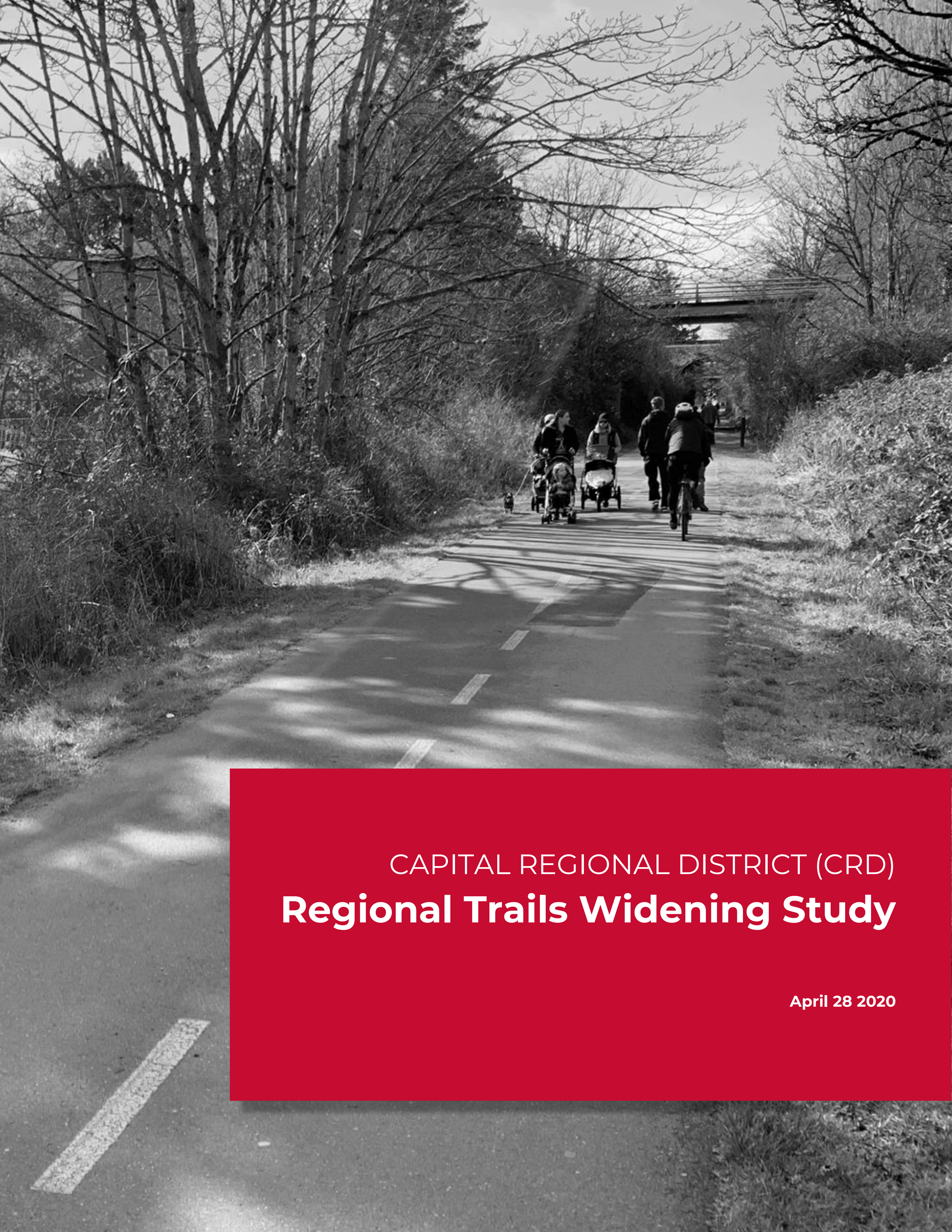

CAPITAL REGIONAL DISTRICT (CRD)

Regional Trails Widening Study

April 28 2020

Report for

Capital Regional District
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April 28 2020

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File no. 001692.0049.01

Contents

1.0 Introduction

1.1 Background

The Galloping Goose and Lochside Regional Trails have steadily increased in popularity since being constructed in the late 1980s (Galloping Goose) and early 2000s (Lochside). The increase in user volumes and conflicts in urban trail sections have been identified as challenges for years. The Capital Regional District (CRD) manages the Galloping Goose and Lochside Regional Trails as part of the Regional Parks service and is seeking to ensure both trails continue to provide a safe, comfortable user experience in consideration of both existing conditions and possible future changes in trail user volumes and travel modes. Lighting is also an important opportunity to improve safety and comfort among trail users, recognizing that trail use is not limited to daylight hours. Possible impacts of trail lighting, such as impacts on adjacent properties, must also be considered.

The 2016 *Regional Trails Management Plan* (RTMP) identifies assessing the feasibility of separating or widening the Galloping Goose between Selkirk Trestle and McKenzie Avenue / Highway 1 (Section 3.5, 3), as well as to assess widening the Lochside between the Switch Bridge and McKenzie Avenue (Section 4.5, 4) as a short-term need. The RTMP also identifies the need to study the possibility of adding lighting along regional trails.

1.2 Purpose

The purpose of this study is to identify and recommend conceptual designs for separating or widening two segments of CRD Regional Trails based on an analysis of the engineering feasibility, costs, benefits and best practices. The project also includes an assessment and recommendations for lighting the segments of trail. Both items are in pursuit of identified action items from the 2016 RTMP.

While this study is focused specifically on the trail segments identified in *Section 1.4*, the research and recommendations may have application when considering trail widening and lighting elsewhere in the regional trail system.

1.3 Overview

This study includes the following general components:

1. A review of existing trail conditions, including user volumes, trail width and constrained locations that may impact design options;
2. A review of research and best practices for trail widening, separating and lighting based on available technical guidelines documents and a review of precedent trails in other communities;
3. Identification of opportunities and challenges for three trail widening and reconfiguration options with supporting design concepts and cost estimates, including lighting concepts for each;
4. Research and recommendations on whether to light the identified trails sections and a long-term approach to trail lighting; and
5. A recommended trail widening or separation option supported by a multi-criteria evaluation of three options.

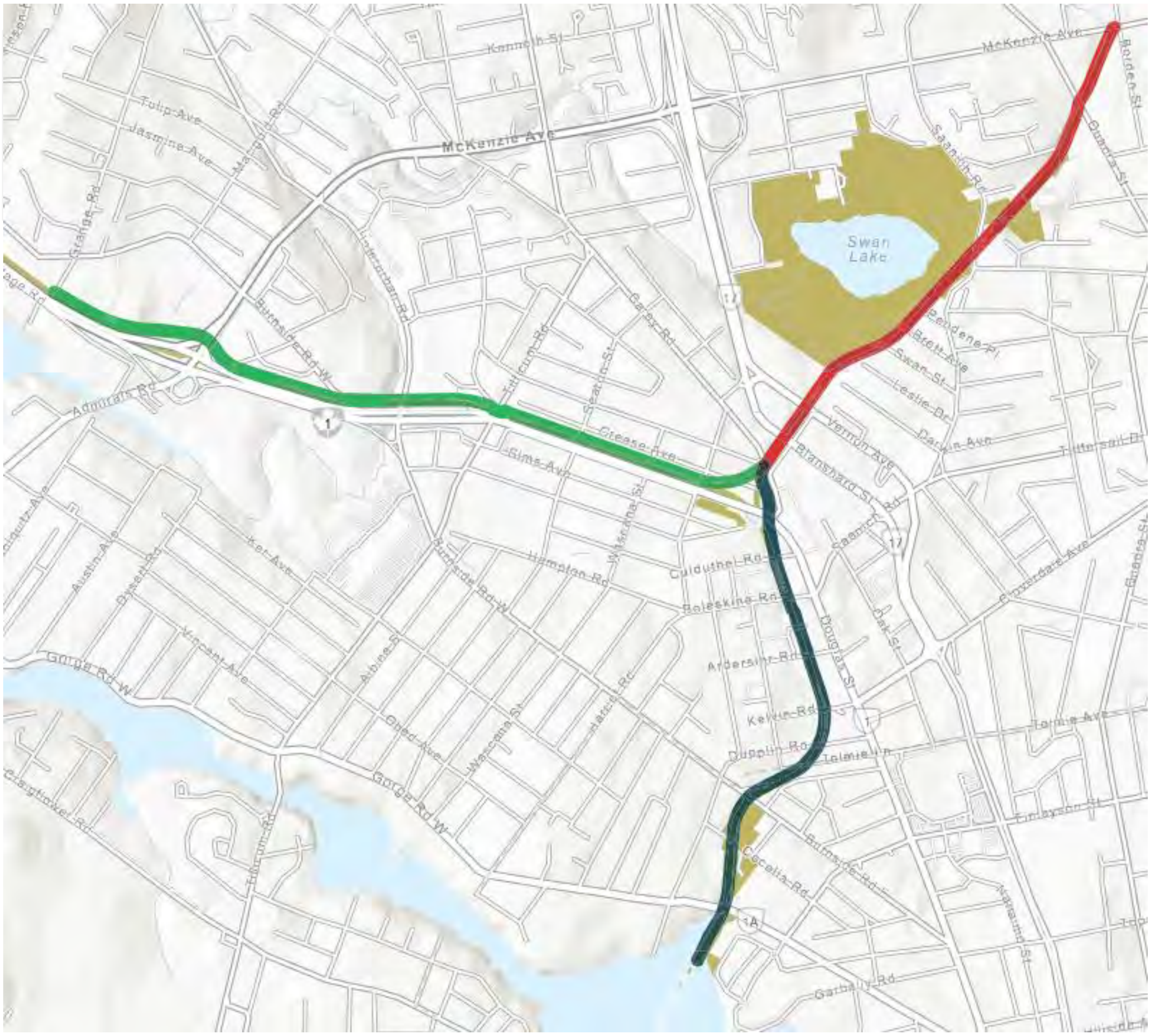
1.4 Study Area

The study considers a total of 6.6km of the Galloping Goose and Lochside Regional Trails. The study area includes three distinct trail sections that are referenced throughout this study, as summarized below and identified on **Map 1**:

- **Section A**. Galloping Goose Regional Trail between the Selkirk Trestle and Switch Bridge (2.0km);
- **Section B**. Galloping Goose Regional Trail between the Switch Bridge and Grange Road (2.6km); and
- **Section C**. Lochside Regional Trail between the Switch Bridge and McKenzie Avenue (2.0km)

The regional trail sections that are the focus of this study are urban and generally experience the highest level of use in the regional trails system. The section of the Galloping Goose Regional Trail south of the Selkirk Trestle is under the City of Victoria's jurisdiction and has not been included in the detailed investigations contained in this report.

Map 1. Study Area



Trail Sections

- **Section A**. Galloping Goose, Selkirk Trestle to Switch Bridge
- **Section B**. Galloping Goose, Switch Bridge to Grange Rd
- **Section C**. Lochside Trail, Switch Bridge to McKenzie Ave

1.5 Jurisdiction

The regional trail corridors are owned by the Province. The CRD Regional Parks service manages the trails under a licence of occupation.

Intersections with adjacent roadways, as well as select infrastructure along the corridors (i.e., bridges, underpasses), are generally under the local municipal (District of Saanich, City of Victoria) or Ministry of Transportation + Infrastructure's (MoTI) jurisdiction, thereby limiting the CRD's direct influence over these facilities.

2.0 Current Condition

2.1 Design Parameters

The following is a brief summary of existing conditions and key trail parameters that may dictate the feasibility of trail widening and lighting options.

2.1.1 Trail Classification

The classification of the sections of the Galloping Goose and Lochside Regional Trails that are the focus of this study are the starting point for identifying the intended function of the trail and the trails users that can be anticipated. These trail sections are classified in the *Regional Parks Strategic Plan* as "Bike and Pedestrian Trails". The definition given to these facilities is as follows:

> *Regional trails that are designated primarily to accommodate a high volume of users for recreational and commuting cycling, and for walking and running. Non-motorized vehicle transportation corridors for commuters, they are the arterial cycling trails in the region. These trails have major infrastructure and a paved surface.*

The RTMP provides further guidance on trail use and management, noting specifically that in high-use, urban areas the transportation role of trails is to be given primary consideration in trail planning and management.

2.1.2 Trail Dimensions

Rights-of-Way

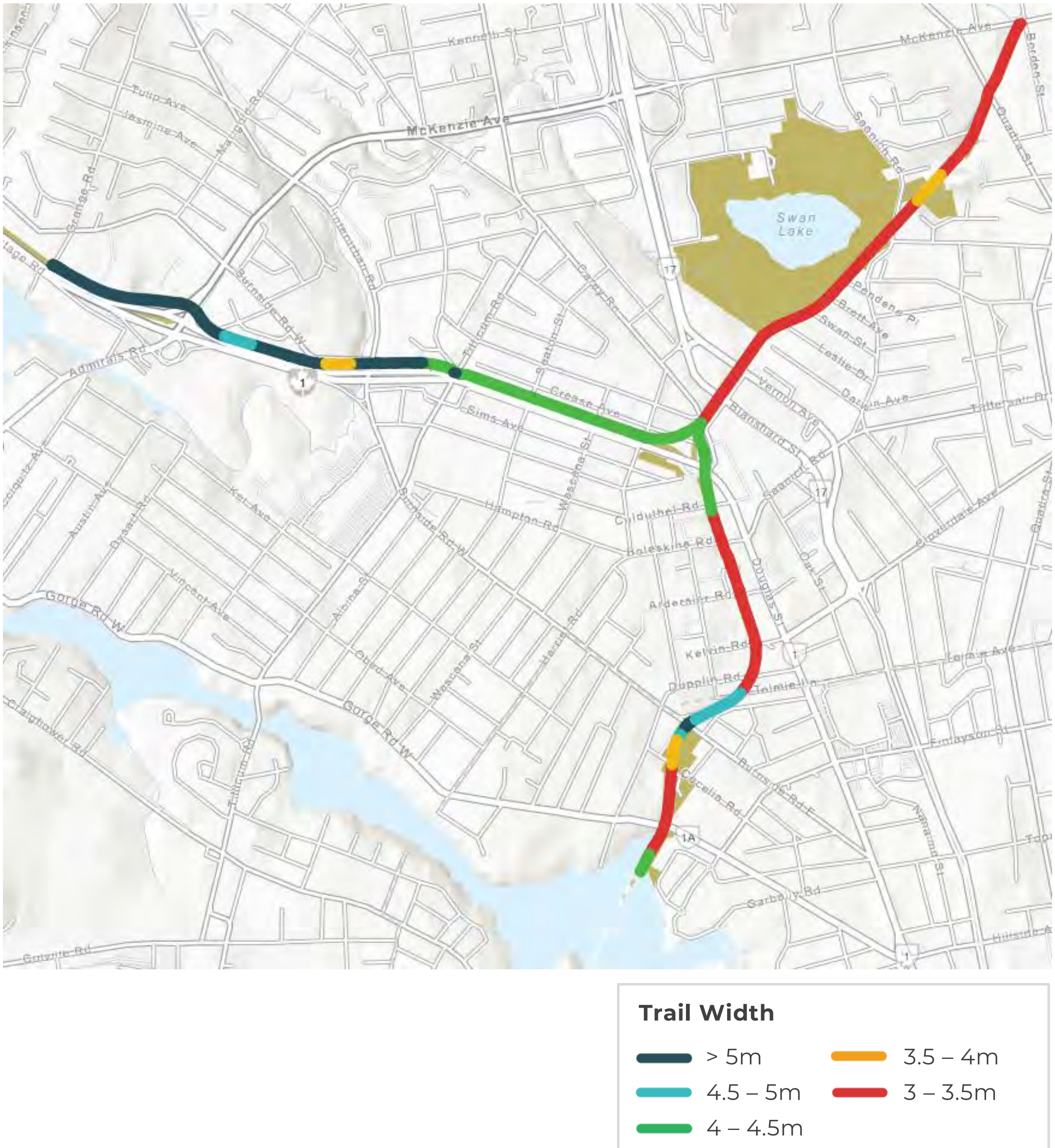
The trail rights-of-way vary significantly along their entire length. Widths are typically in the range of 15.0 to 20.0m, and as low as 10.0m in their narrowest locations.

The trail rights-of-way will be wide enough in all locations to accommodate possible widening or reconfiguration options and are not a constraint that need to be considered in this study.

Trail Width

The existing trails are multi-use facilities that accommodate pedestrians, cyclists and other trail users in a shared space. Directional travel is separated by a painted centre line (either dashed or solid) in most locations. Generally, the trails widths are 3.0 – 4.0m wide throughout the study area. The Lochside Regional Trail (Section C) is 3.0 – 3.5m along its entire length, whereas the portion of the Galloping Goose Regional Trail is approximately 4m wide, with increased width west of Interurban Road as part of recent upgrades associated with the McKenzie Interchange. A full inventory of the trails widths is included in **Map 2**.

Map 2. Existing Trail Widths



2.1.3 Corridor Constraints

Physical "pinch points" such as bridges, trestles and underpasses are unlikely to change in width as part of any trail widening / reconfiguration due to the prohibitive cost of alterations and in some cases the CRD's lack of jurisdiction over the structures. This includes five overpasses (i.e., bridges / trestles) and six underpasses. Each has been catalogued below in **Table 1**. Some consideration is given in subsequent sections to trestles that are known to require significant investment and/or replacement by the CRD in the next twenty years and where future widening may be considered.

Beyond physical infrastructure constraints, the corridors present challenges with the trail elevation relative to adjacent lands, largely a result of the corridors initially being established and constructed as railway lines. Rock cut and corridor drainage facilities result in constrained widths on the Galloping Goose Regional Trail between Gorge Road and Tolmie Avenue, as well as the Lochside Regional Trail between Switch Bridge and Darwin Avenue. Areas where the trail bed is elevated relative to surrounding areas is also a challenge to trail widening, particularly on the Galloping Goose west of Crease Avenue and on the Lochside north of Darwin Avenue. These locations are considered in detail in the concept design options in **Section 4** below in terms of both the costs associated with potential widening, as well as the impacts on adjacent areas.

Table 1. Summary of Infrastructure Constraint Locations

Location		Available Width	Jurisdiction
Section A	Gorge Road (underpass)	8.5m	City of Victoria
	Burnside Road (underpass)	5.4m	City of Victoria
	Boleskine Road (underpass)	6.7m	District of Saanich
	Switch Bridge (overpass)	4.0m	MoTI
Section B	Interurban Road (overpass)	4.0m	CRD
	McKenzie Interchange (overpass)	5.5m	MoTI
Section C	Carey Road (underpass)	6.0m	District of Saanich
	Blanshard Street (underpass)	7.8m	MoTI
	Vernon Avenue (underpass)	5.8m	MoTI
	Brett Trestle (overpass)	3.5m	CRD
	Swan Lake Trestle (overpass)	3.5m	CRD

2.1.4 Trail Surface

The majority of the trail surface within the study area is asphalt with exceptions where the trails pass over a bridge or trestle, as follows:

- Concrete surface on the Switch Bridge and McKenzie Overpass structures;
- Wooden deck planks on the bridge over Interurban Road; and
- Wooden deck planks that were recently capped on the Swan Lake and Brett trestles.

The CRD Trail Development Guidelines for Bike and Pedestrian Trails (RTMP, Appendix 3) clarify that the trail sections that are the focus of this study are to be paved surface and intended to allow for cycling, walking, running, skateboarding and rollerblading.

2.1.5 Lighting

The CRD has no existing lighting on regional trails and electrical infrastructure in the study area is limited to installations by other jurisdictions. The following is a summary by trail section.

Section A, Galloping Goose Regional Trail, Selkirk Trestle to Switch Bridge

- Small street lighting junction box exists adjacent to bridge abutment on south end of Selkirk Trestle (west side).
- The City of Victoria has lighting at accesses to Waterfront Park (at Selkirk Waterfront, south of Gorge Road).
- The City of Victoria has light junction boxes and conduit over approximately 400m from Cecilia Ravine Park to Tolmie Avenue (COV lighting at accesses on both sides of the Galloping Goose at accesses to Cecilia Ravine Park between Washington Avenue and Cecilia Road).
- The District of Saanich has a single streetlight at the Barbon Place / Galloping Goose Regional Trail crossing (immediately south of Boleskine Road).

Section B, Galloping Goose Regional Trail, Switch Bridge to Grange Road

- Lighting on Highway 1 between Harriet Road and Tillicum Road, approximately 750m (spacing 50.0 to 90.0m), owned and installed by MoTI.

- Pedestrian scaled lighting on the Galloping Goose over approximately 500m between McKenzie Avenue to 150m east of Grange Road, owned by MoTI and installed as part of the McKenzie Interchange project. Spacing is generally 35.0m when no highway lighting contribution.

Section C, Lochside Regional Trail, Switch Bridge to McKenzie Avenue

- Vernon Avenue / Ravine Way underpass – Two luminaires adjacent to the walkway on the adjacent south abutment. These luminaires are not on the regional trail corridor and contribute very little light to the Lochside Trail.

2.2 User Volumes

Trail volumes are used when considering appropriate trail widths, possible separation of users, and considering and prioritizing lighting on trails. Measures of trail user volumes are typically expressed as average daily traffic (ADT) and hourly traffic in best practices research and when comparing facilities in different communities. The following is an overview of both existing and projected future trail user volumes.

2.2.1 Current Volumes

The CRD undertakes trail user counts at key regional park and trail locations, including locations on the Galloping Goose and Lochside trail sections within the study area. While the available data has some limitations, it is considered to be reliable for the sake of establishing approximate trail user volumes and pedestrian-to-cyclist ratio for the purpose of comparing to trail facilities in other communities and applying guidelines and best practices.

