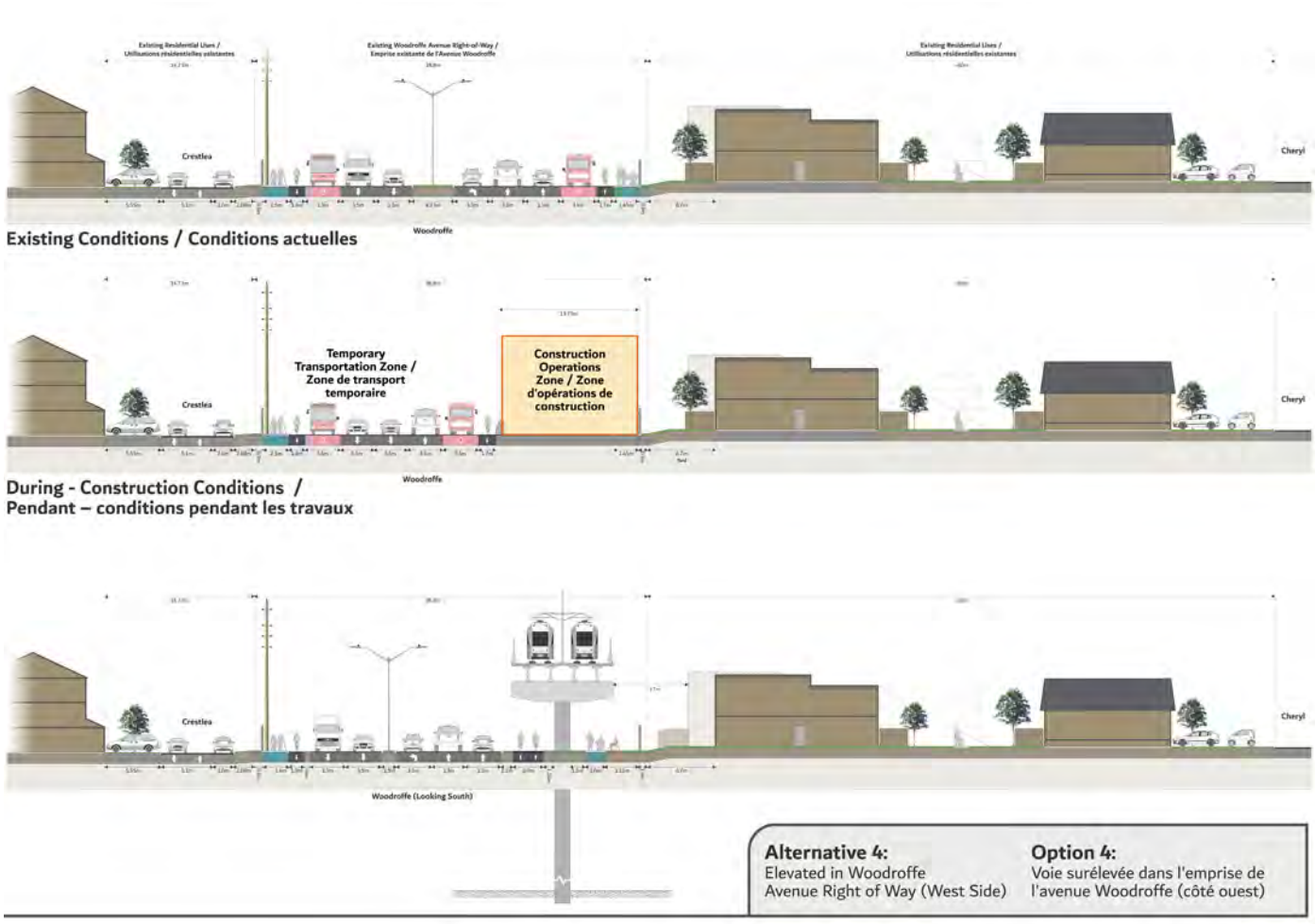


### Alternative 4: Elevated in Woodroffe Avenue Right-of-Way (West Side)

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 area.

The resulting conditions would bring the LRT facility within 7m of some of the existing residential buildings and would likely require privacy and 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**).

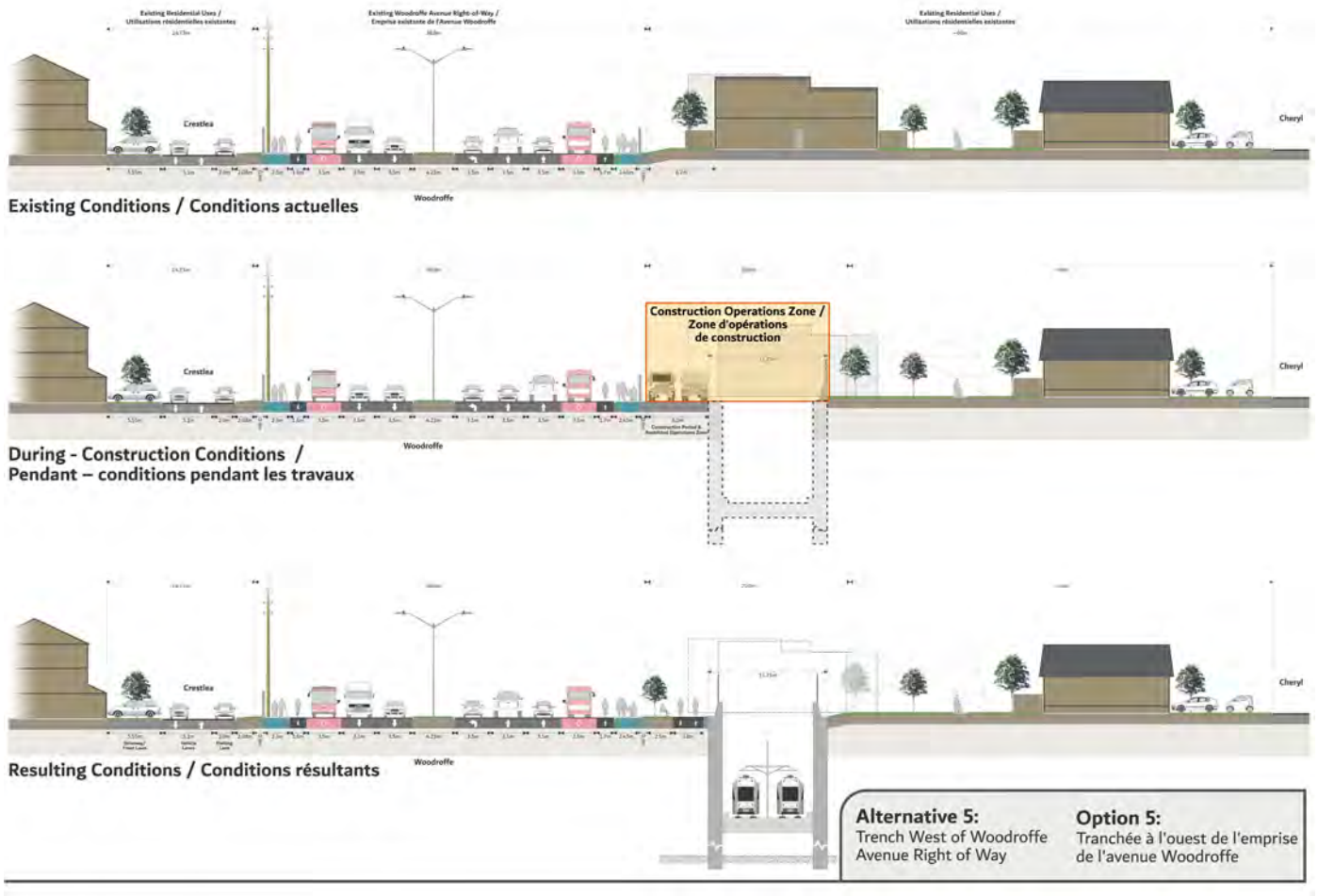
Figure 6-11 Alignment of Alternatives 5 and 6 outside of the Woodroffe Avenue Right-of-Way


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

This alternative extends the LRT in a trench consistent with the protected corridors west of the Woodroffe Avenue Right-of-Way north and south of the Pinch Point. **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 that described for Alternative 2.

As the Woodroffe Avenue corridor would be largely unaffected during construction, there would be no need as part of the project to renew Woodroffe Avenue. A 20m wide strip will be required from the properties located 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