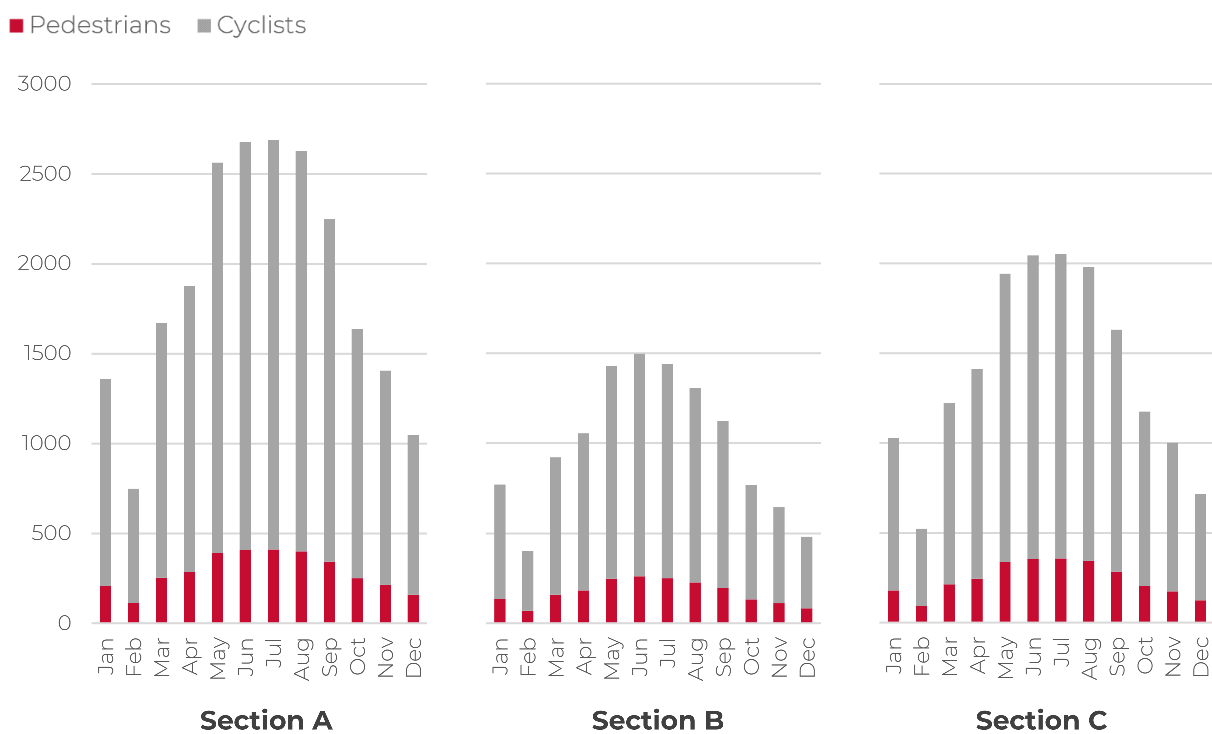
Estimated trail user count data is presented in **Table 2** as the average daily user volume for the busiest month of the year, based on the methodology described in **Appendix A**. The results indicate that average daily volumes are approximately 2,700 trail users in the busiest section (Section A) and 1,500 in the least busy section (Section B). Average daily trail user volumes on the Lochside Regional Trail (Section C) are approximately 2,000 trail user per day.

Figure 1 shows the monthly variation in average daily trail user volumes for each of the three sections. While there is some variation between the three count locations in terms of the month with the highest user volumes, volumes are generally at or approaching their peak between May and August. Overall trail user volumes are split approximately 80% cyclists and 20% pedestrians.

Table 2. Existing Average Daily Trail User Volumes, Busiest Month (based on 5-year average[1])

	Average Daily User Volumes (Two-Way)			Busiest Month
	Total	Pedestrians[2]	Cyclists	
Section A	**2,689**	410 (18%)	2,279 (82%)	July
Section B	**1,499**	260 (21%)	1,239 (79%)	June
Section C	**2,054**	356 (21%)	1,697 (79%)	July

Figure 1. Monthly Variation in Average Daily Trail User Volumes, by Section (based on 5-year average[3])



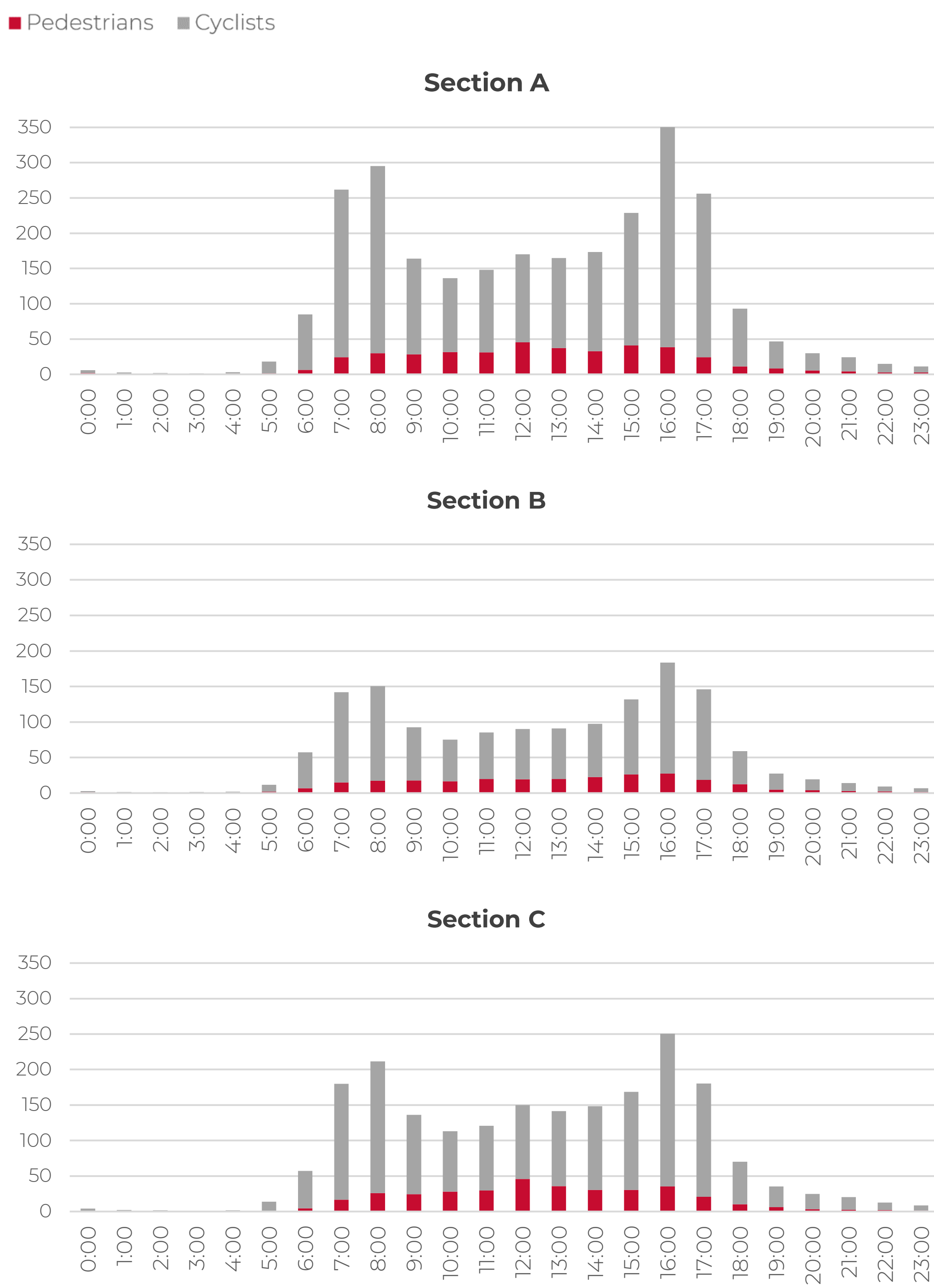
[1] See **Appendix A** for methodology

[2] Pedestrian count data calculated based on a comparison of multiple data sources (see **Appendix A**)

[3] See **Appendix A** for methodology

Figure 2 shows the hourly variation in average daily trail user volumes based on the busiest month for each of the three sections. Each section shows a similar trend, with overall user volumes peaking during the morning and afternoon commute periods. Cyclist volumes follow this commute pattern closely, while pedestrian volumes are more evenly spread out during the day; in fact, peak pedestrian volumes occur around noon in Section A and Section C.

Figure 2. Hourly Variation in Average Daily Trail User Volumes, by Section (busiest month, based on 5-year average [4])



2.2.2 Projected Volumes

Recommendations for trail width, separation and lighting are to accommodate future levels of trail use. The user volume data presented above has therefore been factored to represent a 20-year horizon (2040) with consideration of the factors that may influence pedestrian and cyclist use in future. The following is a summary of factors that were considered:

- Historic growth in volumes on regional trails.
- The impact that potential widening, separating and/or lighting may have on activity levels on regional trails.
- Active transportation infrastructure improvements on parallel corridors, either by municipalities (Saanich, Victoria) or the Ministry of Transportation + Infrastructure, that may divert pedestrians or cyclists away from regional trails.
- The likelihood that electric bicycles continue to decrease in cost, potentially making cycling an attractive and attainable travel mode for a broader range of the population.
- 20-year regional population projections suggest an increase of approximately 22%.
- Possible future rate of development along the regional trail sections as compared to historic growth in the area, including areas adjacent to both trails through Saanich's Uptown Douglas Corridor immediately adjacent to the Lochside Regional Trail.
- Potential for increases in fuel prices, as well as other cost factors such as cost of living and housing prices, facilitating a shift to less expensive travel options such as walking and cycling.
- A continued trend among the general population to both reduce environmental impact and to improve personal health and well-being is likely to increase uptake of active transportation.

The average growth in user volumes on the three trail sections has been approximately 2.5% per year over the past five years[5]. The factors identified above suggest that this growth rate could increase in future due to development along the trail and increasing interest in active transposition, as well as possible improvements to the trails. There is also potential that new municipal infrastructure and natural limits on trail use result in capped use on the trails.

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[4] See **Appendix A** for methodology

[5] Based on 5-year user volume data provided through the CRD's TRAFx count system, accessed March 3, 2020.

A growth factor of 2.5% per year is recommended as the basis for projecting future trail user volumes. This suggests that average daily volumes during the busiest month in 2040 will be approximately 4,500 per day on Section A, 2,500 per day on Section B, and 3,500 per day on Section C. See **Table 3**.

Table 3. Projected 20-Year Trail User Volumes, Average Daily Pedestrians + Cyclists

	Existing Volumes	Growth Factor	Approx. Projected Volumes (2040)
Section A	2,689	2.5% per year	**4,500**
Section B	1,499		**2,500**
Section C	2,054		**3,500**

2.3 Operating Characteristics

Operating characteristics should be understood when considering appropriate trail facility widths and possible separation of trail users. The following section identifies the basic operating characteristics such as operating space and travel speed for pedestrians, cyclists and other active travel modes. The material presented is largely based on the *British Columbia Active Transportation Design Guide, 2019 Edition*[6], a detailed engineering resource with design recommendations specific to BC communities.

2.3.1 Operating Space

An understanding of the operating space for various trail users is required in determining appropriate trail facility widths. The following describes the horizontal dimensions for trail users. Consideration is given to the physical width of the various users, as well as the operating space required to accommodate safe, comfortable operations.

[6] The British Columbia Active Transportation Design Guide is available on the Ministry of Transportation + Infrastructure's website:

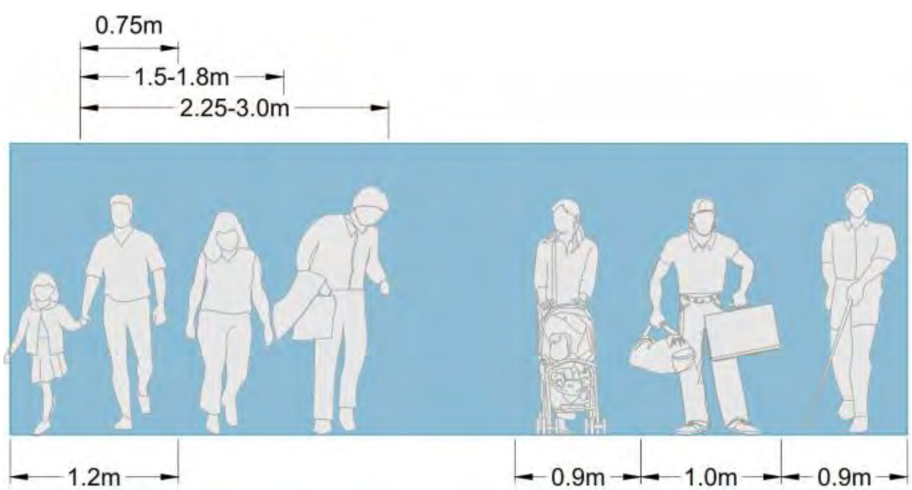
https://www2.gov.bc.ca/gov/content/transportation/transportation-infrastructure/engineering-standards-guidelines/traffic-engineering-safety/active-transportation-design-guide

Pedestrians

People walking and using mobility devices are the target design users when considering trail facilities intended to accommodate pedestrians. This covers a range of people of all sizes, ages and abilities, as shown in **Figure 3**. The following are some of the key dimensions for pedestrians on trail facilities:

- The typical width of an adult pedestrian is 0.5m wide from shoulder-to-shoulder. The horizontal operating space for a typical adult pedestrian is 0.75m wide, which accounts for lateral sway when walking. People with shopping bags, pushing a stroller or using a guide have horizontal operating spaces in the range of 0.9 to 1.2m.
- An adult and child walking together require 1.2m operating space, two adults walking together require 1.8m and groups of more than two require 3.0m.
- The typical width of a person using a wheelchair is 0.8m wide, which accounts for an electric wheelchair and the hand motion required to propel a manual wheelchair. The horizontal operating space for an individual using a wheelchair is 0.9m wide.
- A minimum of 1.8m is required for two people in wheelchairs to pass or travel side-by-side. Two adults walking side-by-side have an operating envelope of 1.5 to 1.8m, with the upper end of this range providing for added comfort and personal space. Research indicates that pedestrians desire 0.8m of personal space between two people walking for comfort, although this cannot always be achieved.

Figure 3. Typical Pedestrian Dimensions[7]



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[7] Figure adapted from British Columbia Active Transportation Design Guide, Figure B-8 and Figure B-9

Cyclists

An individual on a bicycle is the target design user when considering multi-use and cycling-specific trail facilities. The horizontal operating space for cyclists are highlighted in **Figure 4**. The following are some of the key dimensions for accommodating cyclists on trail facilities:

- The typical physical width of an adult on a bicycle is 0.75m from handlebar-to-handlebar. Certain bicycle types (i.e., cargo bikes, newer model e-bikes) are up to 0.9m wide. Bicycles are variable in size and trails should be designed in consideration of the range of bicycles, as shown in **Figure 5**.
- To allow for lateral movement (common when pedalling uphill or travelling at higher speed), the minimum operating space is 1.2m wide and the preferred operating space is 1.5m wide.
- The preferred operating space to allow passing or side-by-side travel is 3.0m. Reduced width is generally not appropriate on bi-directional trail facilities where cyclists are constrained and unable to steer into adjacent areas to avoid conflict.
- Other trail activities such as skateboarding and inline skating are generally accommodated within the operating space dimensions above. An inline skater, for example, typical requires approximately 1.5m of width.
- Additional lateral clearance is required where a cycling facility is adjacent to a vertical obstruction such as a fence, bollard, bench or rock wall. A minimum 0.2m lateral clearance is required where the obstruction is 0.1m to 0.5m high (typically a curb) and a minimum 0.5m lateral clearance is required where the obstruction is greater than 0.5m high.

Figure 4. Typical Cyclist Dimensions[8]

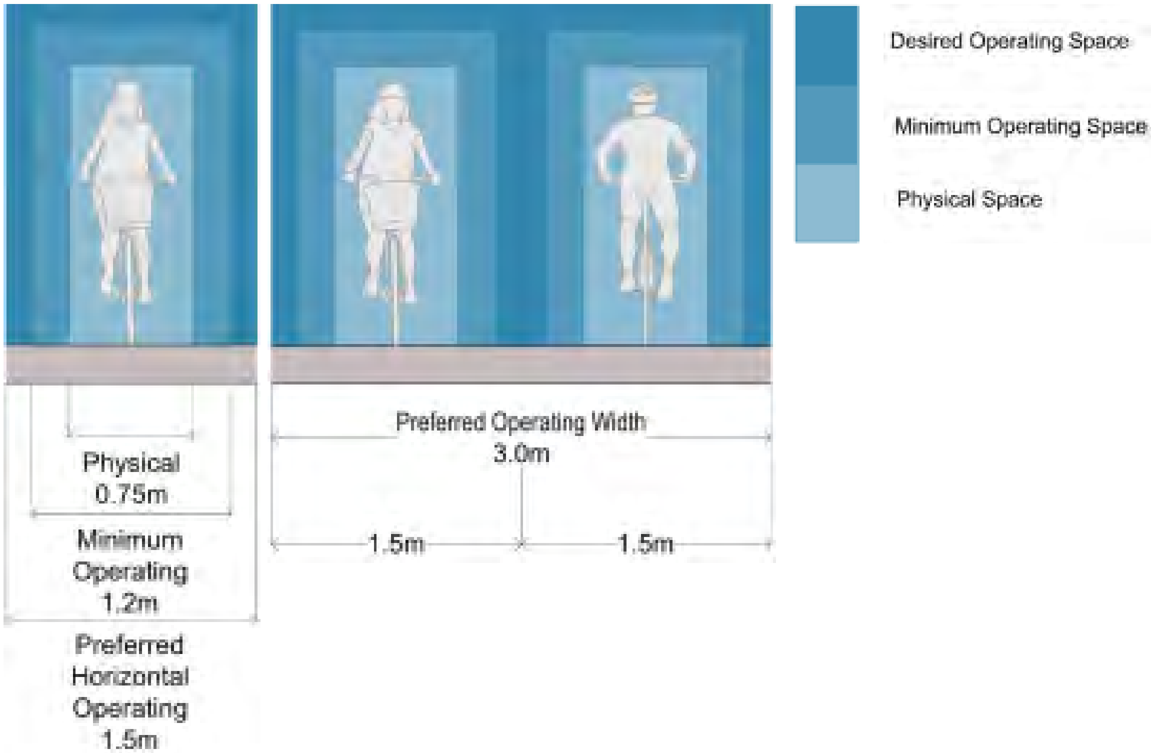
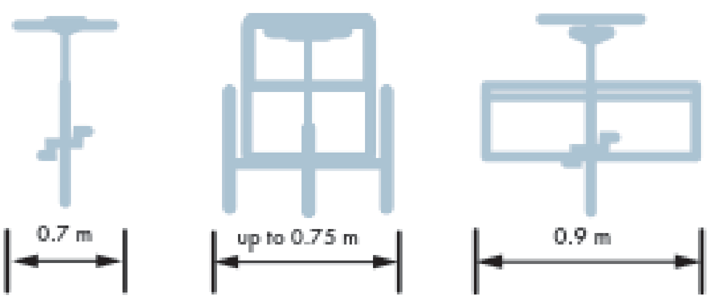


Figure 5. Typical Bicycle Widths - standard bicycle (left), bicycle with trailer (centre), cargo bicycle (right)[9]



[8] Figure adapted from British Columbia Active Transportation Design Guide, Figure B-12
[9] Figure adapted from British Columbia Active Transportation Design Guide, Figure B-11

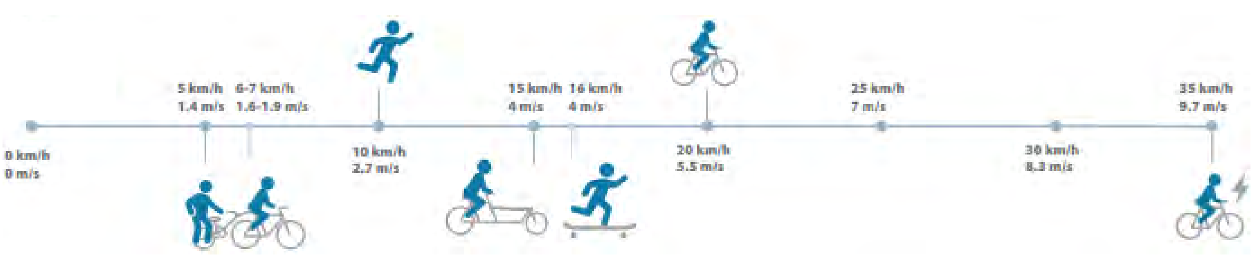
2.3.2 Travel Speed

An understanding of the travel speed for various trail users is beneficial when considering trail widths and/or separating trail uses. Of primary importance is the speed differential between modes when considering trail user safety and comfort, and the frequency of users passing one another on a facility. Generally greater user volumes and higher speed differentials warrant wider trail widths.

Travel speed varies considerably between trail user groups, as well as between trail users of varying experience levels and/or physical abilities. Typical active transportation user speeds are identified in **Figure 6**. The following are some of the key travel speed measures:

- Walking speed for the general popuation is 5 km/h (1.4m per second). Older adults walk at approximately 3 km/h (0.8 to 1.0m per second). An individual running / jogging travels at approxiamtely 10 km/h (2.8m per second).
- Travel speed for a typical adult cyclist is approximately 20 km/h (5.5m per second). Cyclist travel speed may range from between 10 km/h and 30 km/h, with e-bikes and elite cyclists achieving speeds up to 35 km/h.
- Travel speed for motorized wheelchairs / mobility scooters are in the range of 7 to 10 km/ (2.0 to 2.5m per second).
- The above travel speeds assume a flat surface. Travel speeds increase on downhill grades and and decrease on uphill grades, particularly among wheeled travel modes (i.e., bicycles, wheelchairs, inline skates).

Figure 6. Typical Active Transportation User Speeds[10]



[10] Figure adapted from British Columbia Active Transportation Design Guide, Figure B-15

2.4 Key Issues

The following is a summary of key issues on the Galloping Goose and Lochside Regional Trails, primarily based on the *Regional Trails Management Plan* (2016) and feedback received from the *Regional Trails Visitor Use Survey* (2019).

User Volumes

Trail user volumes continue to increase, particularly during summer months and special events (i.e., Bike to Work week). A greater number of trail users leads to more frequent interactions between users, particularly users of differing speeds and in opposing directions, creating more opportunities for conflict and generally leading to a less comfortable user experience.

Speed Differential

Speed differential between different user groups is the source of much of the conflict on the trails. An adult cyclist may travel at speeds between 20 and 30 km/h, where a pedestrian typically travels at approximately 5 km/h. The differential leads to faster trail users overtaking slower ones and a willingness to pass through smaller gaps or with reduced safety as trail user volumes increase, leading to greater conflict. A need for increased enforcement of trail speeds and etiquette was cited.

Trail User Safety

Trail user safety concerns largely stem from high user volumes and speed differential leading to possible conflict or collision. Other contributing factors include poor visibility due to a lack of trail lighting, as well as temporary blindness due to on-coming trail user headlights. Some concerns also relate to the "surprise" factor of other users passing quickly and unexpectedly due to the use of headphones, lack of lighting on bicycles approaching from behind, and the lack of verbal signaling and bell use to alert to passing.

Personal Security

Personal safety concerns have been identified along the length of the Galloping Goose and Lochside Regional Trails due to observed and potential criminal activity. Some high-profile incidents in past have increased trail user concerns.