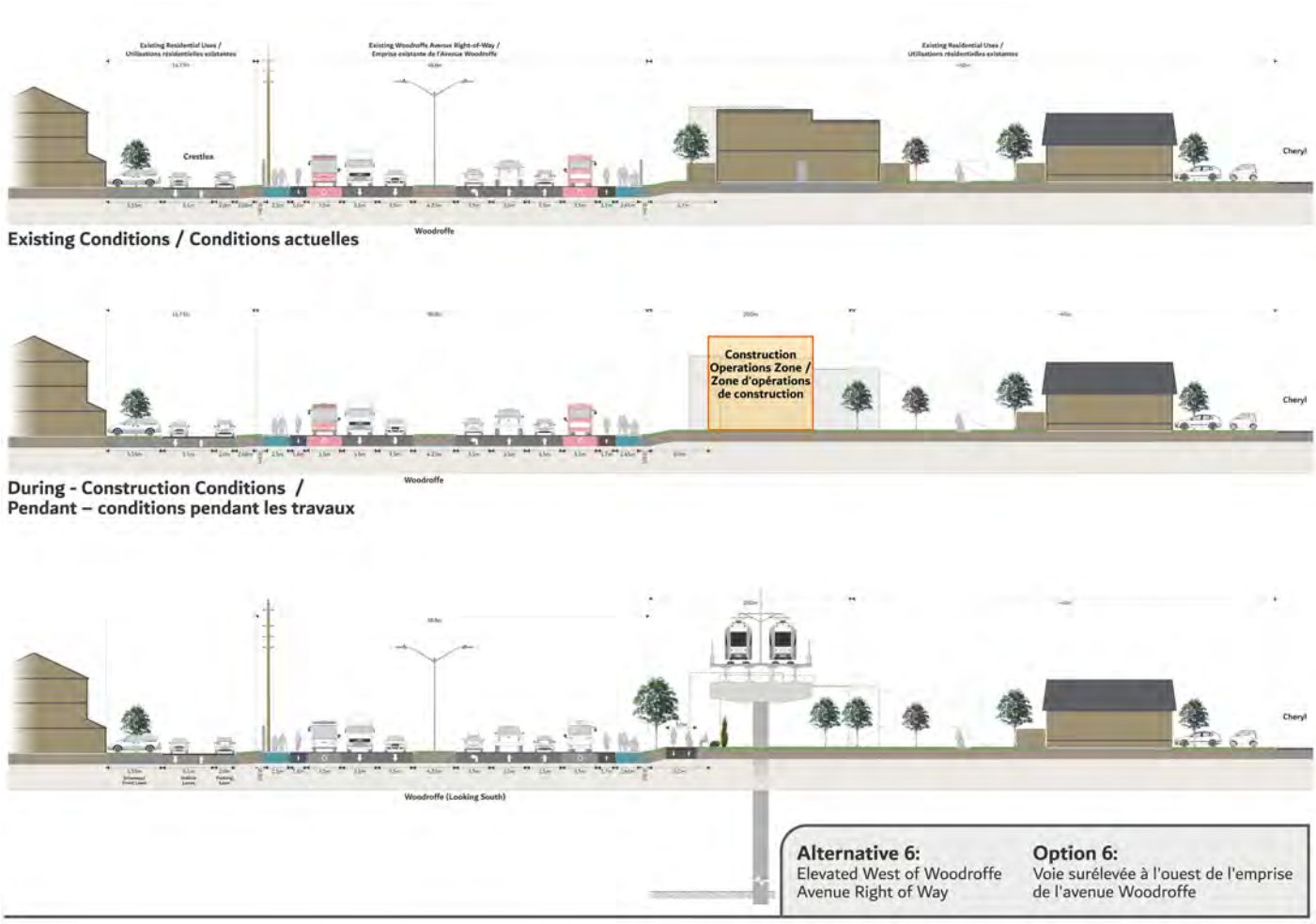
### Alternative 6: Elevated West of Woodroffe Avenue

This alternative extends LRT as an elevated facility consistent with the protected corridors west of the Woodroffe Avenue Right-of-Way north and south of the Pinch Point. **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, there would be no need as part of the project to renew Woodroffe Avenue. A 20m wide strip will be required from the properties located 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 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 in **Table 6-3** and discussion follows.

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 score 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. |

| Number | Criteria | Indicator | Alternative Number | | | | | | Qualifier |
|---|---|---|---|---|---|---|---|---|---|
| | | | 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. | |
| | | | 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. Altematives 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. |

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). **Figure 6-14** illustrates these subsurface challenges. 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 25 metres below the ground surface. The existing water-table is very high throughout the Study Area, in some places extending up into the clay layer. Therefore, the construction of any below-grade LRT facility would extend into the permeable sands lying beneath the sensitive marine clay layer. The bottom would be several metres below the existing groundwater, 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.

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 is likely to 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, and if it was to occur 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 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 ones may be punched through the trench walls passing through a water-tight sleeve. However, some will require significant and costly relocations to connect elsewhere. **Figure 6-15** illustrates typically how underground infrastructure conflicts 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 that would have to be crossed or relocated, along with many others. 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.

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

In conclusion, below-grade options would bring notable risk to the City of Ottawa for the life span of this investment. For these reasons, the below-grade Alternatives 1, 2 and 5 are not recommended.

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

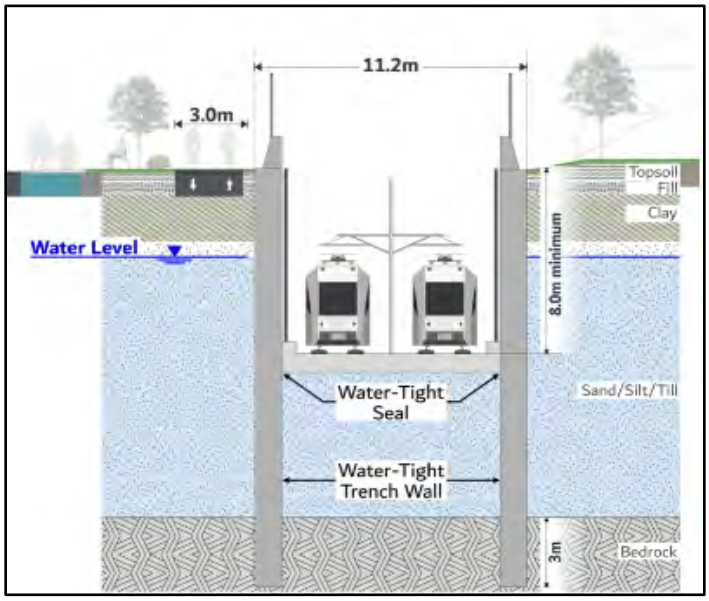
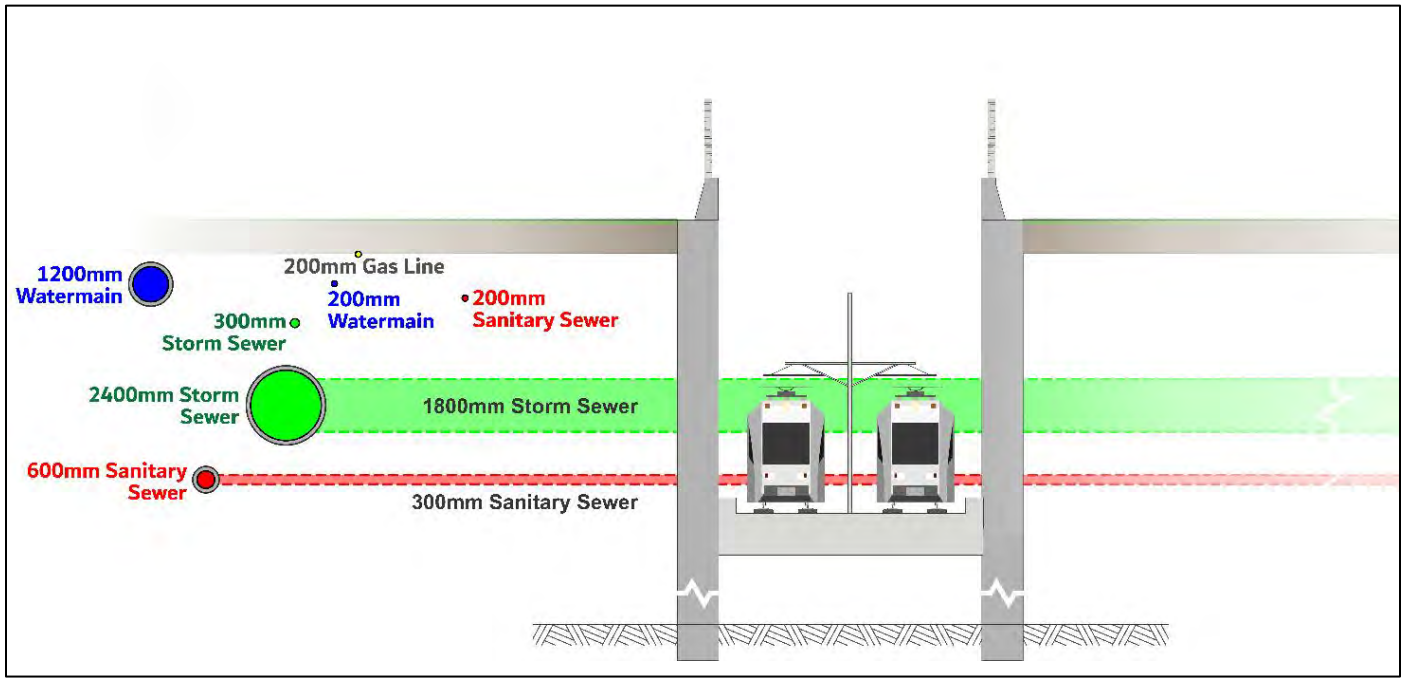



Figure 6-15 Underground Infrastructure Conflicts with Alternative 5




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

Woodroffe Avenue is one of the City's vital north-south arteries and Alternatives 3 and 4, being located within the Right-of-Way, will introduce notable transportation impacts and disruption to all modes both during and post-construction. This is because the space beneath the elevated guideway would not be available for general purpose traffic lanes.

The elevated guideway would be located on beams supported by piers using deep foundations that extend down into the underlying bedrock. The location of the supporting piers would generally be in the middle of the road for Alternative 3, or to the west of the road for Alternative 4. Their exact 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). Locating the dripline of the elevated guideway over travel lanes is not recommended, 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 the Knoxdale, Majestic, West Hunt Club and Nepean Sportsplex north entrance intersections. The remaining space not taken up by the LRT would be constrained for other complete street elements, including reduced space for pedestrian and cycling facilities, snow storage, landscaping, and left turning vehicles –leaving 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, as some existing vehicle left-turn lanes would need to be removed, and there would be insufficient space left for transit priority lanes and some active transportation infrastructure.