Vehicle Traffic / Intersection

Conflict between motorists and trail users was identified as a key safety concern, particularly at at-grade intersections where trail users have concerns that motorists may not adhere to stop / yield controls or motorists, once they have stopped, cannot see cyclists approaching the crossing at quick speeds.

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Trail Etiquette

Numerous reported trail user conflicts stem from a lack of understanding or failure to adhere to proper trail etiquette. Commonly cited issues include the following:

- Failure to alert other trail users before passing
- Inattentive / irregular travel behavior (e.g., excessive meandering)
- Poor passing etiquette (i.e., faster users passing too closely, slower users travelling on the left making passing difficult)
- Failing to travel single file during peak periods, particularly among recreational / professional cycling groups

New Technology (Change)

The introduction of electric bicycles in recent years has created challenges when mixed with other, non-power assisted trail users primarily due to the speeds that e-bikes can achieve. E-bikes are also generally larger and heavier than conventional bicycles, increasing the damage / injury that may occur in case of collision. Further, the range of motorized devices becoming available is making the distinction between motorized and non-motorized more difficult to define and therefore more challenging to regulate and enforce.

3.0 Best Practices Review

A review of trail design best practices is presented in this section to understand the latest guidance with respect to trail widening and separation, as well as illumination. The focus of the review is on trail standards and precedent facilities that are representative of the sections of the Galloping Goose and Lochside trails that are the focus of this study. The following sections include a comprehensive scan of research and guidelines documents from professional agencies and other communities, as well as a comprehensive review of ten representative trails in other communities.

3.1 Research + Guidelines

A review of available research and guidelines from professional organizations and other communities was undertaken to understand best practices on the key items being given consideration in this study, as follows:

- What is an appropriate multi-use trail width to provide safe, comfortable conditions? What factors contribute to the need to widen a multi-use trail? (Section 3.1.2)
- Under what conditions should a multi-use trail be separated to provide distinct facilities for pedestrians and cyclists? (Section 3.1.3)
- What are the advantages and disadvantages of lighting trails? Are there certain conditions where lighting is less or more desirable? What are appropriate lighting types / technologies on trails? (Section 3.1.4)
- What are other, alternative trail configurations? What are the advantages and disadvantages compared to more typical multi-use or separated trail facilities? (Section 3.1.5)

The following sections provide a summary of best practices for each of the questions / problem statements identified above. A detailed list of reference documents is included at the back of this document.

3.1.1 CRD Trail Development Guidelines

The CRD's own Trail Development Guidelines (RTMP, Appendix 3) provide a starting point for understanding desirable trail design characteristics. As summarized in the RTMP, the general trail development guidelines for facilities classified as Bike and Pedestrian Trails that apply to the trail sections that are the focus of this study are as follows:

- Primarily cycling and pedestrian use; skateboarding and roller blading may also occur.
- Standard tread width 4.0m; may be up to 7.0m width in high use areas; may be as narrow as 3.0m in areas with restricted corridors.
- Standard shoulder width (each side) 0.5m minimum; in sensitive areas or low use rural or wilderness areas a shoulder width of 0.25m may be considered.
- Cleared width – tread width plus 1.0m on each side.

The Trail Development Guidelines also note that if separation of uses is implemented, the ideal design would be a dual direction pedestrian trail with a minimum 2.0m width, a separation/buffer between it and wheeled use trail of 3.0 – 5.0m in width.

While the above gives guidance on typical trail standards for the CRD's regional trail facilities, the trail sections that are the subject of this study experience the highest use of any section in the regional trail system and require specific consideration of possible widths and configurations beyond those typically applied in the region.

3.1.2 Trail Width

Design guidelines provide recommendations for minimum and recommended trail widths that are comparable to the CRD's Trail Development Guidelines. Trail width design guidance prefers consistency for trail design versus frequently shifting design conditions. Minimum widths are provided, but most design guides note that trail minimums or constrained widths should only be used for short distances where physical constraints limit the trail width. Several design guides note that consideration should be given to providing signage and/or trail calming measures where trail widths are constrained.

In most cases, there are no maximum trail widths. The *Toronto Multi-Use Trail Design Guidelines* notes possible justifications for exceeding default designs including:

- Significant user volume pressure, including where special uses occur
- Destination trails
- Physical, environmental and spatial constraints are surmountable
- Other opportunities exist for exemplary trail facility (i.e., funding, community support)

The Federal Highway Administration's (FHWA) *Evaluation of Safety, Design, and Operation of Shared-Use Paths Final Report* notes that when considering wider trails, trail designers should think in smaller increments and consider level of service based on trail user volumes to avoid overbuilding, increasing costs and environmental impacts. The study also noted that "trails of 3.35 – 4.57m (11 to 15 feet) are wide enough to operate as three-lane paths" and that these trails increased capacity "improves level of service and increases the trail's ability to absorb higher volumes and more diverse mode splits without severely degrading service." General industry practice is that trails over 6.0m should consider separation of users and or separate pathways to avoid large cross-sections of pavement.

Specific guidance from various design resources related to multi-use pathway width in summarized in **Table 4**.

Table 4. Recommended Multi-Use Trail Widths from Design Guide Documents

Design Guide	Trail Width	Lateral Clearance
British Columbia Active Transportation Design Guide 2019	3.0 – 4.0m (for high volume facilities with a variety of different user types, consider using widths at the higher end of the design domain) Constrained width: 2.7m	0.6m (lateral clearance may increase depending on side slope)
TAC 2017 Design Guide: Chapter 5 Bicycle Design	3.0 – 6.0m Minimum width: 2.7m	0.2m for obstructions 100 – 750mm high 0.5m for obstructions >750mm
CROW 2016 Design Manual for Bicycle Traffic	Minimum width: 2.4m	0.25m for low curbs 0.5m for higher curbs 0.7m for fixed objects 1.0m for closed wall
Toronto Multi-use Trail Design Guidelines 2015	3.0 – >4.1m Minimum width: 2.7m	0.6m minimum 1.0m recommended
OTM Book 18 2013 & Ontario Bikeways Design Manual 2014	4.0m Minimum width: 3.0m Constrained width: 2.4m (over very short distances only)	0.5m minimum
Vélo Québec Planning + Design for Cyclists 2010	3.0m	1.0m minimum

3.1.3 Trail Separation

Rationale

Providing separation between bicycle users and other trail users can help enhance safety and make the facility more comfortable for all users. The decision to separate trail users is based on a number of factors including available right-of-way width, total volume of current and anticipated users, and the ratio of pedestrians to all daily pathway users. Trail separation can mean anything from painted lines or different surface materials to physical separation (e.g. curb, bollards, or landscaping). The design guidelines reviewed vary in their approach to providing a threshold for when to separate trail users, as summarized in **Table 5**.

Table 5. Recommended Trail Separation Guidance from Design Guide Documents

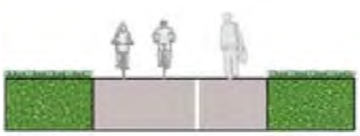
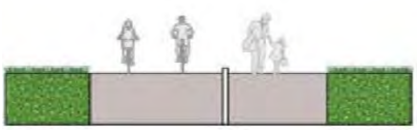
<table>
<tr><th>Reference</th><th>Cyclist-Pedestrian Separation Rationale</th></tr>
<tr><td>British Columbia Active Transportation Design Guide 2019</td><td rowspan="2">>20% of users are pedestrians and total user volumes are >33 persons per peak hour, or

<20% of users are pedestrians and total user volume is >50 persons per peak hour</td></tr>
<tr><td>Transportation Association of Canada (TAC) 2017 Design Guide: Chapter 5 Bicycle Design</td></tr>
<tr><td>CROW 2016 Design Manual for Bicycle Traffic</td><td>Number of pedestrians per hour per metre of profile width:
<100 – full combination of users – shared pathway with no distinct user separation or markings
100-160 – separation at grade, separation along pathway provided as a line, bollard, or other marking
160-200 – grade separation between users
>200 – no combination possible, users should be separated</td></tr>
<tr><td>Toronto Multi-use Trail Design Guidelines 2015</td><td>Separation between cyclists and pedestrians can be used to resolve potential conflicts between users, especially where pedestrians form an above-average proportion of trail users</td></tr>
<tr><td>Ontario Traffic Manual (OTM) Book 18 2013 & Ontario Bikeways Design Manual 2014</td><td>Where space permits, separating pedestrians and cyclists should be considered</td></tr>
<tr><td>Vélo Québec Planning & Design for Cyclists 2010</td><td>In urban settings, parallel pedestrian and cycling paths are recommended</td></tr>
</table>

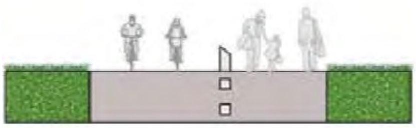
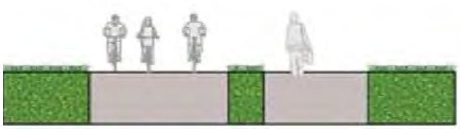
Types of Separation

The BC Active Transportation Design Guide provides specific guidance on the types of treatments that may be applied to achieve separation between users on a separated trail facility. A summary is provided in **Table 6**.

Table 6. Trail Separation Options[11]

Separation Options	Pros / Cons
 **Paint Separation**	• Provides a visual cue to trail users that a separate space is designated for different user types. • Difficult to detect the separated bicycle space as there is no physical separation between users. As a result, encroachment occurs into both spaces. • Minimal impact on the overall facility width.
 **Curb Separation**	• Provides physical separation and a detectable separation between facilities, creating a clear indication to pathway users of the separate facilities. • Limited or no trail widening required. • Can make the two facilities feel more constrained with less room to maneuver when passing. • Can create an obstruction if visibility of the separation is limited due to lighting or weather conditions. • Can impact pathway drainage and restrict crossing opportunities. • Can pose issues for maintenance as curb may be obstruction to equipment (e.g. snow clearing, sweeping).

[11] Adapted from the BC Active Transportation Design Guide, Section E-3, pg E30

 **Post Separation**	• Provides a vertical separation between facilities. • Creates breaks in the separation to allow users to cross into or over the adjacent facility. • Can create an obstruction if visibility of the separation is limited due to lighting or weather conditions. • Can make the two facilities feel more constrained with less room to maneuver when passing. • Can pose issues for maintenance as curb may be obstruction to equipment (e.g. snow clearing, sweeping).
 **Boulevard**	• Provides a buffer space between the two facilities, resulting in a greater degree of separation. • Can be a grass boulevard but also creates space for landscaping, vegetation, and facilitates drainage. • Increased maintenance may be required to prevent overgrown vegetation and ensure upkeep.
 **Median with Furniture**	• Provides the highest degree of separation between users. • Offers space for furniture, lighting, and other trail amenities. • Creates an inviting environment and opportunities to enhance the character of the facility. • Requires a significant amount of right-of-way and results in a wide trail facility.

Separated Facility Widths

Where it is decided that users should be separated, additional guidelines apply for minimum and desired widths of bicycle and pedestrian only pathways. The Transportation Association of Canada (TAC) recommends that a two-way exclusive bicycle pathway should be a minimum of 2.5m wide, which allows oncoming bicycle to safely pass each other. The BC Active Transportation Design Guide provides a constrained limit of 3.0m and a desirable width of 4.0m for bicycle only pathways. Pedestrian-only pathways should consider accessibility, in particular, providing enough space for two on-coming wheelchairs to pass each other (minimum 1.8m). The BC Active Transportation Design Guide provides a constrained width of 1.8m and a desirable width of 2.5 – 3.0m for pedestrian only pathways.

3.1.4 Trail Lighting

Specific guidance on trail lighting is relatively limited. The following is an overview of best practices based on guidance available specific to lighting trail facilities, as well as more general guidance related to the illumination of transportation infrastructure.

Pros + Cons of Lighting Trails

Guidance provided in the various reference documents offers a generalized list of the advantages and disadvantages of lighting trail facilities. The advantages of trail lighting are:

- Increased user comfort and safety
- Aids in wayfinding and navigation
- Allows users to see and be seen
- Recognize hazard, conflict and decision points more readily
- Generally considered a deterrent to criminal activity and vandalism
- Addresses 2 of 4 Crime Prevention Through Environment Design (CPTED) principles:
  - Natural surveillance - See and be seen
  - Natural access control – See intruders entering trail from access points
  - The other two principles relate to territorial reinforcement and maintenance
- Reduce risk of collisions during darkness hours
- Extend hours of when users are comfortable on trail

The disadvantages of trail lighting are:

- Capital, maintenance and operating costs
- Potential / perceived stray light impact on surrounding areas including residential communities and natural spaces
- Environmental concerns with respect to affects on nocturnal creatures
- Light poles creating an additional obstacle for trail users and added maintenance
- Perceived contribution to overall "sky glow" in urban areas, as defined by the International Dark Sky Association

Lighting Priority

Where lighting is being provided on a trail facility, best practices generally suggest the following locations should be prioritized:

- Underpasses and tunnels
- Bridges and overpasses, including at bridge ends and staircases
- Intersections between trails and roads

- Areas with higher crime rates or the potential for criminal activity
- Public gathering areas, open spaces
- Junction of trails/trails and accesses
- Commuter routes, areas of high trail user volumes

Lighting Levels

Preferred lighting levels are generally determined by pedestrian volumes and are related to land use. The latest version of the Illuminating Engineering Society's RP-8 (IES RP-8, currently 2018), Chapter 16 – Off Road lighting, is considered the authoritative reference for recommended lighting levels and uniformities. Tables 16.1, 16. 2 and 16.3 of IES RP-8 provide recommended lighting average, minimum and uniformity levels for walkways/bikeways for high, medium and low pedestrian activity. The 2006 TAC Guide for the Design of Roadway Lighting – Chapter 16- Off Road Lighting also provides guidance for walkways/bikeways lighting levels. Typical medium pedestrian density trail lighting average levels are 5 lux minimum, although may vary based on a need to achieve uniformity along the corridor.

Light Technology

- LED light sources should be used throughout. LEDs represent an energy consumption savings over conventional lighting, with approximately 50 % of the energy consumption of high-pressure sodium light sources. LEDs also allow for improved light control and longer life for light source, expected to last 20 years within specified light output, whereas high pressure and non-LED light sources require lamp replacement 4-5 years or more to retain specified light output.

- Warm light colour temperatures are preferred, measured at 3000 degrees Kelvin colour temperature or less. LED light sources are available in a variety of colour temperatures, including warm temperatures. 3000 degrees Kelvin is considered a "warm" light source and is the highest colour temperature recommended by the Dark Sky Association. Both the City of Victoria and District of Saanich use predominantly 3000 degrees Kelvin colour temperature luminaires in municipal street lighting.

- Luminaires should not include an up-lighting component, with minimal backlight and full cut-off to minimize glare. Back-up-glare ("Bug") rating should be 1-2 for back; 0 for up and 1-2 for glare to minimize and control light spill. The Bug rating system is an industry accepted method to evaluate the performance of an outdoor luminaire by measuring light trespass (backlight), sky glow (up light) and high angle brightness (glare) control. The rating system was developed by the Illuminating Engineering

Society of North America (IES) and the International Dark Sky Association. Additional information on how the outdoor luminaire classifications are determined can be referenced in IES Technical Memorandum TM-15-11 and associated addendums

- Provide provision for dimming, timing and motion detection on trail luminaires, with the application to be determined by the owner.
    - Dimming allows for light levels to be changed to suit trail user density levels, must be programmable, and may be used in conjunction with motion detection. Dimming may also be used with timing to set pre-determined lighting levels by time of day. For example, recommended level from dusk until 11:00pm, lower level unless motion from 11:00pm to 5:00am, recommended level from 5:00am until dawn.
    - Motion sensing can be used in a number of programming options including low light level to recommended light level or off to recommended lighting level. Motion sensing functionality must allow for changes in programming if not optimum in the event of complaints or increased vandalism, include multiple options for control, and have the ability to differentiate between small animals and people.

Lighting Infrastructure

The following guidance relates specifically to trail lighting infrastructure:

- Lighting and poles on trail facilities should be pedestrian scaled to incur lower wattages at an appropriate scale for people and trails, as well as ensuring that light sources do not provide as bright a light or are mounted as high as conventional street lighting, and can therefore more easily control spill light.
- Poles should be a minimum of 4.5m high so as to be low enough to be at a pedestrian scale, but sufficiently high so that they cannot be easily accessed to prevent vandalism and theft.
- Solar lighting may be considered in locations with sufficient solar exposure. Modern solar lighting provides the benefits of not requiring a wired power source, can consist of a single unit containing batteries, solar panels and light fixture, and an 8-year battery life. The primary disadvantage is that the light output per light fixture is substantially lower than hard wired units, therefore requiring more units, poles and concrete bases. Solar lighting generally cannot meet IES RP-8 pedestrian and bike lighting level guidelines for winter months in northern latitudes including Victoria.

Solar lighting performance can be improved/mitigated by employing various lighting programs including combinations of dimming, motion detection and timing plans during off peak times. Solar lighting should not be implemented without fully understanding its limitations. Solar lighting for this application would typically be mounted at 6m and would have a separate luminaire and solar panel/battery array

- Cost effective, vandal resistant luminaires and other lighting components are preferred. Equipment should be purpose made and rugged to resist damage. Luminaires should be chosen for their aesthetics, but also their performance. Overly decorative high-cost luminaires should be avoided, with preference for proven technologies with local representation and a 10-year warranty.
- Junction boxes and other access points to be hardened to deter wire theft. All junction boxes should have vandal resistant fasteners, all other access points shall be of hardened construction. Consider aluminum conductors to reduce the value of theft reward, as well as minimizing the number of access points.

3.2 Representative Trails

A comprehensive review of regional-level trail corridors in other communities has been undertaken to understand the characteristics and design features of other facilities and how regional trails might be improved in the CRD. The focus of the review is on trails that are regional facilities, within a similar context, and with similar user characteristics to those on the Galloping Goose / Lochside Regional Trails. Only those facilities / communities where pertinent information is available – either through research and/or interviews – have been included in the review.

Trail Facilities Reviewed

Detailed investigations were completed for the following trail facilities:

1. Vancouver Seaside Greenway ("Seawall", Vancouver, BC)
2. Arbutus Greenway (Vancouver, BC)
3. BC Parkway (Vancouver, BC)
4. Ottawa River Pathway (Ottawa, ON)
5. Martin Goodman Trail (Toronto, ON)
6. Meewasin Trail (Saskatoon, SK)
7. Burke-Gilman Trail (Seattle, WA)
8. Springwater Corridor (Portland, OR)
9. Chicago Lakefront Trail (Chicago, IL)
10. Midtown Greenway (Minneapolis, MN)

Approach

The investigations included cataloguing a number of specific characteristics of each facility, with consideration for the location and context of each facility. The intent is to understand how the design and configuration of each compares to the Galloping Goose / Lochside Trails, as well as how the user and functional characteristics compare with specific design features.

The following specific characteristics were catalogued for each facility:

- Location, and Community Population
- Adjacent Land Use Context
- Trail Facility Configuration (i.e., multi-use, separated, other)
- Trail Characteristics (width, length, average slope, surface material)
- Trail User Volumes, including mode split where available
- Lighting (i.e., presence of lighting, lighting type)
- Facility Design (Surface material, signing, landscape, signs)

A feature sheet for each precedent trail facility is included in **Appendix B**.

Summary of Take-Aways

Generally, the surveyed trails provided a wide range of trail characteristics and facility configurations. The variability in trail widths, whether trails were separated between users, and trail lighting often fluctuated according to the age of the facility, whether the trail had been upgraded since construction, and specific site constraints. Trail widths varied between 2.0m and over 10.0m in width. The trend with all trails surveyed apart from one, was to move towards widening and in most cases separating trail users as either new trail sections are built, or old trails are reconstructed or retrofitted.

For trails that separate pedestrians and cyclists, most often the method of separation was a paint treatment. Pathways that see significant user numbers (i.e. more than 5,000 users per day on average), in particular high pedestrian use (Chicago Lakefront Trail, Martin Goodman Trail, and Vancouver Seaside Greenway) often provided additional separation between pedestrians and cyclists through landscaped buffers or greenspace. These trails are all located along waterfronts, in linear greenways, and possess significant space that allow for wider pathways and landscape treatments. Trail widening and separating projects are currently underway for several of the trails investigated (BC Parkway, Ottawa River Pathway, and Meewasin Trail). Information obtained from interviewees indicated that the trails were planning phased implementation of trail widening, targeting sections of trail that recorded the highest user volumes and where anecdotal information provided locations of potential or perceived user conflicts between cyclists and pedestrians.

Regarding trail lighting, eight of ten trails investigated were either completely lit, partially lit, or have active plans to introduce lighting in the future. Trails in natural areas were noted as not being lit due to environmental concerns. Several regional trails that stretched from urban centres to suburban settings were lit in the downtown and higher density areas, but lighting would be discontinued as the trail moved further from the urban core. Lighting was often noted as a “nice to have”, but costs were noted as potentially prohibitive to installing lights along entire trail networks. There were very few notable instances of lighting maintenance and/or vandalism issues with regards to lighting.

In summary, there is no consistent approach used across all jurisdictions for the design of trails with regards to trail widths and separation of users as well as the provision of lighting. The trails surveyed did reflect a common trend across multiple jurisdictions to provide wider trails and where possible to separate users. Many interviewees noted that the process to widen and or separate trails is a slow one, with costs being a determining factor. Trail providers may need to weigh widening an existing trail or providing a new trail due to limited trail building dollars.

Table 7. Summary of Key Take-Aways from Precedent Trail Research

Trail Name	Trail Width	User Separation	Lighting	Notes
Vancouver Seaside Greenway	6.0 – 7.0m	Yes 3.0m bidirectional bike path and 3.0m pedestrian path Landscape buffer separation where possible	Yes	Bicycle and pedestrian paths also differ in surface materials (asphalt versus pavers). Paint and signage also used to differentiate between user spaces. Estimated 8- to 10-million annual users, average of 2,800 daily cyclists[12]
Arbutus Greenway	4.0 – 6.0m	Yes Painted lanes and symbols	Yes Currently conducting limited solar trial, plans to light entire trail	Future plans include full separation between users with a minimum buffer of 1.0m. Average of approximately 250 people per hour
BC Parkway	2.5 – 4.0m	Planned for future implementation 2.5 – 3.0m bidirectional bike path and 2.5 – 3.0m pedestrian path	Yes Lighting not continuous	Current trail design notes issues at transition areas, rest areas, and attractions. These areas require additional trail space. Approximately 200 – 300 persons per hour
Ottawa River Pathway	3.0 – 4.0m	Planned for future implementation Details to be published Spring 2020	Yes Pedestrian scale lighting exists in the core area.	The National Capital Commission is undertaking a Review of the Strategic Plan for the Capital Pathway that will detail future trail improvements such as width, user separation, and lighting.