Alternatives 3 and 4 also introduce back-to-back curves into the LRT rail alignment which in turn would require trains to slow down increasing travel time and reducing overall ride quality for riders. More importantly, the curves will cause wear-and-tear on both vehicles and tracks, resulting in added maintenance and service disruptions leading to higher operating costs and reducing service reliability over the lifetime of the facility. Alternative 3 introduces the largest curves as the LRT alignment would have to completely cross over the southbound lanes of Woodroffe Avenue in the vicinity of both Knoxdale Road and West Hunt Club Road with no tradeoff benefit.

Locating the facility within the Right-of-Way would cause the proposed location of Knoxdale Station to be shifted 40 - 45 metres to the north. 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.

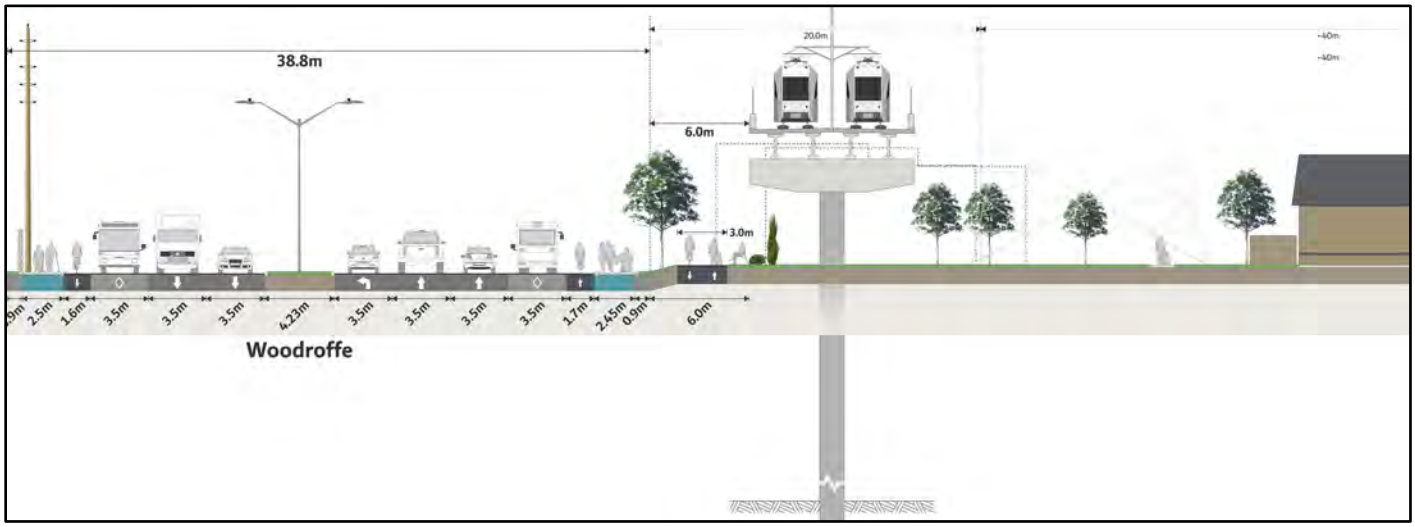
By requiring the station to be pushed further north, Alternatives 3 and 4 diminish the attractiveness of transit at this location. Alternatives 3 and 4 do not require the removal of existing residential buildings. Alternative 3, located within the middle of Woodroffe Avenue is relatively equidistant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

The study team has concluded that the above-noted concerns cannot reasonably be mitigated. On final analysis any alternative within the Woodroffe Avenue right-of-way is 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 alignments 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 compared to the other elevated alternatives. It does not require the reconstruction of Woodroffe Avenue, and with construction predominantly occurring outside of the Right-of-Way impacts during construction are minimized. Being located west of the right-of-way it provides a greater available width for the potential future Complete Street renewal of Woodroffe Avenue, as well as providing an opportunity to activate the space underneath the guideway by creating parks and greenways along with facilities for the active modes. It also 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. It also permits Knoxdale Station to be optimally located with its 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**

However, Alternative 6 will require the acquisition of a 20 metre wide strip of land for the LRT Right-of-Way from three (3) private properties in the Pinch Point adjacent to the west side of Woodroffe Avenue with municipal mailing addresses of: 1, 3, 5, 19 and 23 Cheryl Road, 1668 Woodroffe Avenue and 5 Majestic Drive (**Figure 6-17** and **Figure 6-18**). Construction of the LRT will require the removal of 100 of the existing 179 rental units spread across the three private properties affected.