[12] All trail user volume figures are based on available technical studies and/or anecdotal estimates obtained through verbal or written correspondence from local contacts. These figures should be treated as high level estimates only.

Trail Name	Trail Width	User Separation	Lighting	Notes
Martin Goodman Trail	2.6 – >7.0m	Yes Some sections of trail are divided into two separate pathways with landscaping between 3.5m bidirectional bike path and 2.7m pedestrian path	Yes Trail lighting exists along most of the corridor	Recent trail construction has included consideration and inclusion of amenities such as rest stops. The trail at times widens out into a plaza setting along the waterfront.
Meewasin Trail	2.0 – 5.0m	Planned for future implementation Future trail design widths range from 3.0 – 6.0m for a multi-use trail or optional separated bike and pedestrian trails between 3.0 – 4.5m each	Yes Pedestrian scale lighting limited to the downtown core Natural areas are unlit	Meewasin Trail Study (2014) provides design standards of: • 3.0m multi-use trail for less than 200 persons per hour • 4.0m multi-use trail for 200 – 300 persons per hour • 6.0m multi-use trail or two 3.0m separate trails for 300 – 600 persons per hour • Two 4.5m separate trails for over 600 persons per hour
Burke-Gilman Trail	3.0 – 5.0m	Yes Sections near the Univ. of Washington have been widened and separated 3.0m asphalt bidirectional bike lanes, 3.0m concrete pedestrian pathway	No With the exception of small sections near the Univ. of Washington	The trail includes a crushed granular shoulder along most of its length, offering a softer surface for runner and joggers. Approx. 3,000 – 4,000 daily users

Trail Name	Trail Width	User Separation	Lighting	Notes
Springwater Corridor	3.7 – 4.3m	No	No	Trail width is limited by site constraints adjacent river and active rail line. Approx.. 600 persons per hour
Chicago Lakefront Trail	5.0 – >10.0m	Yes The trail has been fully separated into a pedestrian bidirectional trail and a bike bidirectional trail.	Yes	The trail at times widens out into a plaza setting along the waterfront. While often located adjacent each other, the pedestrian trail and the bicycle trail at times may be over 200m apart from each other. Approximately 30,000 daily users.
Midtown Greenway	3.7 – 6.0m	Yes Painted lanes and symbols	Yes Some sections under lit including under bridges	Trail located in a trench along a former rail right-of-way. Available trail space is constrained by sloped walls and numerous bridge crossings. Approximately 4,000 – 5,000 daily users

Local Examples of Lit Trails

The following are examples of trails in Greater Victoria that include sections of illumination:

- Town of Sidney installed lighting along a local trail, Weiler Avenue to Ocean Avenue, alongside Patricia Bay Highway – 400m of solar pedestrian scale lighting. This section of trail is being used as an updated route for the Lochside Trail (luminaires remain owned by Sidney). Lighting levels appear to be very low.
- MoTI installed luminaires McKenzie Avenue to Spectrum Lane (500m) along the Galloping Goose, at the request of School District 61, as part of the McKenzie Interchange project. MoTI owns/manages these.
- Lighting in the underpass at Helmcken Road along the Galloping Goose, installed / owned by MoTI.
- City of Victoria has lighting in dark, vegetated areas near the intersection of Dallas Road and Camas Circle (300m) along the new Dallas Road Waterfront Trail.
- Lighting in the pedestrian underpass beneath Highway 1 at Seaton Street, east of Tillicum Road, installed / owned by MoTI.
- University of Victoria has lighting on approximately 600m of various campus pathways.

4.0 Trail Improvement Options

The following section considers trail improvement options for the subject portions of the Galloping Goose and Lochside trails. This includes three candidate trail configuration options based on the best practices review and understanding of current trail dimensions, as well as identifying locations and methods for lighting the trails. Conceptual design plans for all improvement options are included in **Appendix C**.

4.1 Trail Widening / Reconfiguration Options

Three candidate trail configuration options are recommended to be advanced to more detailed study. These options were selected based on both the background research completed of guidelines and best practices, as well as in consideration of the corridor constraints and what might reasonably be achieved on the corridors.

The recommended candidate trail configuration options are as follows:

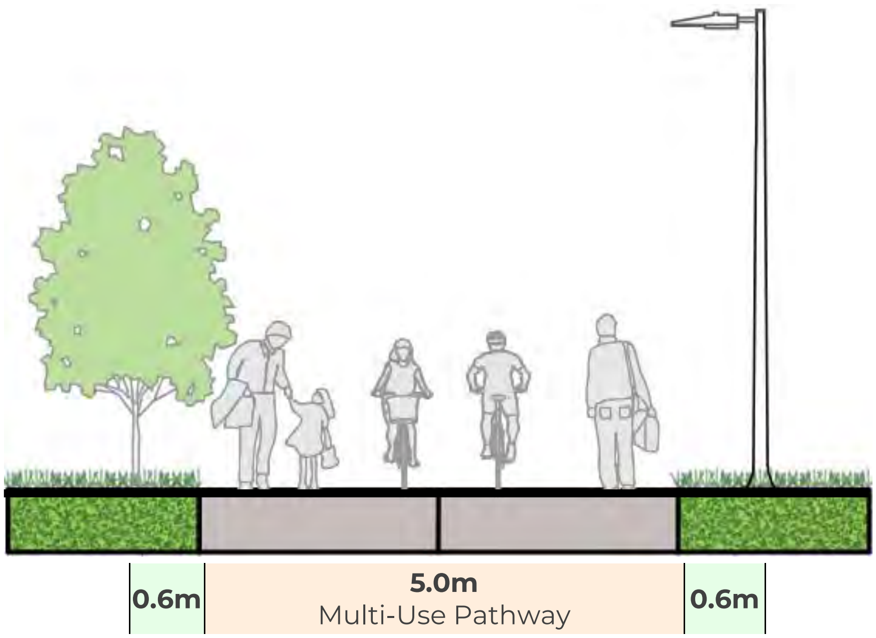
- Option 1. Widened Multi-Use Pathway
- Option 2. Separated Use Pathway
- Option 3. Separated Pathways with Centre Boulevard

A summary of the key characteristics of each option is provided in **Table 8**. The full corridor long design concepts for each have been included in **Appendix C**, with a high-level summary on the following pages.

Table 8. Summary of Trail Configuration Options

		Option 1. Widened Multi-Use Pathway	Option 2. Separated Use Pathway	Option 3. Separated Pathways with Centre Boulevard
Configuration		Combined Uses	Separated Use Pathway	Separated Uses on Separated Pathways
Width	**Total**	5.0m	6.5m	8.5m
	Pedestrian	5.0m	2.5m	
	Bicycle		4.0m	

Configuration Option 1.
Widened Multi-Use Pathway



A 5.0m wide multi-use pathway option represents a similar configuration to the current trail condition, but with widening of up to 2.0m along its length. The treatment includes two 2.5m multi-user lanes with a dashed yellow centre line that allows for passing.

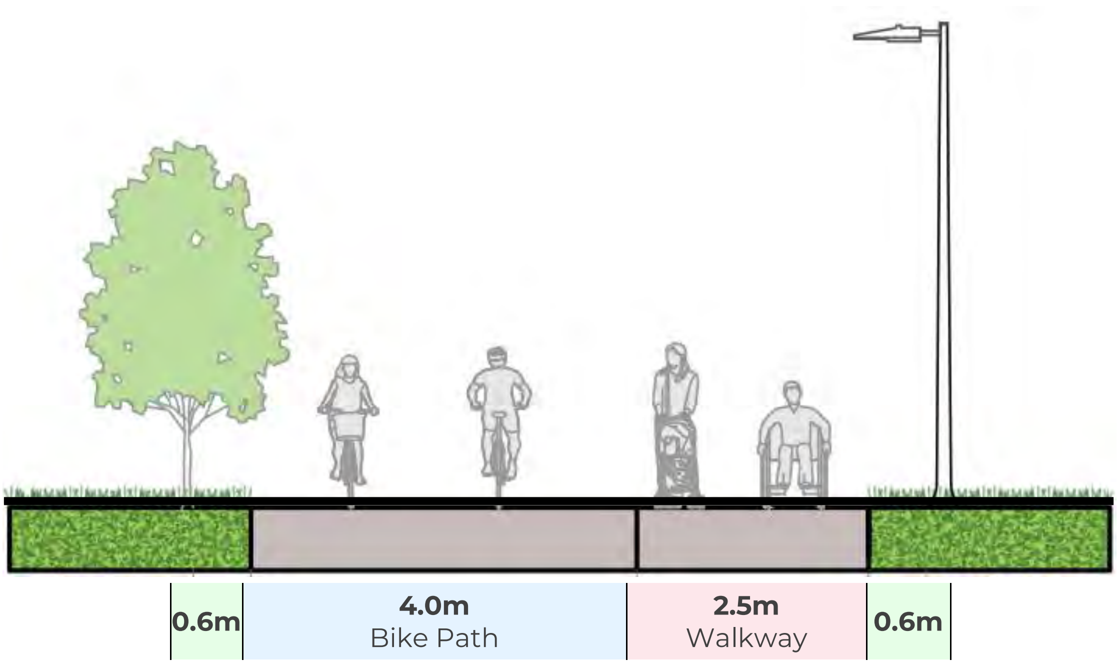
The portion of the Galloping Goose on the east approach to the McKenzie Interchange is an example of a 5.0m wide multi-use trail.

These widths allow for two bikes to pass one another within their lane, or a bike to pass a pedestrian travelling the same direction within the lane. Wheelchairs can safely overtake or be overtaken by cyclists or pedestrians within their lane. Also of importance, a 2.5m lane allows for pedestrians and pedestrians pushing strollers to comfortably travel side-by-side, promoting social interaction and enhancing the trail's recreational function.

The 5.0m width exceeds much of the guidance that is available on multi-use trail widths, which typically suggest a maximum width of 4.0m (note: RTMP Guidelines give consideration up to 7.0m). The high trail user volumes experienced on these trail sections is considered good rationale to increase to the full 5.0m. Further, the works involved in any trail widening are significant and widening to a full 5.0m is recommended if widening is being considered.

The 5.0m multi-use pathway fits beneath all underpasses in the project area but would need reduced width over the bridges. Transitioning to narrower sections over the bridges is easy as cyclists and pedestrians are mixed. At-grade crossings will also be combined crossings.

Configuration Option 2.
Separated Use Pathway



A separated pathway option is considered that includes a 4.0m bike path and a 2.5m walkway. The treatment includes a solid white line separating the cyclist and pedestrian facilities, as well as dashed yellow markings on the bike path and pavement markings indicating the intended user and travel direction in each space.

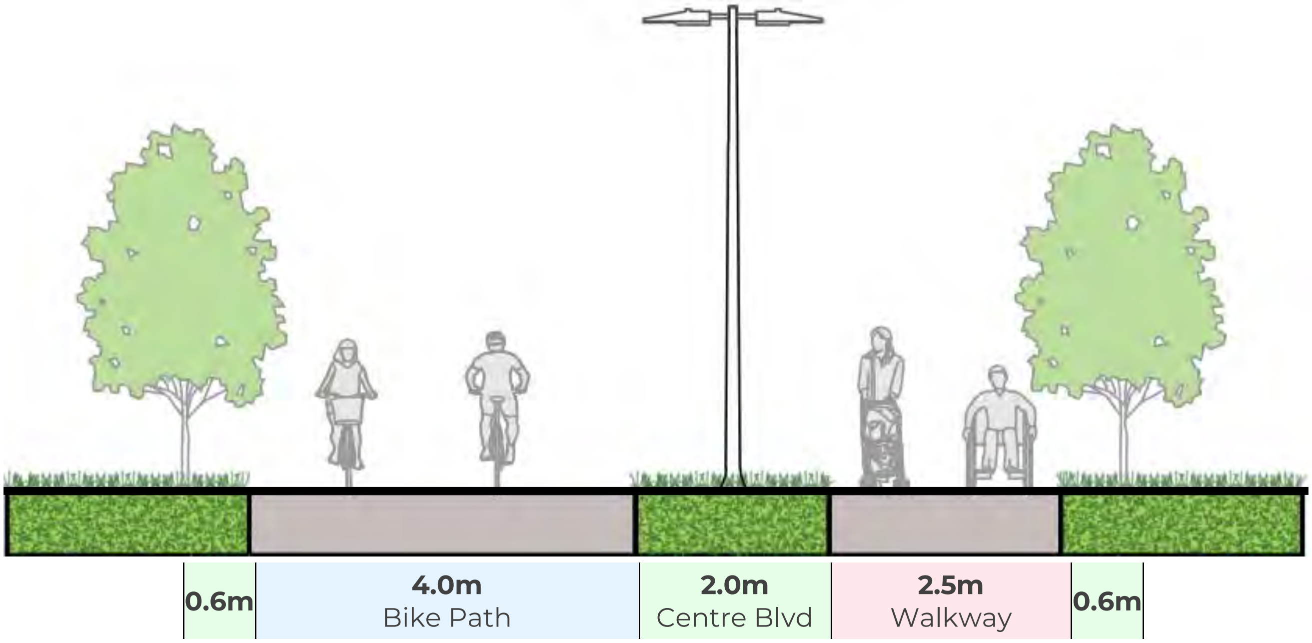
The primary benefit of this option is the physical separation of cyclists and pedestrians, something which has been identified as desirable in user surveys and which best practices documents indicate as generally appropriate as user volumes increase. The bike path and walkway widths both generally meet preferred facility dimensions in best practices documents. The 4.0m bike path allow for cyclists to comfortably pass one another without impeding on-coming cyclists. The 2.5m walkway facilitates side-by-side pedestrian traffic, as well as comfortable conditions for faster pedestrians overtaking slower ones.

Constrained conditions result in reduced facility widths (but still separated) in the following locations - Burnside Bridge Underpass, Carey Road Underpass, Vernon Avenue Underpass. The separated facility will transition to a combined facility prior to the following locations - Switch Bridge, Brett Trestle, Swan Lake Trestle, Interurban Road Overpass. These locations may include warning signage and pavement marking (i.e., “SLOW”) to appropriately message the upcoming change in trail condition.

URBAN SYSTEMS

Configuration Option 3.

Separated Pathways with Centre Boulevard



Another separated pathway option is considered that includes a 4.0m bike path and a 2.5m walkway (as above), but with a 2.0m wide centre boulevard space. The bike path has a dashed yellow centre line and pavement markings indicating the intended travel direction.

The primary benefit of this option over Option 2 is the physical separation of the cycling and walking spaces. The centre boulevard space would generally be grass, with low shrubs in places. All materials would be low maintenance. Rain gardens / stormwater management features could be located in this space, but trees would not be planted in this space due to fall leaves and debris, as well as maintenance concerns. The 2.0m width allows for benches, garbage bins, signs and other furnishings if desired. Lighting would also be located in this area (as opposed to at the side of the trail in other options).

The portion of the Galloping Goose managed by the City of Victoria south of the Selkirk Trestle is a separated pathway with similar widths as shown in this option and a landscaped boulevard between the two facilities of 1.0m – 4.0m in places.

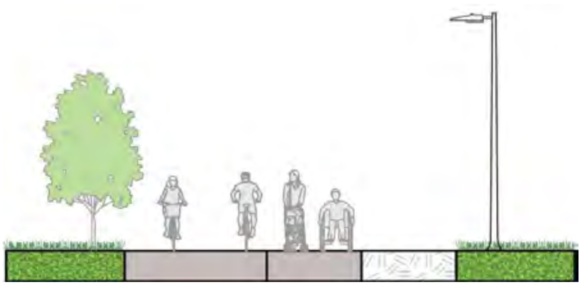
This option is the widest of the three options at 8.5m (plus shy spaces). Similar to Option 2, there are constrained locations where typical cross-section widths have been reduced - Burnside Road Underpass, Carey Road Underpass, Vernon Avenue Underpass.

The separated facility will transition to a combined facility prior to Switch Bridge, Brett Trestle, Swan Lake Trestle, Interurban Road Overpass, and McKenzie Interchange.

4.1.1 Alternative Configuration Options

The following options were given consideration as possible trail reconfiguration options but were ultimately not recommended for further study for various reasons. A brief description of each, including why each is not recommended, is provided below.

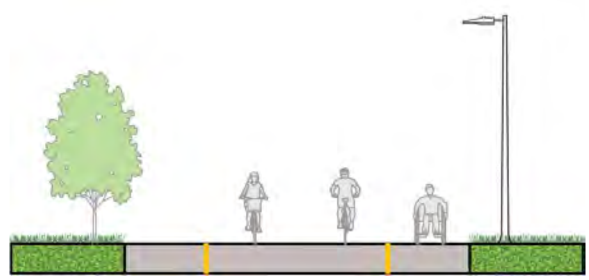
Separated Pathway with Adjacent Soft Surface Trail



Separated bike path and walkaway, with an adjacent soft surface trail.

- Greater maintenance required due to tracking granular / chip onto adjacent asphalt area
- Not accessible – extra space does not accommodate wheelchairs
- Drainage can be issue – get mucky and tracks onto asphalt pathway
- User survey and plan documentation does not indicate a strong desire for soft surface in urban trail sections, nor is there the volume of joggers to warrant the added cost and maintenance

Bicycle Path Flanked by Uni-Directional Walkways



A central bike path with uni-directional walkways on either side.

- May lead to further pedestrian and cyclist conflicts as pedestrians cross across bike path
- Enforcing compliant trail user behaviour will be challenging (i.e., pedestrian directional travel, cyclists in pedestrian space)
- Not a standard treatment – will require significant education and signage

Other, more significant interventions were discussed but not advanced to detailed consideration, such as elevated / stacked trail facilities and linear property acquisition for corridor realignment.

4.2 Trail Lighting

The general intent of trail lighting is to improve trail user comfort and safety while negative impacts on nearby properties are mitigated. The general best practice is to consider lighting trails as user volumes increase, which has historically been experienced on the subject trail sections.

Trail lighting may be suitable along much of the corridors for the following specific reasons:

- To increase trail user safety by reducing the potential for trail user collisions during periods of darkness, as well as permitting trail users to recognize hazards and decision points more readily.
- To improve on the trail user sense of personal security by illuminating areas on and adjacent the trails to reduce real and perceived intruder threats during periods of darkness. This specifically addresses two of four Crime Prevention Through Environmental Design (CPTED) principles:
    - Natural surveillance – “see and be seen”
    - Natural access control – see intruders entering trail from access points
    - The other two CPTED principles relate to territorial reinforcement and maintenance, which lighting does not directly impact.
- To aid in wayfinding and navigation during periods of darkness, helping trail users to successfully navigate the trail and supporting navigation at key decision points where a turn movement to/from the trail is required as part of the trail user trip.
- To recognize hazards and irregular trail conditions that would otherwise not be expected, addressing both the fear of and actual safety issue associated with unforeseen hazards.
- To deter deviant and criminal activity as a means to both improve broad trail user comfort and decrease maintenance efforts resulting from vandalism.
- To increase trail use by extending the hours when trail users feel safe and comfortable using the trails, permitting more trail usage during non-peak periods.

Trail lighting may not be suitable through the section of the Lochside Trail through the Swan Lake area as it could have negative impacts on adjacent natural spaces. This includes possible negative impacts on the sleep patterns of wildlife, particularly nocturnal animals, as well as interrupting the natural conditions adjacent wildlife is accustomed to. The installation of lighting includes trenching and other construction activities related to luminaire installation, which would also impact natural areas during construction periods.

The scope of this assignment did not include an environmental assessment of the Swan Lake area and the affects of trail lighting. In addition to the content above, the International Dark Sky Association has stated that artificial lighting can:

- Impact wetland habitats were amphibians exist such as frogs and toads, impacting nocturnal activity, interfering with breeding and reproduction.
- Drawing insects to lighting, making it easier for predators to diminish their species.
- Other means to enhance wayfinding in the Swan Lake area during darkness hours include applying high visibility reflective tape on structures and installing posts with reflectors at regular intervals.

The approach to lighting the trail corridors should include developing a priority-based program that can rolled out based on the availability of funding toward realizing the long-term lighting strategy. Consideration is to be given to opportunities for partnership with municipalities and other agencies to pursue lighting as nearby infrastructure projects are undertaken. Detail designs for the sections funded for construction should be undertaken well in advance to ensure adequate time for reviews, tendering and construction.

As lighting is pursued, efforts should be made to ensure installation of appropriate lighting that provides the intended illumination benefits and mitigates any possible negative impacts on surrounding areas. The following is recommended:

- Energy efficient LED “warm colour” sources should used with dimming, time of day and motion detection capability.
- Lighting should be pedestrian scale and have “tight” light control with a suitable “BUG” rating that focuses light on the trail and avoids spillover onto adjacent areas.
- Designs should be economical and concise with respect to light output and light control, energy consumption, longevity, maintenance, installation and replacement.
- Equipment and installations should be selected to mitigate vandalism and theft.
- Lighting levels and uniformity should meet recommended IES RP-8 guidelines.

Diagrams depicting single- and dual-luminaires are shown in **Figure 7**. Single-luminaires would be installed at the trail edge for Options 1 and 2, whereas dual-luminaires would be centrally located in the boulevard space associated with Option 3. The photometric distribution varies with each option, as shown in **Figure 8**, to ensure desired illumination levels are achieved given differing trail dimensions. These diagrams are intended to depict the approximate type/model, dimensions and light output associated with trail lights. Details would be confirmed during subsequent design phases.

Davit poles are to be installed to along the trails to illuminate key road crossings. These lights are commonly installed on roadways throughout the Capital Region.