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

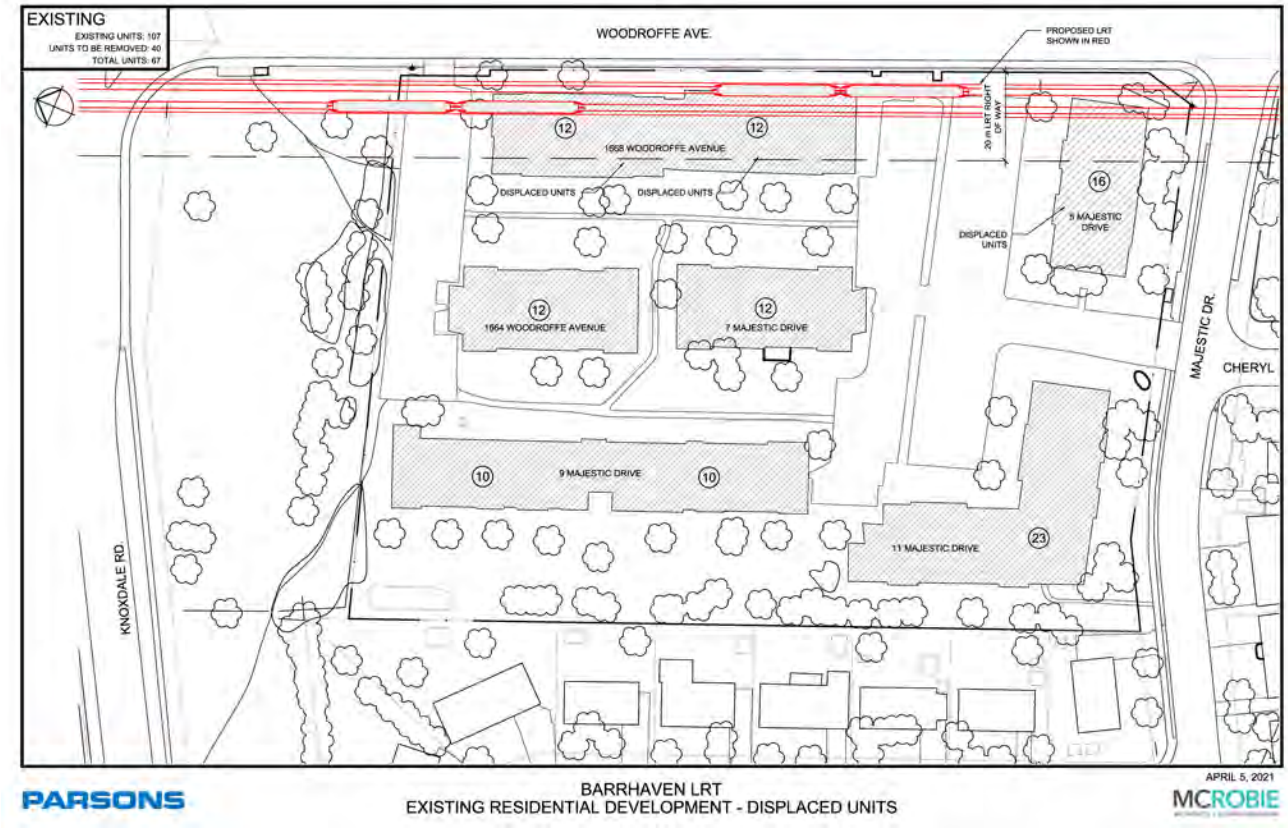
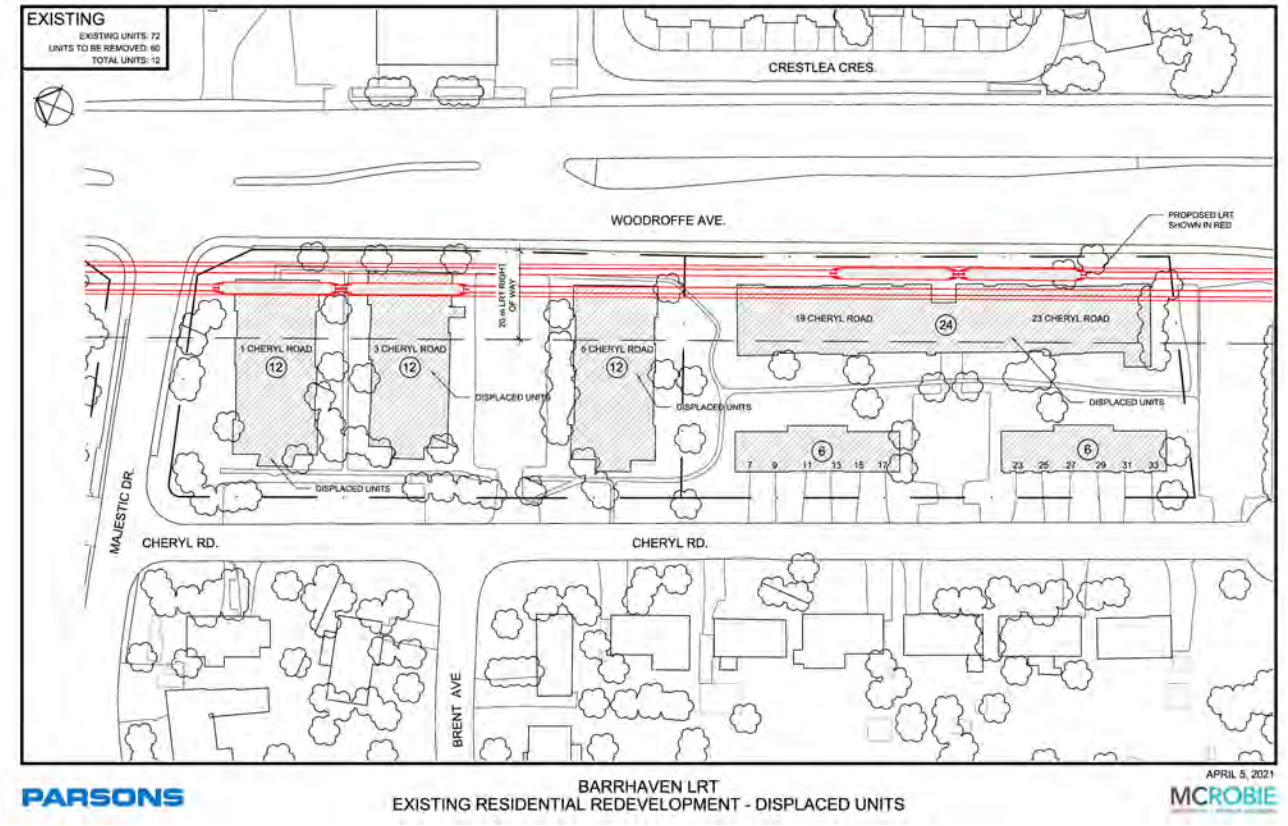