Figure 7. Luminaire Diagram (Option 1 and 2 at left, Option 3 at right)

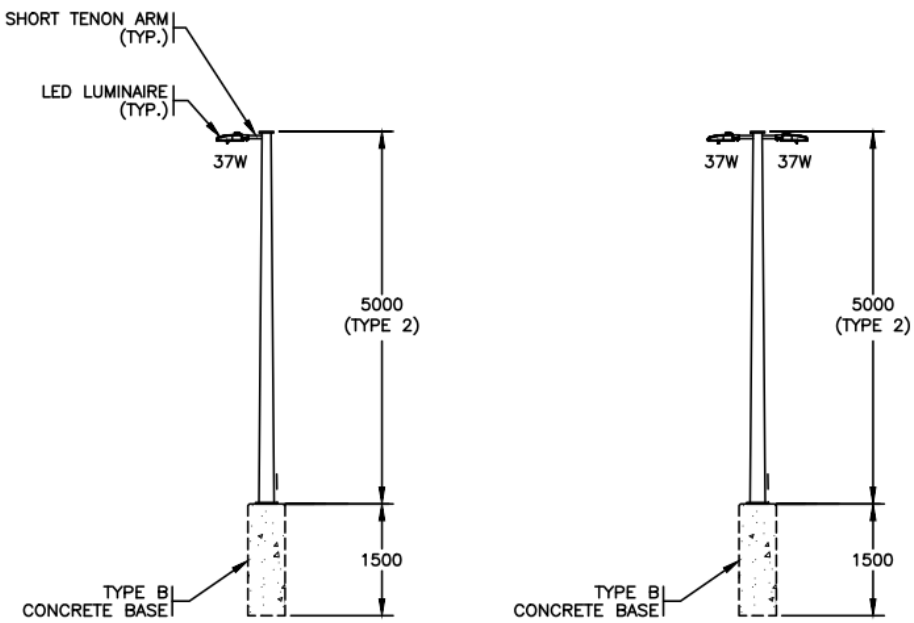
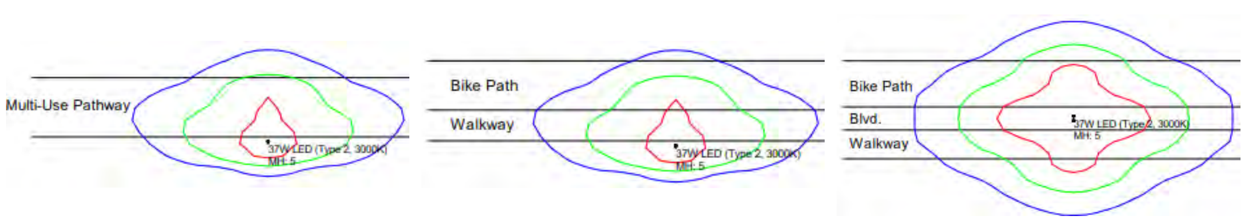


Figure 8. Diagram of Photometric Light Output



Option 1.
Multi-Use Pathway

Option 2.
Separated Use Pathway

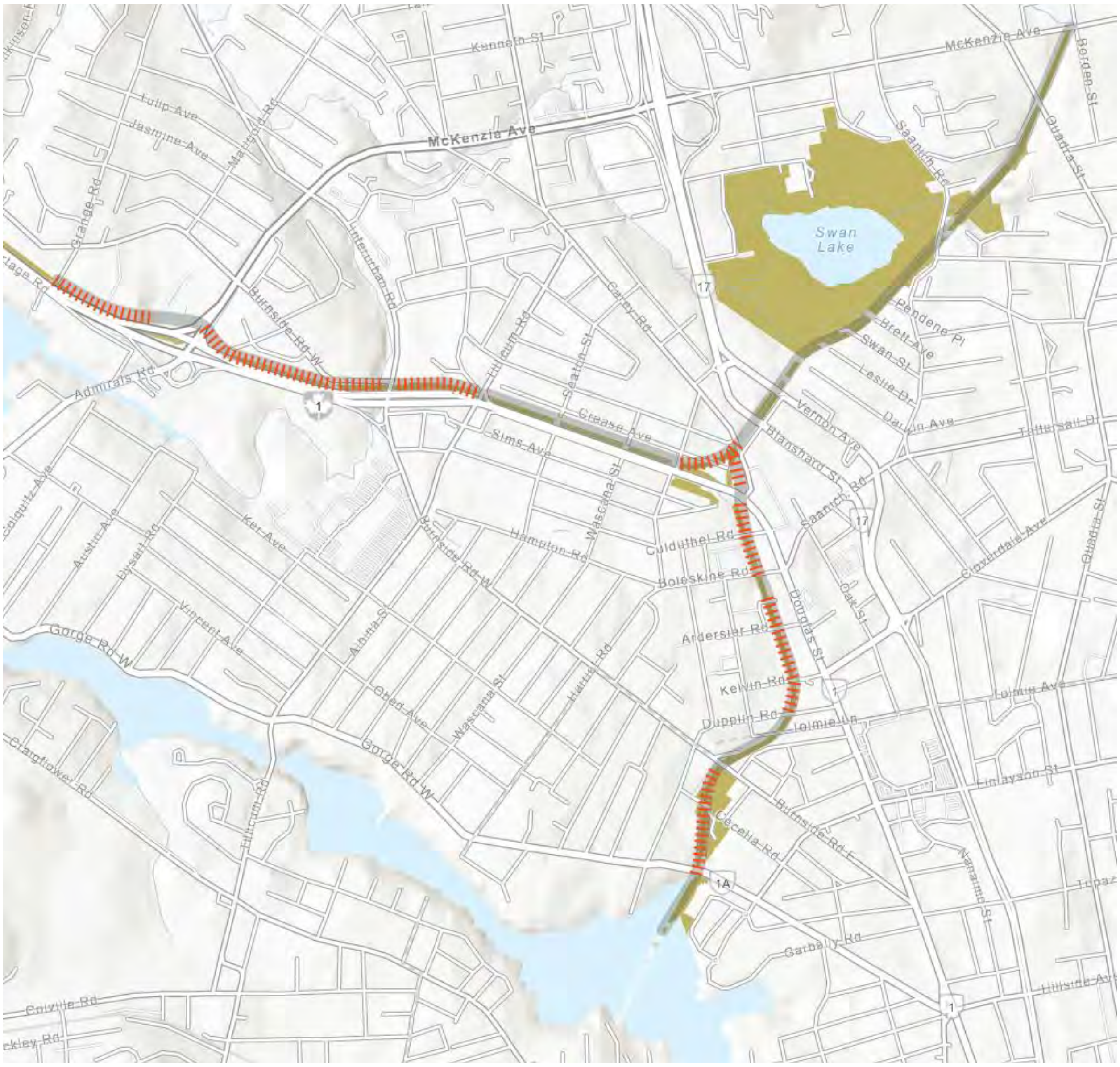
Option 3.
Separated Pathways with Centre Boulevard

Solar light was given consideration as an alternative to hardwired lighting but is generally not suitable due to challenges with solar exposure in many locations throughout the study area. Select locations may be pursued where localized conditions may support solar lighting, as have been identified in **Map 3**, and where solar may be given further consideration as trail lighting is implemented. The following limitations of solar lighting should be noted:

- The capital cost of solar lighting is approximately 1.5- to 2-times higher than the cost of hardwired options due to the greater number of luminaires required.
- Recommended lighting levels cannot reasonably be achieved with solar luminaires, particularly during Winter months when lighting is needed most. The amount of solar energy available in Winter is significantly less than Summer and the power budget required in Winter is significantly greater due to the longer hours of darkness.
- While solar provides approximately $18 in annual energy savings per luminaire, the greater number of luminaires required to achieve basic lighting levels and reduced energy consumption associated with modern LED luminaires minimizes the energy savings of solar over a hardwired system.

Dimming systems were also given consideration and generally not suitable due to the associated capital costs and limited benefit with respect to power bill savings for this application. The annual power bills for full lighting of the three sections (less the Swan Lake section) are estimated at $3,000 per year (in 2020$). The potential power savings by dimming to 50% light output for 50% of the darkness hours would be approximately $750 per year. The estimated cost for implementation of dimming a dimming system is $35,000 in capital costs plus $2,800 per year operating cost. Further, the capital and operating costs of motion detection combined with dimming far exceed the potential power savings. Individual luminaire motion detection on and off is not suitable for cyclists travelling at higher speeds as they would not allow vision more than approximately 30m ahead (a cyclist travelling at 20 km/h is travelling at 5m per second).

Map 3. Candidate Locations for Consideration of Solar Lighting



Candidate Locations for Solar Lighting

5.0 Options Evaluation

The three trail widening/reconfiguration options, including lighting, identified in **Section 4** are evaluated in the following section. This section includes an overview of the evaluation approach (criteria, scoring) and the summary of the results of the evaluation of options. A more detailed description of the evaluation is included in **Appendix D**.

5.1 Evaluation Approach

5.1.1 Criteria

Seven pre-defined criteria were established as the basis for evaluating the three trail widening / reconfiguration options, as follows:

1. Capital Cost
2. Trail User Comfort / Experience
3. Safety / User Conflicts
4. Environmental Impacts
5. Facility Quality
6. Constructability
7. Maintenance / Operations

All criteria are described in detail in **Table 9**, including a description of each, the measure that is to be used, and whether a positive or negative scoring.

Measures

Both quantitative and qualitative evaluation measures have been established. Quantitative measures include capital cost estimates, level of service (LOS) calculations, and quantity measurements from concept design. Qualitative measures are established based on assessment and recommendation by the consultant team.

5.1.2 Scoring

Each widening / configuration option has been assigned a simplified scoring for each criterion ranging from "Very High" to "Very Low". The scoring is intended to reflect the extent to which each widening / reconfiguration option achieves the intent of the criteria, as identified in **Table 9**. Assigned scoring is supported by a more detailed assessment contained in **Appendix D**.

Scoring System

Very High	●
High	◕
Moderate	◑
Low	◔
Very Low	○

Positive / Negative Scoring

Scorings applied to each criterion are either positive or negative, as identified in **Table 9**. Positive scorings (identified with a "**+**") are those where a higher or greater evaluation is assigned a higher score. Negative scorings (identified with a "**-**") are those where a lower evaluation is assigned a higher score. For example, a lower capital cost indicates the option is less expensive and therefore receives a higher scoring.

Table 9. Trail Widening / Separation Evaluation Criteria

Criteria		Measure	
1. Capital Cost	The capital cost of the trail widening or reconfiguration	Class "D" cost estimate	-
2. Trail User Comfort / Experience	The relative improvement in trail user comfort and experience as a result of the trail widening or reconfiguration	Trail level of service (FHWA calculator)	+
3. Safety / User Conflicts	The extent to which the trail widening or reconfiguration provides for a safe trail facility and addresses user conflicts	Qualitative evaluation between options	+
4. Environmental Impact	The extent to which the trail widening or reconfiguration impacts environmental features such as trees and natural spaces	Mature trees impacted (approx.) Vegetated space impacted (approx.)	-
5. Facility Quality	The overall quality of design achieved by the trail widening or reconfiguration option, including creating a consistent corridor design, limiting "pinch points" and providing strong transitions between trail sections and changes in facility types	Qualitative evaluation between options	+
6. Constructability	The presence / requirement for slopes, drainage, rock blasting, property encumbrances, constrained existing infrastructure and other challenges that impact the ease of construction	Qualitative evaluation between options	-
7. Maintenance / Operations	The level of maintenance and operational effort required for by the trail widening or reconfiguration	Qualitative evaluation between options	-

5.2 Evaluating Options

A summary of the evaluation of trail widening / separating options is presented below. The evaluation has been completed at a broad scale using the seven criteria defined above and considered for the three trail sections independently. While parts of the evaluation are quantitative, numeric scoring and weighting factors have not been applied. The intent of the evaluation is not to outright determine the preferred option, but rather to provide a basis for understanding the strengths and weaknesses of each and ultimately supporting the recommended configuration option contained in **Section 6**. This approach is flexible and may be replicated by the CRD or others when considering trail improvements in the future, acknowledging that priorities may change over time and impact the evaluation result.

A summary is provided below for each trail section, with a more detailed description of the evaluation included in **Appendix D**.

Evaluation Summary,
Section A (Galloping Goose, Selkirk Trestle to Switch Bridge)

	Option 1.	Option 2.	Option 3.
1. Capital Cost	●	◕	○
2. Trail User Comfort / Experience	◑	◕	◕
3. Safety / User Conflicts	◔	◕	◕
4. Environmental Impact	◕	◑	○
5. Facility Quality	◔	◕	●
6. Constructability	●	◕	○
7. Maintenance / Operations	●	◕	○

Evaluation Summary,
Section B (Galloping Goose, Switch Bridge to Grange Road)

	Option 1.	Option 2.	Option 3.
1. Capital Cost	●	◑	○
2. Trail User Comfort / Experience	◕	◕	◕
3. Safety / User Conflicts	◔	◕	◕
4. Environmental Impact	●	◕	◕
5. Facility Quality	◔	◕	●
6. Constructability	●	◑	○
7. Maintenance / Operations	●	◕	○

Evaluation Summary,
Section C (Lochside Trail, Switch Bridge to McKenzie Avenue)

	Option 1.	Option 2.	Option 3.
1. Capital Cost	●	◕	○
2. Trail User Comfort / Experience	◑	◕	◕
3. Safety / User Conflicts	◔	◕	◕
4. Environmental Impact	◕	◔	○
5. Facility Quality	◔	◕	◕
6. Constructability	◕	◑	○
7. Maintenance / Operations	●	◕	○

5.3 Summary

The Option 3 (Separated Pathways with Centre Boulevard) configuration represents significantly higher capital costs as compared to the other two options (approximately 35% higher than Option 2, 82% higher than Option 1). It also results in the most challenging construction due to the extent of works attributed with the added width and greater maintenance requirements over time. There are also significant environmental impacts in terms of both tree loss and impacted natural areas on the Section A (Galloping Goose) and Section C (Lochside Trail) segments. The quality of the trail facility, user experience, comfort and safety are greatest of the three options, but not significantly greater than Option 2 due to a greater number of "pinch points" resulting from the overall width and challenges with physically separated spaces precluding cyclist run-off in case of unexpected conflict. This last item is particularly relevant given the high cyclist volumes (approximately 80% of trail users) on the subject trails.

In contrast to the Option 3 configuration, Option 1 (Widened Multi-Use Pathway) represents the lowest capital cost of the three options, with its narrower overall width resulting in reduced environmental impacts and advantages in terms of both constructability and maintenance. While widening the trails to 5.0m represents an improvement over most existing trail segments and will help address trail user conflicts, it does not provide the quality of user experience and safety associated with the separated options (Option 2, Option 3), nor the same level of overall facility quality. And while the FHWA LOS calculator returned a similar level of service, these trails are key corridors for commuter cyclists commonly travelling long distances at higher speeds, and separating pedestrians from cyclists represents a significant improvement in addressing safety and user conflicts (as compared to simply widening the multi-use facility).

The Option 2 (Separated Use Pathway) configuration balances the preference for separated uses with a relatively modest increase in trail width and managed overall impacts. The improvement in trail user comfort and safety associated with separating uses is significant and is the preferred approach for these trail sections. The functional widths of both the bicycle path (4.0m) and walkway (2.5m) are appropriate for the anticipated trail user volumes, while the capital cost and impacts of widening to 6.5m overall are significantly less than Option 3 (8.5m total width).

Further, the Option 2 configuration presents flexibility to include a centre boulevard in unconstrained locations (not possible with Option 1) and can be effectively transitioned through constrained locations where reduced trail widths are required. Modifications to the preferred trails widths would be explored in more detail during subsequent design phases.

6.0 Recommendations

The following are the key recommendations of this study with respect to trail widening / separation and lighting.

6.1 Trail Facilities

6.1.1 Reconfiguration

Option 2 (Separated Use Pathway) is the recommended configuration as future improvements are made on the Galloping Goose and Lochside Trail sections that are the subject of this study. This option scored highly in the multi-criteria evaluation completed in this study and reflects best practices with respect to trail user separation and widths.

The recommended configuration consists of a 4.0m bicycle path and 2.5m walkway, with 0.6m buffer area on either side.

Opportunities to limit environmental impacts, as well as optimizing the alignment to minimize costs associated with cuts and fills and other potential impediments, are to be explored through subsequent design phases. This may also include identifying unconstrained locations where additional width and/or a centre boulevard may be achieved with limited capital cost and/or environmental impact.

6.1.2 Implementation Priority

The recommended trail reconfiguration option represents a long-term build-out that will take many years to achieve. As trail improvements will likely be completed in sections as funding becomes available, the following is the recommended phasing of improvements with supporting rationale, as shown in **Map 4**. Recommended phasing may change over time if priorities change and/or opportunities for trail improvement are identified concurrent with other works. Future works should also consider the success of early phases, the level of public support and updated trail user counts over time.

1. Galloping Goose between Selkirk Trestle and Culduthel Road – 1,600m
    - This section of trail has the highest trail user volumes and some of the narrowest current trail widths (approximately 50% of the corridor is <4.0m)
    - Separation of trail facilities can be achieved along entire corridor with only one location of significant narrowing (Burnside Road underpass)
2. Galloping Goose between Culduthel Road and trail junction (including Switch Bridge), and Lochside Trail between trail junction and Darwin Avenue – 700m
    - High volume trail section with a change in trail character from urban to more natural north of Darwin Avenue
    - Could be pursued in combination with trail lighting
    - Support widening of Switch Bridge (currently 4.0m) in coordination with MoTI
3. Lochside Trail, Darwin Avenue to McKenzie Avenue – 1,600m
    - Improvements may be coordinated with Swan Lake and Brett trestle upgrades / replacement
4. Galloping Goose between Lochside Trail junction and Tillicum Road – 950m
    - Current trail widths generally exceed 4.0m, while trail user volumes are lower than other sections
5. Galloping Goose between Tillicum Road and Grange Road – 1,600m
    - Improvements may be completed as bridge over Interurban Road is upgraded/replaced
    - Limited works required west of through McKenzie interchange project area

Map 4. Recommended Trail Widening Implementation Priority

6.2 Lighting

6.2.1 Locations

The recommended approach is to light the portions of the Galloping Goose Regional Trail and Lochside Regional Trail within the study area, with the exception of the 1.3km of the Lochside Regional Trail between Darwin Avenue and Quadra Street, primarily adjacent to Swan Lake. Refer to **Map 5**.

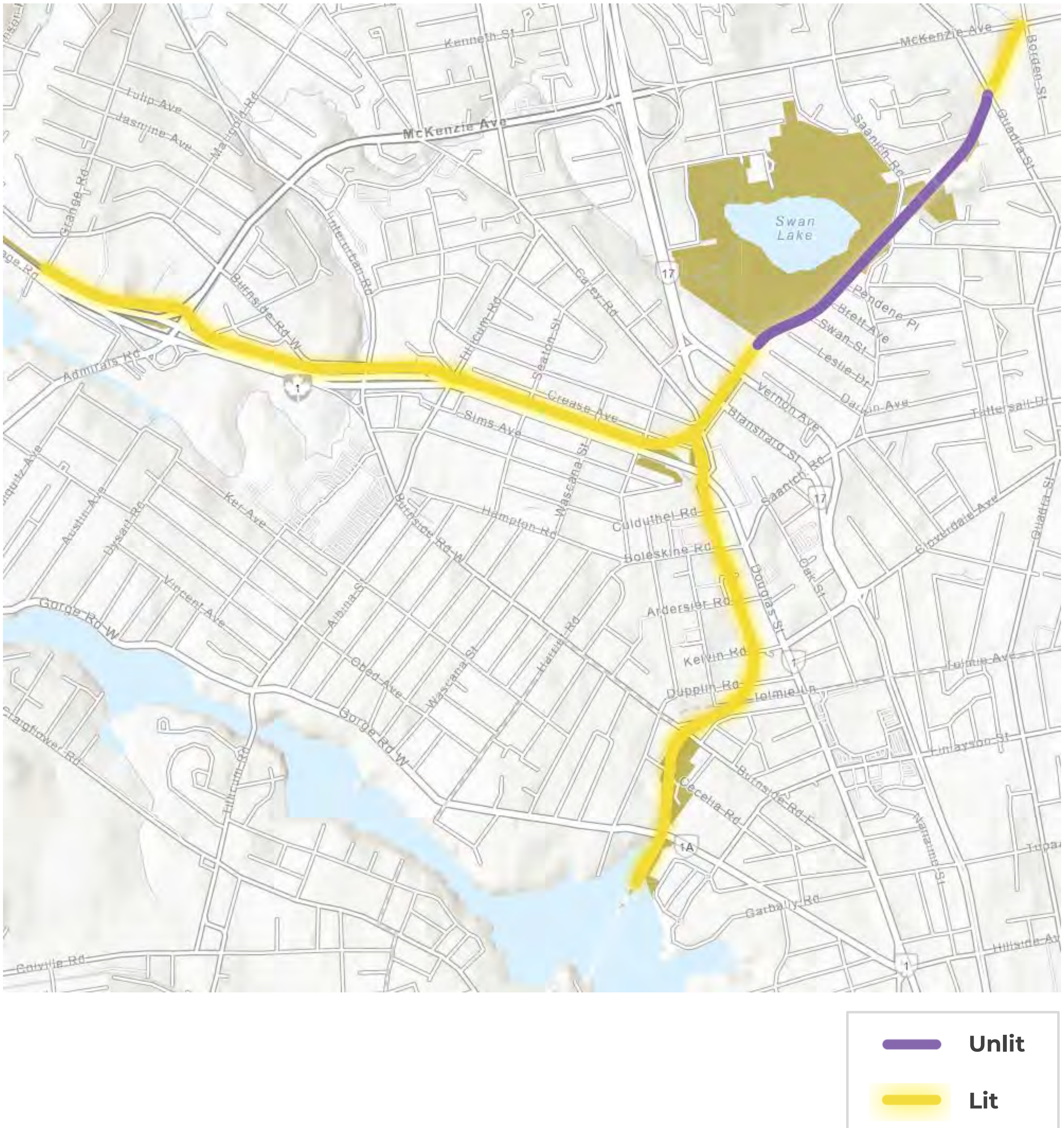
Partnerships or external grant funding should be sought to assist with capital, power and maintenance costs for lighting.

6.2.2 Technology / System

A hardwired system is recommended that employs pedestrian-scaled luminaires at 4.5 - 6.0m in height. Luminaires are to be spaced approximately every 38 - 40m.

Further consideration may be given to lighting technology / options in the Swan Lake section of the Lochside Trail based on consideration of environmental impacts, safety concerns and CPTED.

Map 5. Recommended Long-Term Illumination Approach



6.2.3 Lighting Priority

The recommended approach to trail lighting includes approximately 5.3km of lit pathway within the study area. This represents a long-term build-out that will take many years to achieve, likely occurring as trail improvements are pursued as well as infrastructure projects nearby the trail corridors are undertaken.

Based on the review of applicable standards and guidelines, the recommended priorities for the implementation of corridor illumination are as follows:

1. CRD should request that those who have jurisdiction for the six underpasses install lighting, with priority from longest to shortest:
    a. Carey Road, Blanshard Street, Vernon Avenue (likely pursued in combination)
    b. Boleskine Road
    c. Burnside Road
    d. Gorge Road
2. The Lochside Regional Trail / Saanich Road intersection, in combination with possible trail and/or road geometric improvements to address overall intersection safety, working cooperatively with the municipality
3. The Galloping Goose / Lochside trail junction to Darwin Avenue (including three underpasses identified above)
4. End points of bridges, with the north end of the Switch Bridge and Galloping Goose / Lochside trail junction as highest priority
5. Intersections between the trail and intersecting roads in partnership with municipalities - District of Saanich and City of Victoria (Tolmie Ave, Dupplin Rd, Kelvin Rd, Ardersier Rd, Barbon Pl, Culduthel Rd, Crease Ave, Tillicum Rd, Darwin Ave, Saanich Rd (identified above)). Lighting would be oriented over the road to illuminate the conflict zone between trail users and motorists as well as the trail to a distance of 25m in each direction from the intersection to illuminate approaching trail users.
6. Remaining trail sections should be prioritized sequentially based on trail user volumes (Section A, Section C, Section B), with consideration of "easy win" sections as demonstration projects.

Acronyms

The following acronyms are used throughout the document.

AASHTO
American Association of State Highway and Transportation Officials

BUG
Back-up-Glare

CPTED
Crime Prevention Through Environmental Design

CRD
Capital Regional District

CROW
Information and Technology Centre for Transport and Infrastructure
(Dutch abbreviation)

FHWA
Federal Highway Administration (United States)

IES
Illuminating Engineering Society

ITE
Institute of Transportation Engineers

LED
Light Emitting Diode

LOS
Level of Service

MoTI
B.C. Ministry of Transportation and Infrastructure

OTM
Ontario Traffic Manual

TAC
Transportation Association of Canada

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Appendix A.

TRAIL USER VOLUMES METHODOLOGY

As indicated in the report main body, the available trail user count data sources have limitations and, as a result, a multi-step process was undertaken to establish reliable measures of current trail user volumes. The following is a description of the approach taken to utilizing trail user count data.

Data Sources

The CRD undertakes trail user counts using automated sensor technology installed at key regional park and trail locations, including locations on the Galloping Goose and Lochside trail sections within the study area. Generally one trail data count location was available for each sections analyzed in this study and data was assumed to be representative of that entire section.

The CRD has recently updated some of its trail user count technology and now has two active methods of collecting data. As a result, data from two different sources was used in this study – TRAFx and Eco-Counter. Key differences are summarized below:

- **TRAFx Data**:
    - Provides historic, year-round data dating back to 2009
    - Certain count locations use electro-magnetic loops in the trail surface with capability to only count bicycles (no pedestrians)
    - Other count locations use infrared sensors that count total users but cannot differentiate between cyclists and pedestrians
    - Therefore, there is no reliable pedestrian count data from TRAFx, and total user data appears to be less accurate than the newer Eco-Counter data

- **Eco-Counter Data**:
    - Installed in Fall 2019, therefore no historic data available
    - Newer technology using both infrared sensors and electro-magnetic loops in the trail surface, meaning it can differentiate between cyclists and pedestrians, providing more accurate user counts

The capabilities and date range for each data source are outlined in the table on the following page.

While the available data has limitations, it is considered reliable for the sake of establishing approximate trail user volumes and pedestrian-to-cyclist ratio for the purpose of comparing to trail facilities in other communities and applying guidelines and best practices.

Trail User Volume Data Sources by Section

ID	Section	TRAFx Data			Eco-Counter Data		
		Counter ID	Mode(s) Counted	Date Range	Counter ID	Mode(s) Counted	Date Range
A	Galloping Goose, Selkirk Trestle to Switch Bridge	#24: GG Dupplin Road Bikes	Bikes only	2009-11-19 to 2020-02-09	GG-South-of-Culduthel	Bike + Ped	2020-11-15 to 2020-02-10
B	Galloping Goose, Switch Bridge to Grange Road	#30: GG Switch Bridge Bikes	Bikes only	2009-11-19 to 2020-02-09	GG-West-Harriet	Bike + Ped	2020-11-01 to 2020-02-10
C	Lochside Trail, Switch Bridge to McKenzie Avenue	#39: LS Darwin St Bikes	Bikes only	2009-12-09 to 2020-02-08	LS-South-Nigel	Bike + Ped	2020-11-08 to 2020-02-10

Methodology:
Daily Average User Volume Calculation

- Best practice dictates that the understanding of average daily trail user volumes should be based on peak periods, which the historical TRAFx data suggests occurs during Summer months
- The Eco-Counter stations provide the most accurate data, but the count data extends back only to October 2019 (when these counters were first installed)
- The TRAFx stations provide count data dating back to 2009, but there is no pedestrian data and the total user counts are not accurate
- Therefore, both the Eco-Counter data and the TRAFx data were used to estimate daily average user volumes along each of the three sections, as outlined below:

    1. Eco-Counter data from November 2019 was analyzed to calculate modal split (i.e. the cyclist-pedestrian ratio) for each section (e.g. 20% pedestrian vs. 80% cyclist). November 2019 was selected because it was the month with the highest ridership and one full month of data available (as compared to October, which had high ridership but only partial data available).

    2. TRAFx data from 2015-01-04 to 2020-02-09 was used to calculate average daily cyclists per month for each section. This data range was selected because it represents the longest timespan offering consistent data for all three sections, as partial data gaps exist in the historic data.

3. Average daily pedestrian volumes per month were estimated by taking the cyclist-pedestrian ratio established in the Fall 2019 count data (step #1) and applying it to the average daily cyclist numbers (step #2), with the assumption that the ratio will remain relatively consistent throughout the year. For example, an average of 1,152 cyclists per day use Section A each January. The cyclist-pedestrian ratio for Section A is 82:18. Therefore, in January, an average of 207 pedestrians per day use Section A (1,152*0.18=207).

4. The total average daily user volume is the sum of the pedestrian and cyclist volumes. Monthly variation in trail user volumes is shown in **Figure 1**. For each section, the months with the lowest and highest average daily trail users were identified, with the busiest month count data summarized in **Table 2**.

Methodology:
Hourly Average User Volume Calculation

- Due to the data limitations discussed above, both the Eco-Counter data and the TRAFx data were again used to estimate hourly average user volumes along each of the three sections, as outlined below:

  1. Eco-Counter data from November 2019 was analyzed to calculate total user volumes per hour for each section. November 2019 was used again for consistency (see reasons discussed above).

  2. Using this data, the percentage of pedestrians and cyclists using the trail during each hourly section was calculated (e.g. on Section A, 10% of all daily pedestrian volumes occur from 15:00-16:00, whereas 8.2% of all daily cyclist volumes occur during that period).

  3. Next, the hourly percentages calculated in step #2 were applied to the average daily user volumes for the busiest month for each section (**Table 2**) to determine the total number of pedestrian and cyclists using the trail during each hourly segment. For example, in Section A, there was an average daily volume of 410 pedestrians in July, the busiest month (as outlined in **Table 2**) and the calculations in step #2 found that 10% of daily pedestrian traffic on Section A occurs at 15:00. Therefore, it was estimated that there was a total of 41 pedestrians at 15:00 on Section A (410*0.10=41). This calculation was repeated for each hour of the day for both pedestrians and cyclists. The results of this analysis are shown in **Figure 2**.

- Note that due to the data limitations described above, this analysis involved making the assumption that the hourly trends in pedestrian and cyclist user volumes will be similar in November and in the Summer months. In reality, there may be changes due to warmer temperature and longer daylight hours in the Summer, which can influence when and how (commuting vs. recreation) people utilize trails in the CRD.

Appendix B.

PRECEDENT TRAIL FACILITIES FEATURE SHEETS

1. Vancouver Seaside Greenway	Vancouver, BC
2. Arbutus Greenway	Vancouver, BC
3. BC Parkway	Vancouver, BC
4. Ottawa River Pathway	Ottawa, ON
5. Martin Goodman Trail	Toronto, ON
6. Meewasin Trail	Saskatoon, SK
7. Burke-Gilman Trail	Seattle, WA
8. Springwater Corridor	Portland, OR
9. Chicago Lakefront Trail	Chicago, IL
10. Midtown Greenway	Minneapolis, MN

1. Vancouver Seaside Greenway

Source: Google Street View

Location: Vancouver, British Columbia

Trail Management and Maintenance: City of Vancouver

Population: 2,463,431 in the census metropolitan area (2016 Census)

Adjacent Land Use:

- Adjacent Vancouver Harbour, English Bay and False Creek
- High density residential, mixed use, and lower density neighbourhoods
- Circumnavigates Stanley Park
- Numerous waterfront parks

Trail Characteristics:

Length: 28 km

Width: 6.0 – 7.0 m

Average slope: Less than 5%

Surface materials: Asphalt and paving stone, some sections in parks include granular surfacing

Trail Facility Configuration:

- Separate pedestrian and cycling pathways
  - Trail cross sections vary
  - Standard is 3.0 m bidirectional bike path and 3.0 m pedestrian path
- Separation occurs using painted lines and symbols, signage, materiality, bollards, and landscaping treatments

Trail User Volumes: The Seaside Greenway sees approximately 8,000,000 – 10,000,000 total users per year. Limited counts are currently conducted for bicycles only at six locations along the greenway. The daily user volumes for bicycles only at these locations over an 18-month period (August 2018 – January 2020) show an average of 2,790 daily cyclists. During the peak month of July (2019) the average daily bicycle count was 4,760. Pedestrian data is not available, but anecdotally it is very high.

Lighting: Pedestrian scale pathway lighting used throughout

Facility Design:

The pathway is well landscaped with numerous rest areas. Signage is used to indicate pathway user types. Materiality plays a key role in differentiating the pedestrian and bicycle trails. The bicycle trail is paved in asphalt, while the pedestrian facility differs between unit pavers, concrete, and asphalt along the length of the trail. Unit pavers and/or concrete bands provide further delineation between users.

Notes:

- Trail upgrades recently completed including upgrading accessibility by removing sections of flagstone to replace with unit pavers
- Separation of trail users is close to mandatory for trail design along the Seaside Greenway
- Compliance by users to select either the pedestrian or bicycle path is good, even with adjacent facilities and only the use of paint as a separation tool
- The Seaside Greenway was noted as being successful because it is a continuous path

2. Arbutus Greenway

Source: Google Street View

Location: Vancouver, British Columbia

Trail Management and Maintenance: City of Vancouver

Population: 2,463,431 in the census metropolitan area (2016 Census)

Adjacent Land Use:

- Runs between two parallel roadways along former rail line
- Adjacent lower density and mixed-use neighbourhoods

Trail Characteristics:

Length: 8.5 km

Width: 4.0 – 6.0 m

Average slope: Less than 5%

Surface materials: Asphalt; limited sections have adjacent bark mulch or granular surfacing

Trail Facility Configuration:

- Separate pedestrian and cycling pathways. Trail cross sections range from:
  - 4.0 m – 2.5 m bidirectional bike path and 1.5 m pedestrian path
  - 5.0 m – 2.5 m bidirectional bike path and 2.5 m pedestrian path
  - 6.0 m – 3.0 m bidirectional bike path and 3.0 m pedestrian path

- Adjacent soft surface trail (bark mulch or granular) along portions of greenway where paved trail width is 4.0 m
- Separation occurs through the use of painted lines and symbols, signage, materiality, and landscaping treatments

Trail User Volumes: Hourly counts conducted in 2018 at four locations along the greenway show average user counts of 267 persons per hour with a range of 109 – 429 persons per hour for weekday and weekend counts. The average mode share was 63% bicycles, 32.5% pedestrians, and 4.5% joggers/runners.

Lighting: City of Vancouver is currently conducting a trial study using 30 solar powered, pedestrian-scale lights along the greenway. Permanent lighting is planned to be installed along the entire corridor in the future with pedestrian-scale lampposts (6 m high) spaced approximately every 25 – 30 m. All lights will be LED, with a warmer temperature selected of 3000 kelvin.

The current solar lighting study has been successful so far with only one battery pack failing. The adjacent neighbourhood was initially opposed to the installation of lights due to a worry of light spillage into private yards. After lighting was installed there were no complaints as lighting was directed towards trail and there was no light spillage into yards.

Facility Design:

The current Arbutus Greenway is a temporary trail that was recently installed on a former rail line. After the rail line was removed, the City was finding people already attempting to walk and cycle the corridor, so a temporary asphalt pathway was installed to provide an accessible surface for all users. The initial path was 4.0 m wide. This path width was found to be too narrow for the volume of users. Sections that were initially paved at 4.0 m were retrofitted with an adjacent soft surface pathway to the pedestrian path to increase the overall trail cross section width. The soft surface path was found to not be used by many pedestrians as it is not accessible for wheelchairs or strollers. Later trails were installed at 5.0 or 6.0 m widths to better accommodate user volumes.

The entire trail is separated between pedestrians and cyclists, mainly using a painted line, symbols and signage. A Vision for the Arbutus Greenway has been completed, but not yet constructed. The final design will see full separation between bicycles and pedestrians with a minimum 1.0 m landscaped buffer, with occasional 2.0 m wide buffer where space permits. Lighting will be installed in the landscape buffer to light both pathways.

Notes:

- The City initially planned to mill out a 1.0 m buffer on the 6.0 m wide trail between the pedestrian and bicycle paths, but the community pushed back and wanted the full 6.0 m available as accessible surfacing

- A buffer between pedestrians and cyclists was milled out of the asphalt at intersections to assist in setting crossings
- To reduce costs on lighting installation, the City is testing screw piles versus poured piles for lampposts
- Initial results from solar lighting trial are very promising
- Lessons learned include facilitating a community stewardship group or program to assist in trail maintenance, planning, programming, etc.
- Trail amenities including benches and port-a-potties have been installed and have been well received

3. BC Parkway

Source: Google Street View

Location: Vancouver, British Columbia

Trail Management and Maintenance: TransLink

Population: 2,463,431 in the census metropolitan area (2016 Census)

Adjacent Land Use:

- Runs parallel to the Expo SkyTrain Line
- Connects Surrey City Centre, New Westminster, South Burnaby, and Vancouver
- Adjacent land uses include transit-oriented neighbourhoods, low-high density residential, industrial, commercial, mixed-use, and parks and open space

Trail Characteristics:

Length: 26 km

Width: 2.5 – 3.0 m

Average slope: Less than 5%

Surface materials: Asphalt and limited areas with paving stone

Trail Facility Configuration:

- Asphalt multi-use pathway

- Signage and stencils indicate shared use path

Trail User Volumes: Bike monitoring program in process of being installed. Limited user intercept surveys conducted in 2016 showed approximately 200 – 300 persons per hour with no breakdown between modes.

Lighting: Majority of trail is lit. Standard is one pedestrian-scale lamppost every 25 m. TransLink will attempt to negotiate arrangements with municipality that TransLink will pay for the capital costs for lighting installation, but then the municipality will assume operating and maintenance costs. TransLink is beginning to explore solar lighting and guideway lighting.

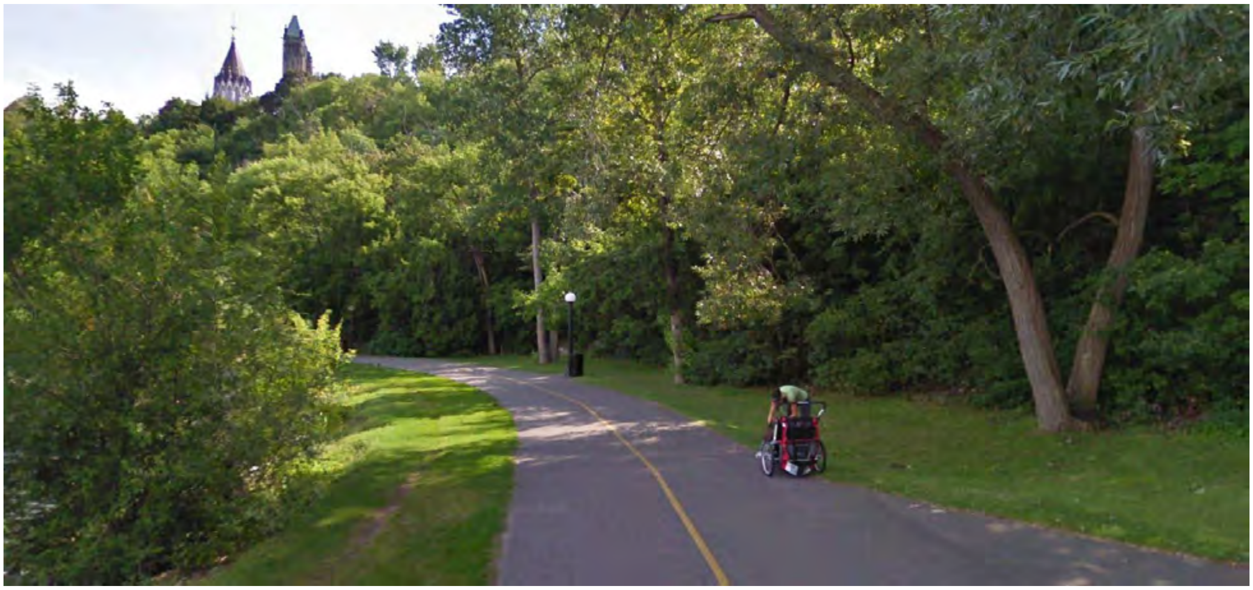
Facility Design:

The pathway is well landscaped with numerous rest areas. Signage is used to indicate a shared pathway.

Notes:

- Transition areas, rest areas, and areas where cyclists may dismount have been difficult to manage and design to reduce conflicts between users. Additional space is required in these areas.
- TransLink has developed a conceptual design report for improvements to the BC Parkway. Conceptual design is for separated pathways for pedestrians and cyclists of 2.5 to 3.0 m.

4. Ottawa River Pathway



Source: Google Street View

Location: Ottawa, Ontario

Trail Management and Maintenance: National Capital Commission (NCC)

Population: 1,323,783 in the census metropolitan area (2016 Census)

Adjacent Land Use:

- The trail runs parallel to the Ottawa River connecting the greenbelt through the core of Ottawa
- The trail is part of the larger Capital Pathway Network of over 250 km of trail
- The trail is located in a linear greenway, largely running between a roadway and the river as well as passing behind Parliament
- Adjacent land uses are largely residential, commercial and institutional

Trail Characteristics:

Length: 48 km

Width: 3.0 – 4.0 m

Average slope: Less than 5%

Surface materials: Asphalt in the core and crushed granular in the greenbelt

Trail Facility Configuration:

- Asphalt multi-use pathway
- Signage and stencils indicate shared use path

Trail User Volumes: Trail user volume was not available at this time.

Lighting: The trail is lit in the core downtown area of Ottawa. As the trail extends from downtown it is not lit. The NCC is working towards lighting areas of the trail with a priority for sections under bridges and underpasses.

Facility Design:

The trail is a typical multi-use pathway shared pathway located in a linear greenway along the Ottawa River. There are numerous trail amenities located adjacent the trail such as rest stops.

Notes:

- The NCC is currently completing an Update to their strategic plan the *Pathway Network for Canada's Capital Region* from 2006. The updated plan will be presented to the public for review in spring 2020.
- The updated plan will include scenarios for the future separation of pathways between users and will identify priority areas to explore further.

5. Martin Goodman Trail

Source: Google Street View

Location: Toronto, Ontario

Trail Management and Maintenance: The City of Toronto

Population: 6,417,516 in the census metropolitan area (2016 Census)

Adjacent Land Use:

- Runs along the waterfront crossing the entire city located between Lake Ontario and Lake shore Boulevard West and the Gardiner Expressway
- Connects to the larger 730 km Waterfront Trail around Lake Ontario
- Adjacent land uses largely include parks and open space, high density residential, commercial, and mixed use

Trail Characteristics:

Length: 56 km

Width: 2.6 – >7.0 m

Average slope: Less than 5%

Surface materials: Asphalt, concrete and paving stone

Trail Facility Configuration:

- Separate concrete pedestrian and asphalt cycling pathways occasionally with landscaping separating the two pathways. Trail cross sections widths:
    - 3.5 m bidirectional bike path and 2.7 m pedestrian path
    - Separation is indicated through signage and stencils
- Separate paving stone pedestrian pathway/plaza spaces with a 3.5 m wide asphalt pathway cutting through for cyclists and other faster moving users
- Other sections of the trail are asphalt multi-use pathway of varying widths
    - Signage indicates shared use path

Trail User Volumes: Trail user volume was not available at this time.

Lighting: The majority of the trail is lit through a combination of pedestrian scale pathway lighting and roadway lighting.

Facility Design:

The pathway is located in a high-density urban setting that is well landscaped with numerous rest areas. Signage is used to indicate a shared pathway as well as for the separated pathways. Wayfinding signage is present as well as a constant painted double blue line painted down the centre of the trail which can be used as additional wayfinding.

Notes:

- The trail connects onto an on-road protected bicycle lane with adjacent sidewalk for pedestrians on Queens Quay West. The protected bike lane transitions to a separated bicycle pathway adjacent the pedestrian sidewalk before merging back into a shared multi-use pathway at the eastern terminus of Queens Quay East.

6. Meewasin Trail

Location: Saskatoon, Saskatchewan

Source: Google Street View

Trail Management and Maintenance: Inside the City of Saskatoon, the Meewasin Valley Authority (a non-profit organization) builds the trail and the City of Saskatoon maintains the trail through a formal agreement. Outside the city, the Meewasin Valley Authority builds and maintains the trail.

Population: 295,095 in the census metropolitan area (2016 Census)

Adjacent Land Use:

- Runs parallel to the South Saskatchewan River along both sides
- The trail is largely located in a linear greenway along both sides of the river
- Adjacent land uses include residential, downtown, parks and open space, institutional and industrial lands

Trail Characteristics:

Length: 80 km

Width: 2.0 – 5.0 m

Average slope: Path varies from 0-10% slopes due to its location in a river valley

Surface materials: The majority of the trail is asphalt. There is concrete at seating nodes, paving stone located in the downtown sections, and some connector trails are dirt (no surfacing).

Trail Facility Configuration:

- Asphalt multi-use pathway that varies in width and surface material

Trail User Volumes: In 2019, approximately 1.65 million users used the Meewasin Trail. User counts were conducted in 2012 and 2013 as part of a 2014 Trail Study. These counts determined that there was a mode share of 57% pedestrians and 43% cyclists along the Meewasin Trail. The counts also saw a systemwide average peak volume of 89 users per hour with a high peak volume of 164 persons per hour.

Lighting: Some sections of the trail are lit. These sections are mainly confined to the downtown. There is currently no lighting policy for the trail and lighting is included in trail projects on a project by project basis.