Figure 6-18 Affected Properties - Cheryl Gardens



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

The 1997 Southwest Transitway EA 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 re-evaluated options for grade-separation, with the outcome being that a road-over rail overpass was 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 the knowledge of the risks associated with it. The three (3) alternatives considered for evaluation are listed below and evaluated in **Table 6-4**.

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

To assist with the evaluation of the three (3) 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 6-4** 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 |
| 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 score 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. |

Geotechnical investigations undertaken to support this study re-confirmed the findings of the 2003 Preliminary Design Report (Delcan Corporation) that significant subsurface challenges exist. 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. Based on the previous pumping test carried out, 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, 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.

Of the alternatives evaluated, Alternative 1 presents the least amount of geotechnical risk, least impact to the transportation network and is 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 and emphasizing its importance as a capital arrival. Safety can be improved for the access to the Royale Equestrian Centre at 2191 Woodroffe Avenue. Temporary and permanent impacts to NCC Greenbelt lands will result. However, access to the NCC agricultural lands and private farmhouse can be maintained through all phases. Visual impacts 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**. This alternative will present less 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. Overhead utility lines will need to be relocated. Construction detours will be required while the permanent overpasses are constructed and will be discussed in **Section 7**. Alternative 1 also provides the opportunity to create an eco-crossing which allows wildlife movements and connections within the Black Rapids Creek vicinity while also providing the opportunity to maintain or enhance natural habitats and particularly riparian areas.

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 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 be very costly. In 2017 the BMRRGSS Feasibility Study 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 for the study. To consider all possible alternatives, the underpass alternative was carried forward for evaluation despite the knowledge of the risks associated with it. The three (3) alternatives considered for evaluation are listed below and evaluated in **Table 6-5**. In all cases for 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 evaluation of the three (3) 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 6-5** 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 score 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. |
| 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. |

| | | | Alternative Number | | | |
|---|---|---|---|---|---|---|
| **Number** | **Criteria** | **Indicator** | **Overpass Road over Rail** | **Underpass Road under Rail** | **Combination Raise Rail and Lower Road** | **Qualifier** |
| | | | **1** | **2** | **3** | |
| 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. |

Geotechnical investigations undertaken to support this study re-confirmed the findings of the 2003 Preliminary Design Report (Delcan Corporation) that significant subsurface challenges exist. 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. 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 4 m 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 25 mm), 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.

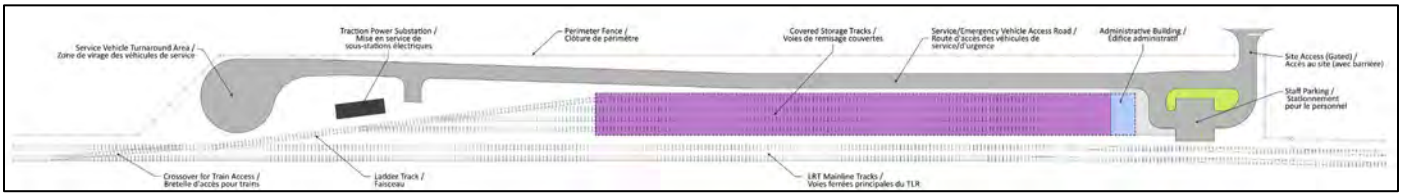
### 6.2.4 EVALUATION OF ALTERNATIVE LOCATIONS FOR THE TRAIN STORAGE AND SERVICING FACILITY

Stages 1 and 2 of the Confederation Line include heavy maintenance and storage facilities at Belfast Road and Moodie Drive respectively accommodating the entire Confederation Line fleet including future extensions to Kanata and Barrhaven. The long distance between Barrhaven Town Centre and these sites requires a supporting facility as part of this project. Based on initial ridership and fleet requirements, a facility capable of accommodating up to eight (8) trains (16 Light Rail Vehicles) has been 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;
- 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 near the end of the line is preferred. The TSSF requirements include a site large enough to accommodate eight (8) trains and provides for mid-day and overnight storage of trains as well as a site that can provide secure access is preferred.