Facility Design:

The trail is set largely in a linear greenway along the river. There are numerous rest areas and greenspace for recreational activities.

Notes:

- A Trail Study was completed in 2014 that is now guiding current and future trail widening and enhancement projects.
- The Meewasin Trail Study (2014) provides design standards of:
  - 3.0m multi-use trail for less than 200 persons per hour
  - 4.0m multi-use trail for 200 – 300 persons per hour
  - 6.0m multi-use trail or two 3.0m separate trails for 300 – 600 persons per hour
  - Two 4.5m separate trails for over 600 persons per hour

7. Burke-Gilman Trail

Source: Google Earth

Location: Seattle, Washington

Trail Management and Maintenance: TransLink

Population: 3,867,000 in the Seattle-Tacoma-Bellevue, WA Metropolitan Statistical Area (2017)

Adjacent Land Use:

- The Trail runs from Golden Gardens Park in Ballard east, through the University of Washington Campus and then north around the perimeter of Lake Washington until ending in Bothell to the east.
- Adjacent land uses include low-medium density residential, institutional, commercial, mixed-use, and parks and open space

Trail Characteristics:

Length: 43 km

Width: 3.0 – 6.0 m

Average slope: Less than 5%

Surface materials: Asphalt with crushed granular shoulder on one side. Section near the University of Washington also includes a concrete pedestrian pathway.

Trail Facility Configuration:

- Asphalt multi-use pathway of varying widths
- Signage and stencils indicate shared use path at some intersections stencils direct pedestrians to one side of the trail and bidirectional flow for bicycles. Paint and stencil markings do not carry on beyond the intersection
- One recently reconstructed section along Seaview Avenue NW includes separate pathways. The separate pathways consist of:
    - 3.0 m wide asphalt pathway for bidirectional bicycle travel (not painted)
    - 1.5 m wide concrete sidewalk for pedestrian travel
    - Both pathways are stenciled for their individual users
- Through the high-volume area near the University of Washington, separate pathways have recently been constructed. The separate pathways consist of:
    - 3.0 m wide asphalt pathway with markings for bidirectional bicycle travel
    - 3.0 m wide concrete pathway for pedestrians

Trail User Volumes: The trail sees approximately 3,000 – 4,000 users per day.

Lighting: The trail is not lit except for small sections near the University of Washington that has pedestrian scale lighting.

Facility Design:

The pathway is well landscaped with vegetation but does not posses many amenities for users except for the section through the University of Washington.

Notes:

- The trail has a well publicized safety code that includes:
    - Go slow
    - Keep right
    - Respect others
- The trail also has posted and publicized information on trail etiquette that includes:
    - Bicycles should yield to pedestrians
    - Bicycles should give audible warnings when passing on the trail
    - All riders should ride at a safe speed and avoid pace lines and pack riding
    - Fast cyclists should use alternate routes

    - Walkers, runner, and skaters should watch for other trail users and listen for audible signals to allow faster users to pass safely
    - When the trail is congested, form a single line to the right
    - Dogs should be on a leash of a maximum of 8 feet
- The Burke-Gilman Trail is one of the first rail to trail conversions in North America with the first portion of trail dedicated in 1978.

8. Springwater Corridor

Location: Portland, Oregon

Source: Urban Systems

Trail Management and Maintenance: Portland Parks and Recreation (for section in City of Portland); City of Milwaukie and unincorporated Clackamas County.

Population: 2,478,996 in the Portland–Vancouver–Hillsboro Metropolitan Statistical Area (2018 Census)

Adjacent Land Use:

- Runs parallel an existing rail line as well as along a former rail line from Boring, Oregon to Portland connecting to the Eastbank Esplanade
- Adjacent land uses include general employment, open space, low-high density residential, commercial mixed-use, commercial residential, industrial, and institutional.

Trail Characteristics:

Length: 34 km

Width: 3.7 – 4.3 m

Average slope: Less than 5%

Surface materials: Asphalt

Trail Facility Configuration:

- Asphalt multi-use pathway
- Signage indicates shared use path

Trail User Volumes: Volunteer counts are conducted at several locations along the trail in September of each year. Most recent counts for 2018 and 2019 show approximately 600 people per hour on the trail at the eleven locations counted.

Lighting: The trail is not lit. There are no plans to light the trail at this time.

Facility Design:

The pathway is a very typical shared multi-use pathway. There are limited trail amenities as well as limited trail access points.

Notes:

- The trail design has always been constrained by the corridor in which it is located. Between being located adjacent a river, an active rail line, and steep banks, there is no room for a wider trail, or a trail separated between users.
- Ideally would have considered a bifurcated trail between pedestrians and cyclists, but reality is constraints limit the width.
- Current practice in the City of Portland is to bifurcate trails between users.
- Lighting was never included due to budget constraints.

9. Chicago Lakefront Trail

Source: Chicago Park District

Location: Chicago, Illinois

Trail Management and Maintenance: The City of Chicago Park District

Population: 9,533,040 in metropolitan area (2018 Census)

Adjacent Land Use:

- The Lakefront Trail runs alongside Lake Michigan between the Edgewater and South Shore neighbourhoods
- The trail is located entirely in a linear greenspace along the waterfront and is separated from adjacent development by roadways including North Lake Shore Drive and South Lakeshore Drive
- The trail runs through and past numerous waterfront parks including Lincoln Park, Grant Park, and Jackson Park. The trail also passes Soldier Field.

Trail Characteristics:

Length: 30 km

Width: 5.0 – >10.0 m

Average slope: Less than 5%

Surface materials: Asphalt

Trail Facility Configuration:

- The trail is fully separated into separate asphalt pedestrian and cycling pathways
    - The cycling pathway is a minimum of 3.5 m wide for bidirectional travel
    - The pedestrian pathway width varies, at times widening into larger pedestrian plaza spaces along the waterfront
    - Pedestrian access paths are a minimum of 1.8 m

- The two trails are often separated with landscaping, at times they can be over 200 m apart with large greenspaces in between them
- When the trails are co-located painted buffer spaces of a minimum of 1.0 m are used to separate the trail users
- Extensive use of paint and stencilling are employed to differentiate the two pathways as well as the bidirectional nature of both pathways
- At high volume conflict points and trail intersections, the trails may also be widened and turning lanes may be provided

Trail User Volumes: The Lakefront Trail sees approximately 30,000 daily users on weekdays. On summer weekends this number increases to approximately 100,000 daily users.

Lighting: Both the pedestrian and bicycle trails are lit with pedestrian scale lampposts.

Facility Design:

The pathway is well landscaped with numerous rest areas and park amenities. Signage and extensive stencilling are used to indicate pedestrian and bicycle pathways. Intersecting pathways include stop and yield paint and signage control to help direct traffic.

Notes:

- In 2016, the City of Chicago laid out plans to separate the entire Lakefront Trail to create separate pathways for pedestrians and cyclists to alleviate significant trail congestion and conflict between cyclists and pedestrians. The project was completed in December 2018.
- The City of Chicago has published a Lakefront Trails Pathway Symbol Reference Guide to provide information on the various paint markings used on the trail. Markings include “SLOW”, “LOOK”, speed reduction markings, and yield markings.

10. Midtown Greenway

Source: Google Street View

Location: Minneapolis, Minnesota

Trail Management and Maintenance: City of Minneapolis

Population: 4,014,593 in the Minneapolis-St. Paul MN-WI Combined Statistical Area (2018 Census)

Adjacent Land Use:

- Trail located on former rail line. Majority of trail located in below grade trench.
- Connects Mississippi River to Cedar Lake Trail in west Minneapolis
- Adjacent land uses include low-high density residential, industrial, commercial, cultural/entertainment, public/institutional, mixed-use, and parks/open space

Trail Characteristics:

Length: 9.2 km

Width: 3.7 – 6.0 m

Average slope: Less than 5%

Surface materials: Asphalt

Trail Facility Configuration:

- Separate pedestrian and cycling pathways
    - Trail cross sections vary
    - Standard is 3.0 – 4.0 m bidirectional bike path and 2.0 m pedestrian path
- Separation occurs through the use of painted lines and symbols, and signage

- Narrower path at western terminus of trail becomes multi-use pathway with painted centre line

Trail User Volumes: Limited counts in 2016 showed approximately 3,800 – 4,250 daily users at select locations along the trail with a mode split varying between 5-20% pedestrians. Currently estimates are that the Greenway sees approximately 4,000 – 5,000 daily users with an estimate of 1,500,000 annual users.

Lighting: Majority of trail is lit. Some sections are noted as being underlit with too great spacing between light poles. There are many underpass crossings along the trail, some of which are also not lit well enough. Lighting was installed when trail was built.

Facility Design:

The pathway is situation along a former rail line with a significant portion of the trail situated below grade in a trench. The pathway design is limited by the location in the trench and the numerous bridge crossings with their supports.

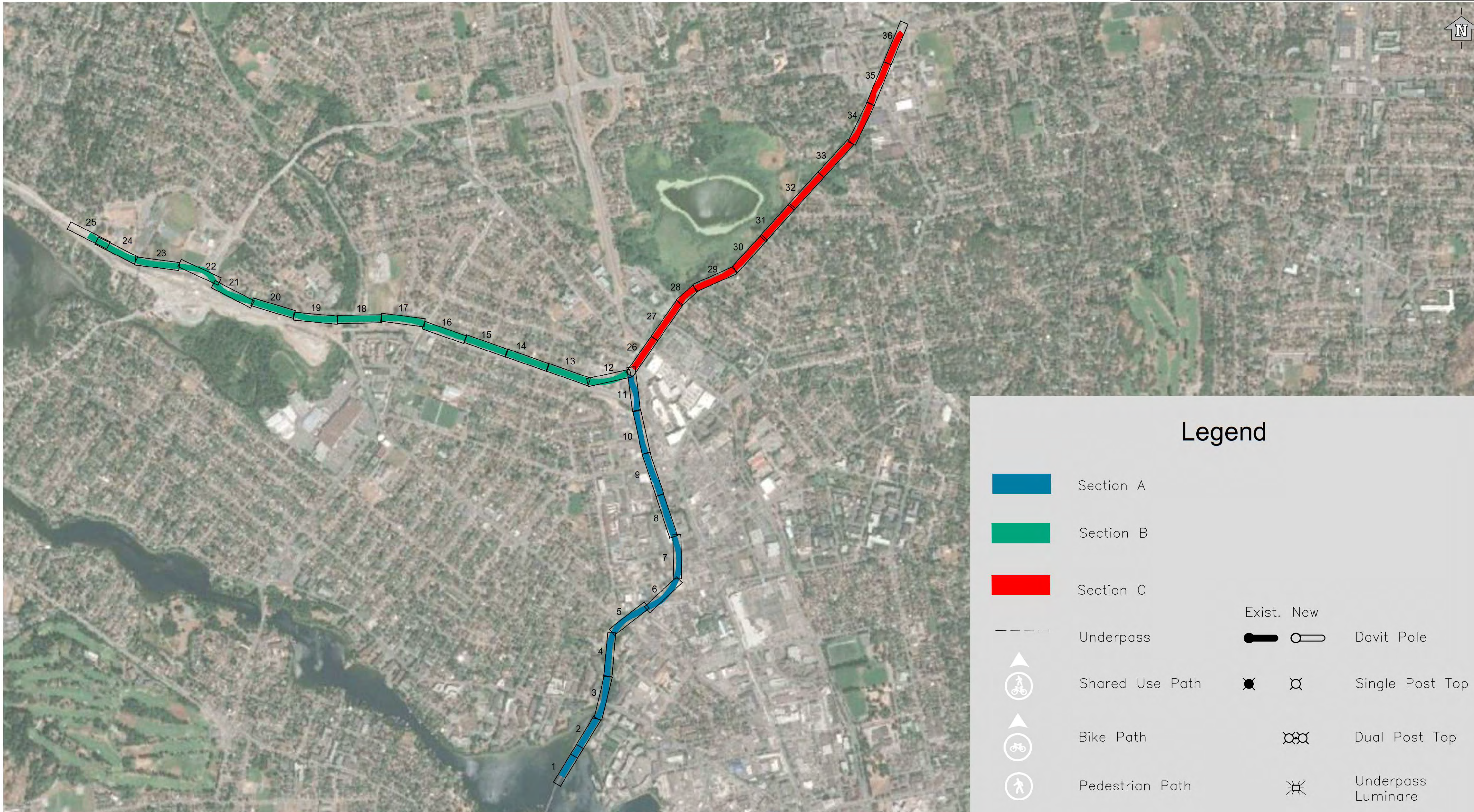
Notes:

- The location of the trail in the trench provides limited access points along the trail. Access is limited to ramps and stairs. Additional access is desired.
- The trail has few amenities along it, more amenities (rest stops, wayfinding signage) are desired.
- The trail has struggled with safety issues and concerns since constructed. The addition of lighting at stairways and ramps has seen a reduction in crime incidents.

Appendix C.

CONCEPTUAL DESIGN PLANS

Regional Trails Widening Study



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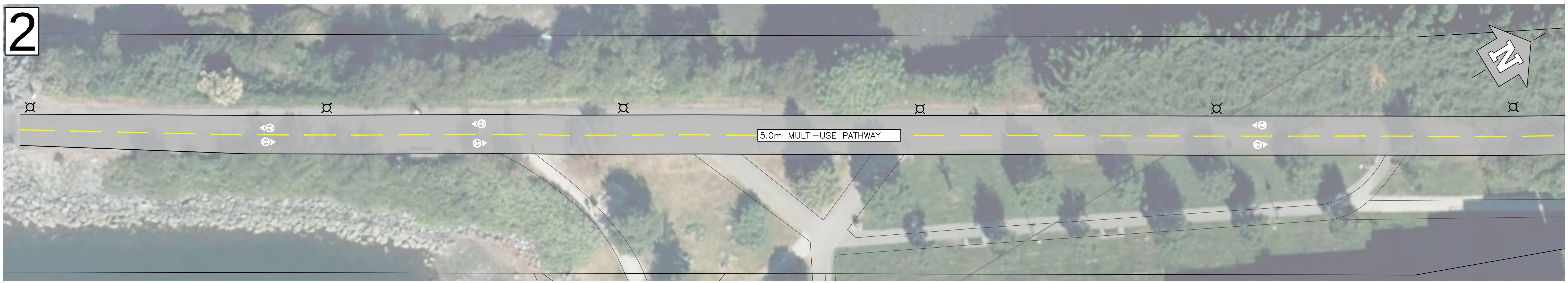

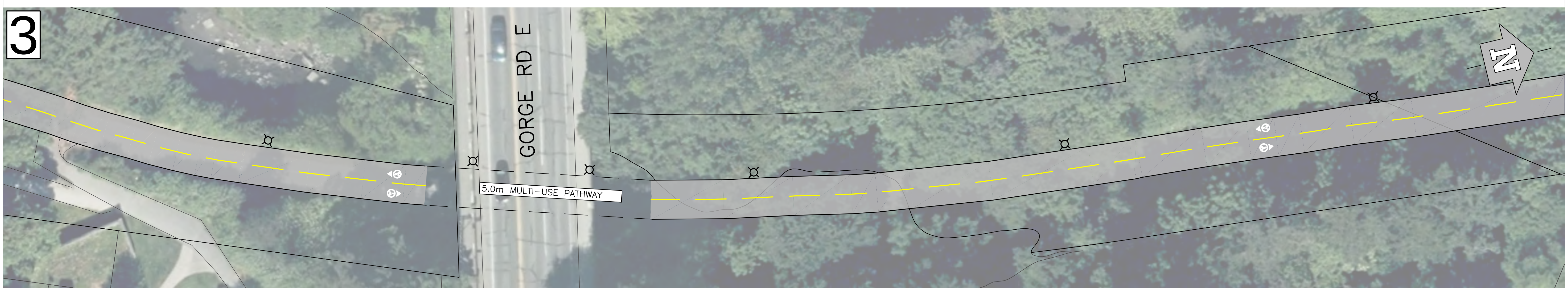

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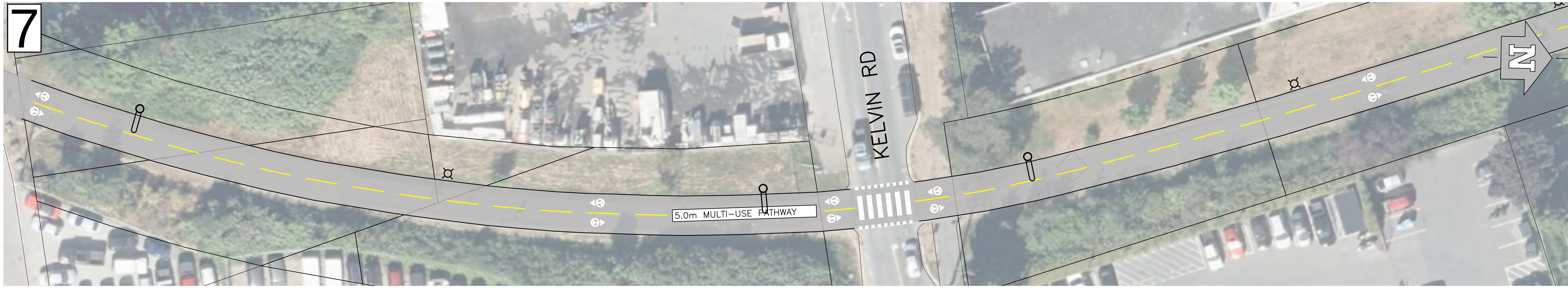

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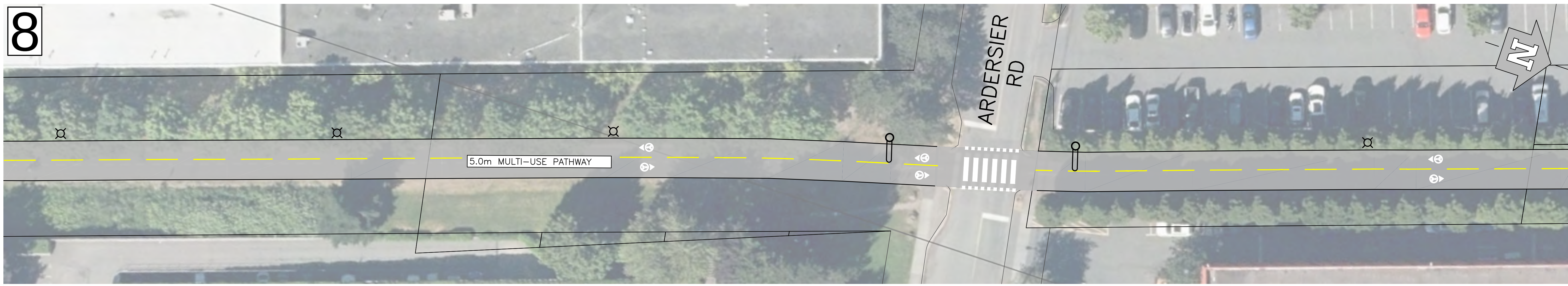

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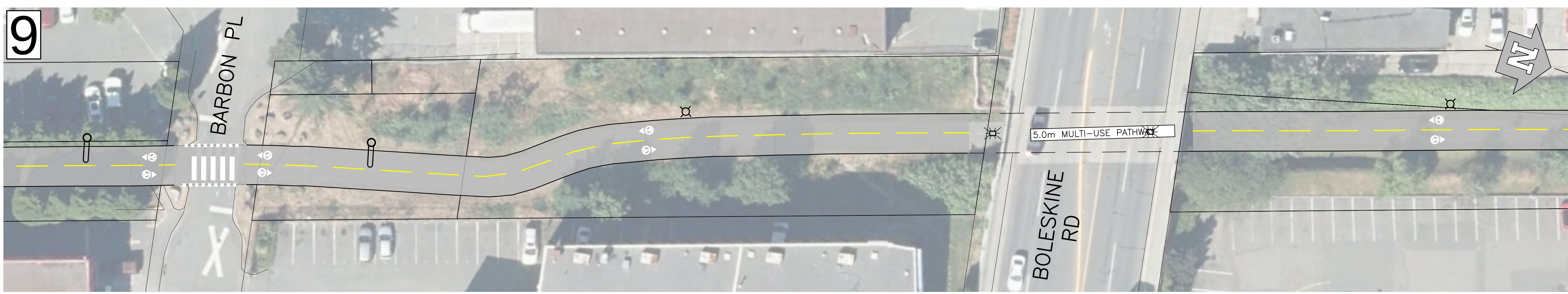

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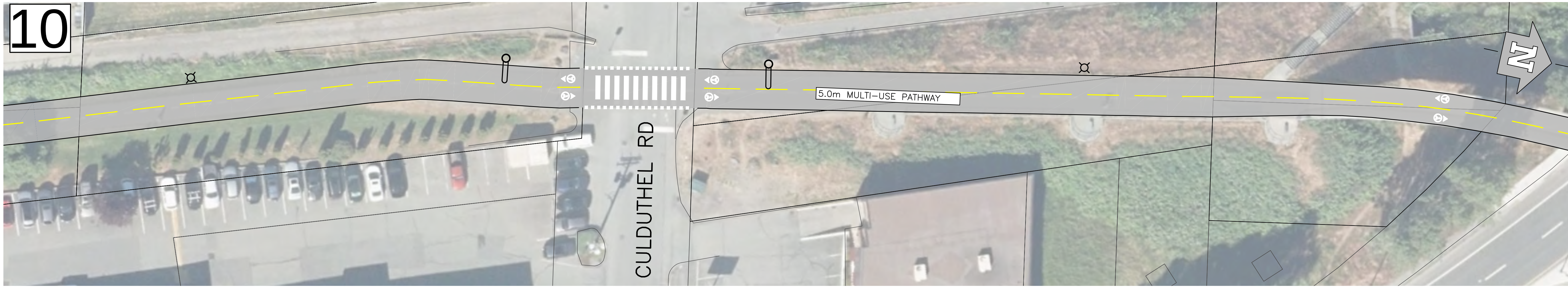