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 score 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. |
| 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. |

| | | | Alternative Number | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Number | Criteria | Indicator | Baseline Station | Woodroffe Open Space | Slack Road | Fallowfield | Greenbank | Barrhaven Centre | Qualifier |
| | | | 1 | 2 | 3 | 4 | 5 | 6 | |
| 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. |

Alternative 1, Baseline, scored well for some criteria, however, exhibits significant design incompatibilities 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 would present from incorporating the facility into a below-grade location that requires quick transition to an elevated facility. For these reasons, Alternative 1 is not the preferred location.

Alternatives 2, 3, 4 and 6 are all significantly constrained by surrounding existing (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 would disrupt existing and planned pathway networks. The City's Pedestrian Plan identifies a MUP in the location of Alternative 2, informal pathways exist currently. Alternative 4 would displace an existing MUP and eliminate its connection to the network. Alternatives 2 and 4 would also disrupt underground infrastructure and stormwater management. Alternative 2 would displace valued open space and would require crossing to the east side of Woodroffe Avenue adding to cost and construction and operational complexity. Further, Alternative 2 would require realignment of critical infrastructure, the Lynnwood Collector runs perpendicular to Woodroffe Avenue in this location. Alternative 3 is not desirable as it is located in the Greenbelt and would impact agricultural operations and infrastructure. Because of the surrounding agriculture operations, the only way to fit the TSSF in this space would be as a long and narrow space which is less optimal. In addition, Alternative 3 does not have sanitary services, connecting to them or installation of a private septic system would require additional impacts and acquisition to NCC lands in addition to disrupted views of the lands. Alternative 4 would require challenging design so as not to impact the grade-separation of Fallowfield Road to the VIA Rail line and the LRT facility. This alternative would also be located close to residential properties. Alternative 6 would result in higher construction costs due to ground conditions and the need for a below-grade facility based on existing topography and future land use compatibility.

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 and located outside of the NCC Greenbelt, immediately adjacent to the existing Southwest Transitway corridor. It is located near the end of the line which is considered a more optimal location for operations especially for the start of morning service. This location would consolidate 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 will include 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 or the location of the TSSF. However, the preliminary preferred plan for the rail grade-separation of Woodroffe Avenue and Southwest Transitway as well as Fallowfield Road and to convert the Southwest Transitway to LRT from Nepean Sportsplex to Barrhaven Town Centre was presented (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 in a round table forum. At these meetings, participants were presented information that was to be communicated at the first public open house 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 discussion on the following topics:

- Desire for overpasses to be designed to best limit impacts to 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.

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

### 6.3.2 PUBLIC OPEN HOUSE #1

Public Open House #1 was held on Wednesday October 30, 2019 at the Nepean Sportsplex – 1701 Woodroffe Avenue from 6:00 to 9:00 PM. The Open House included a series of display boards (**Appendix A**) presenting the work completed to date focusing 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 Open House 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 Public Open House. 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 Public Open House. Members of the public were encouraged to provide written comments via the Comment-Questionnaire and submit them either before leaving the open house or by email or regular mail. A total of 19 sets Comment-Questionnaires were filled out during the Open House. Following the consultation events, a total of 24 additional emailed comments were received. Together, a total of 43 sets of comments were received from this Public Open House event. A number of key themes were repeated from the comments received from the consultation group meetings. Key themes received from this round of consultation includes:

- 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.

For a full record of comments received during this round of consultation, refer to **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 Public Open House. Additional meetings with individual stakeholders were held when needed to discuss their comments, and 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, and converting the remaining portion of the Southwest Transitway corridor from the Sportsplex to Barrhaven Centre from bus to light rail 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.

## 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,<br>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. 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 Farm;
- 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 for private wells.

For a full account of discussion from these consultation group meetings, refer to **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 on 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 develop parameters of landscaping and space programming strategies for various contexts within the LRT corridor. For a full account of discussion from this workshop, refer to **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 and final public open house was arranged online for a period of two weeks, September 9-23, 2020. For this event, three (3) recorded presentations along with information boards were provided on the study's website for stakeholders' review. 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:

1. The evaluation of alternative designs;
2. The functional design of the recommended plan;
3. Preliminary impact assessment;
4. Implementation and staging plans; and,
5. 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 a variety of means. 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 of the consultation event through circulation of approximately 18,500 buckslips and its notice 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 and 12 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 study's website. Alternatively, emails could be submitted, or the City project manager could be contacted to arrange other means of providing feedback. A total of 153 responses to the comment-questionnaire and emails from 29 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 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.

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