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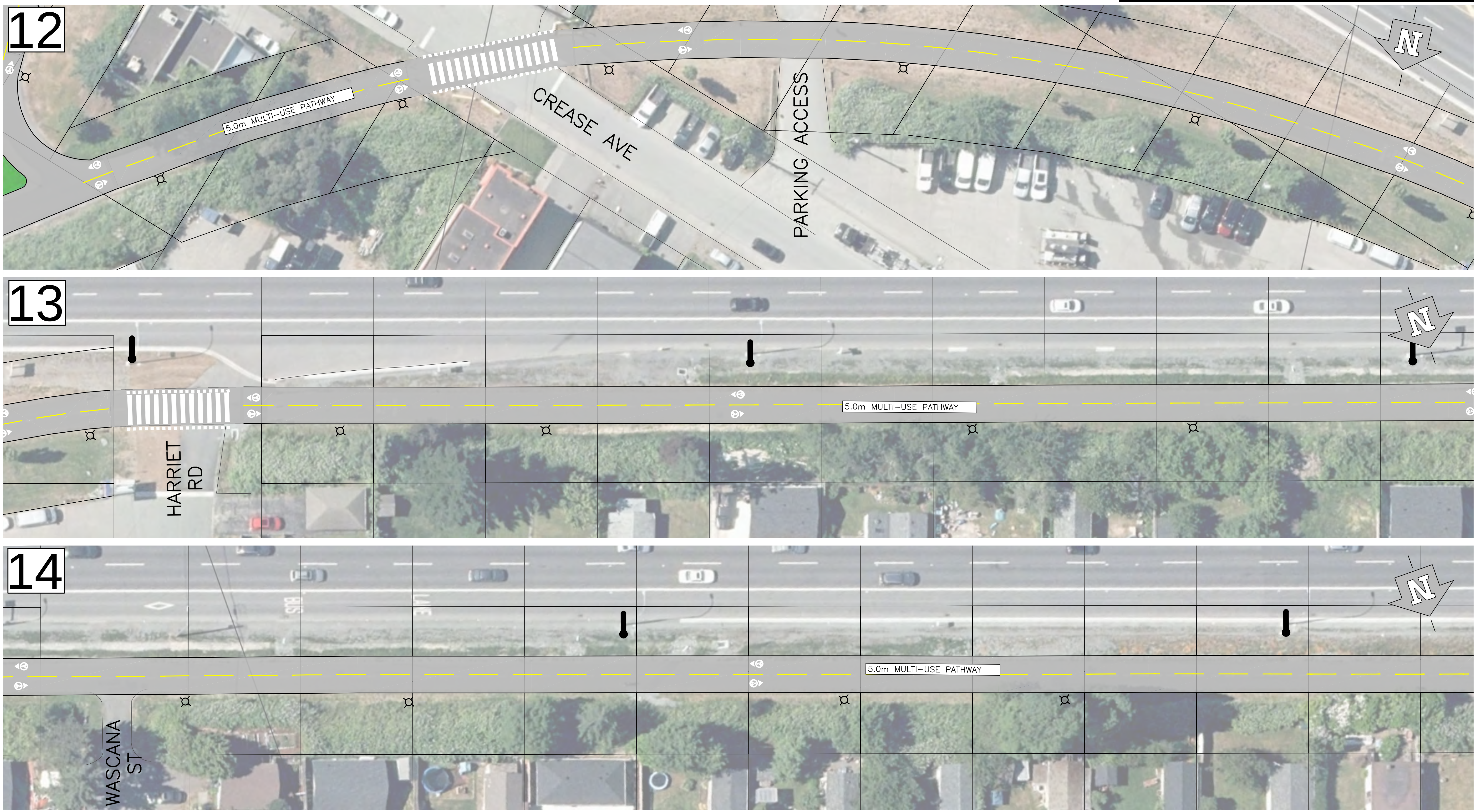

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Section B

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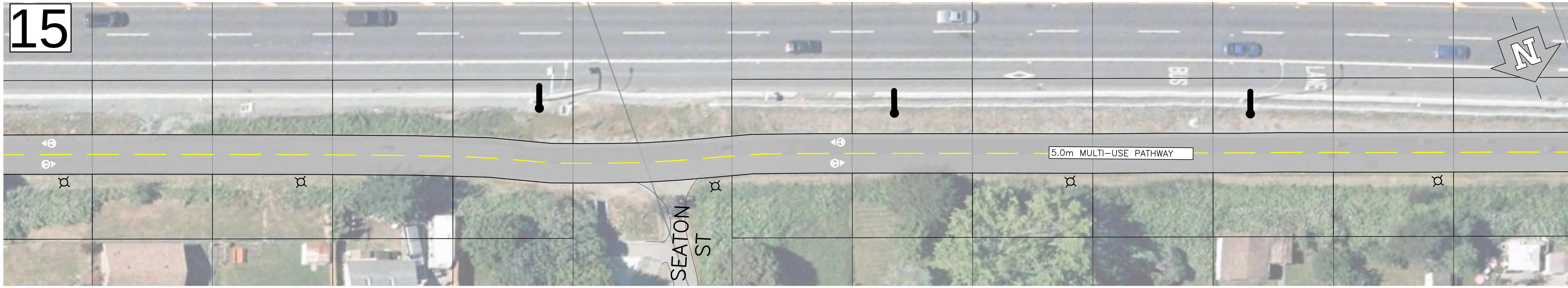

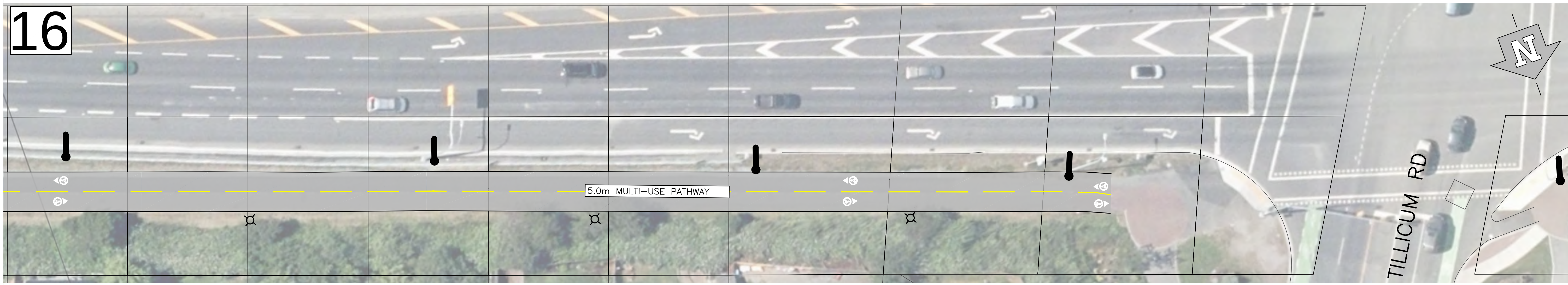

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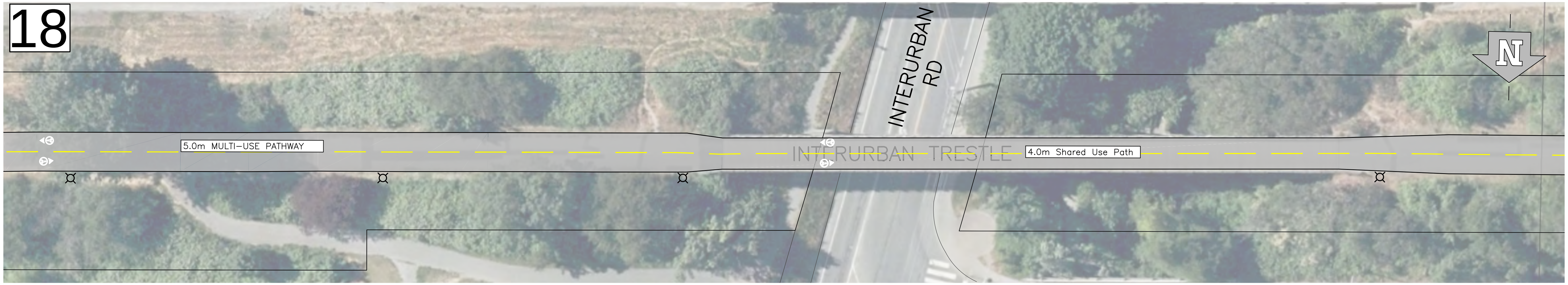

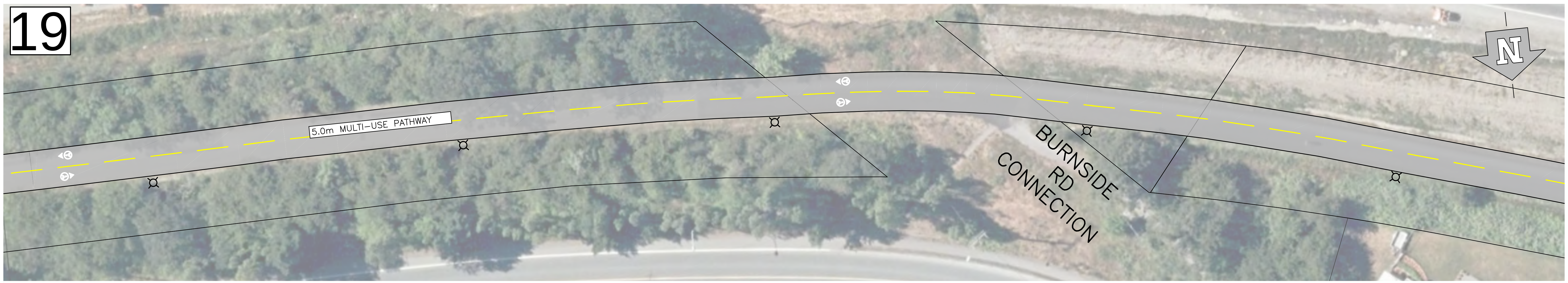

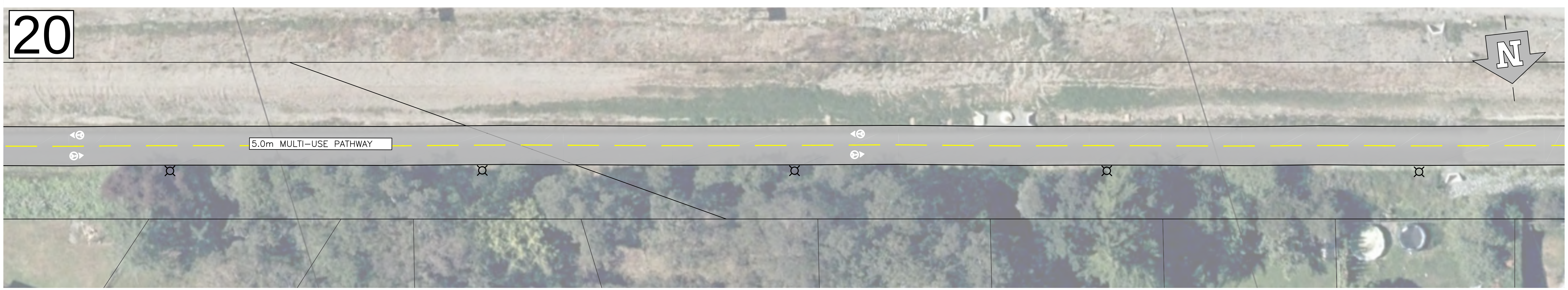

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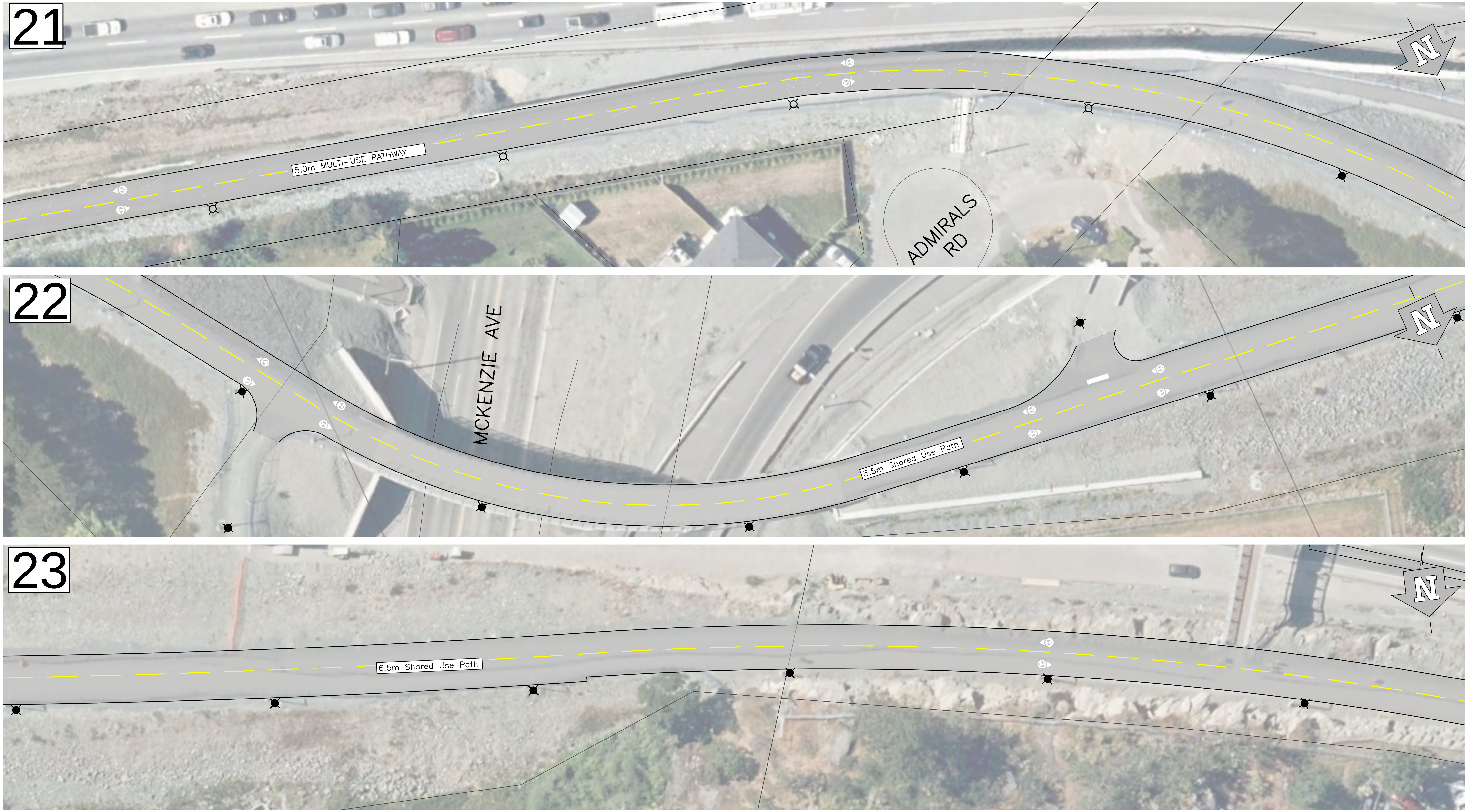

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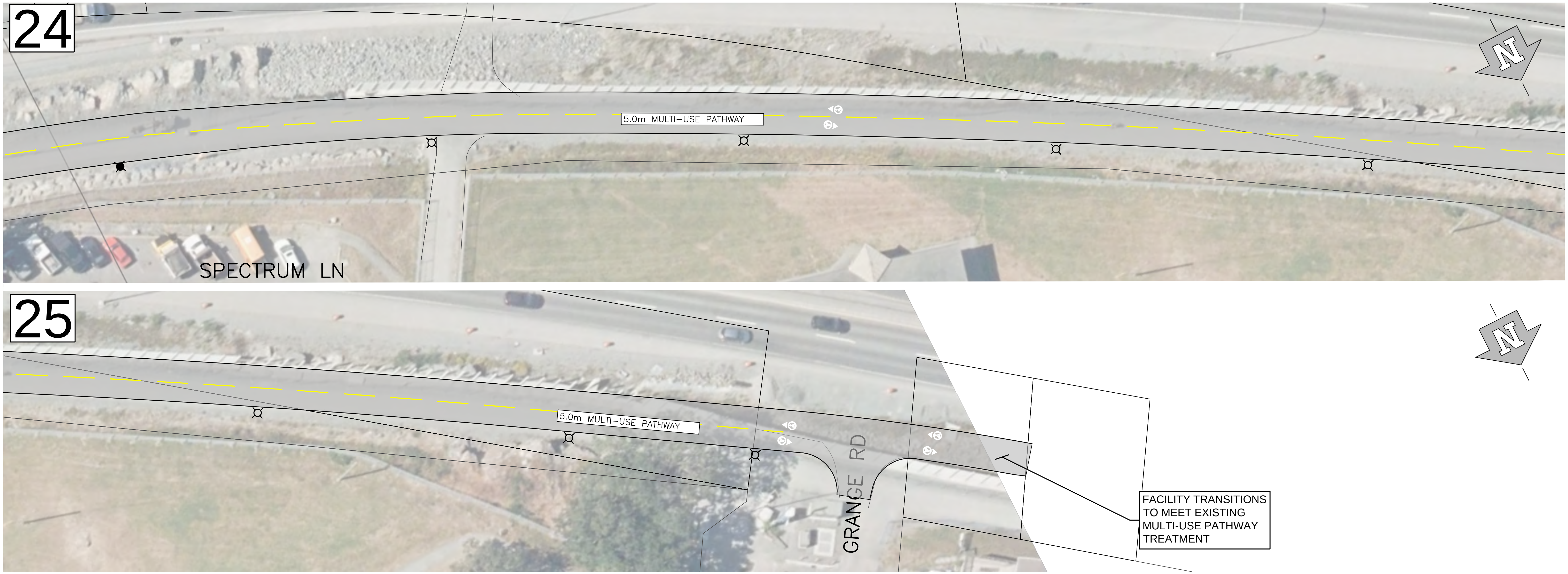

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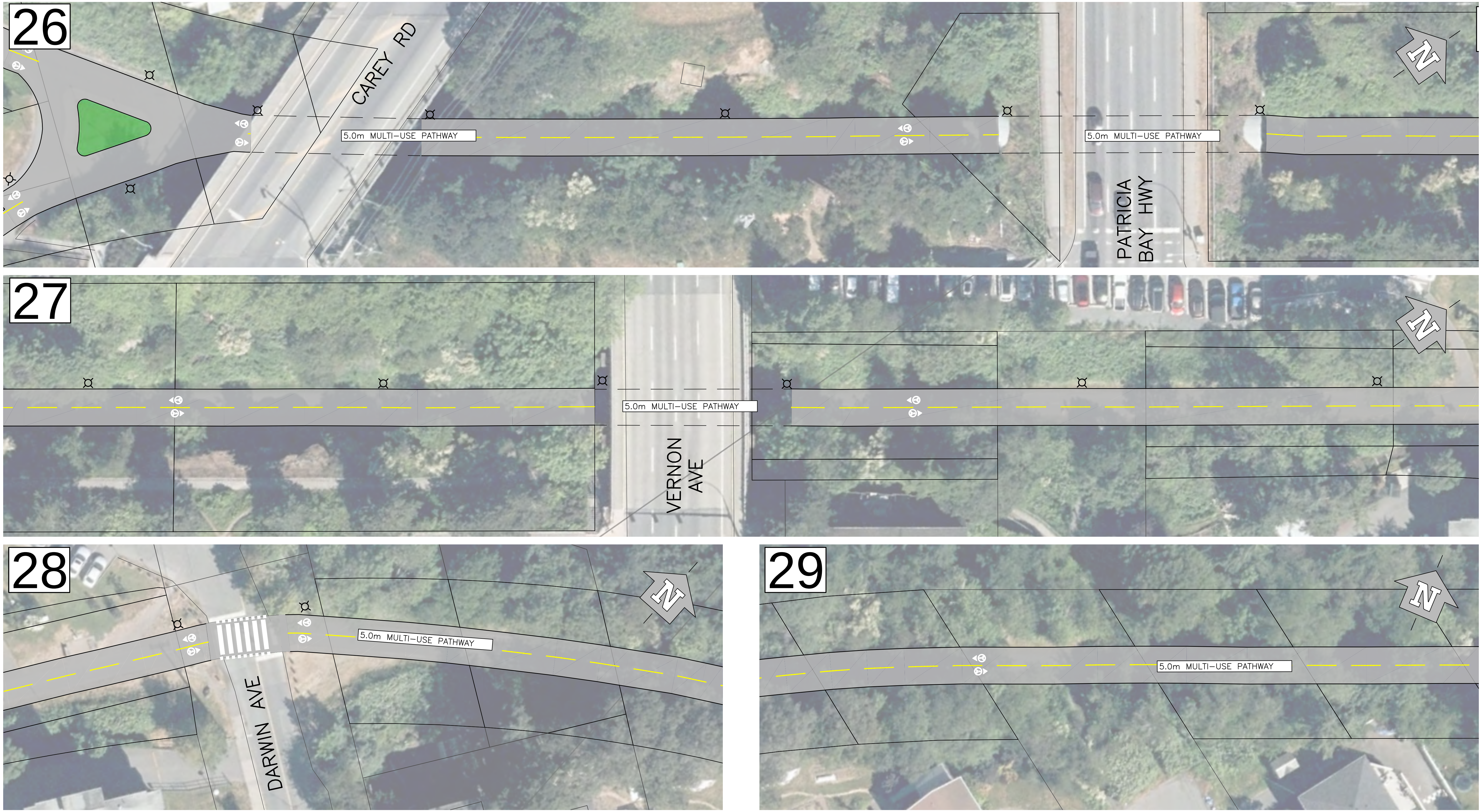

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Section C

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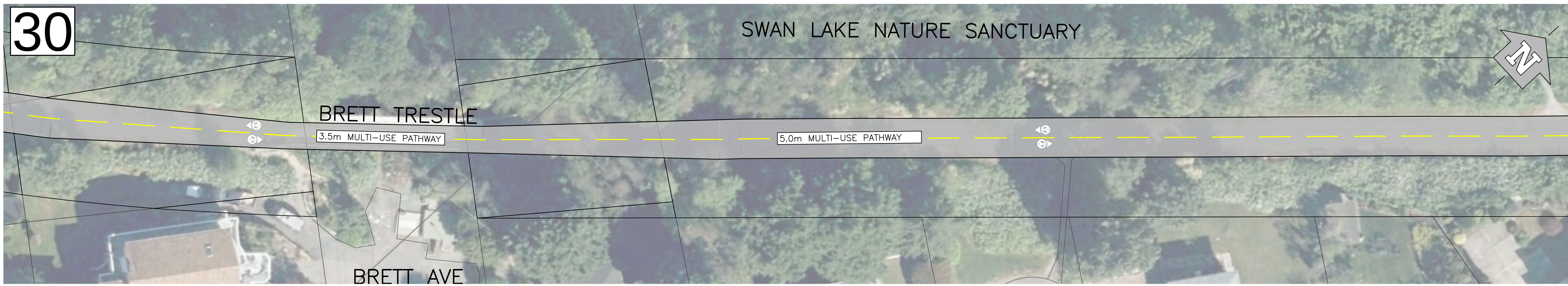

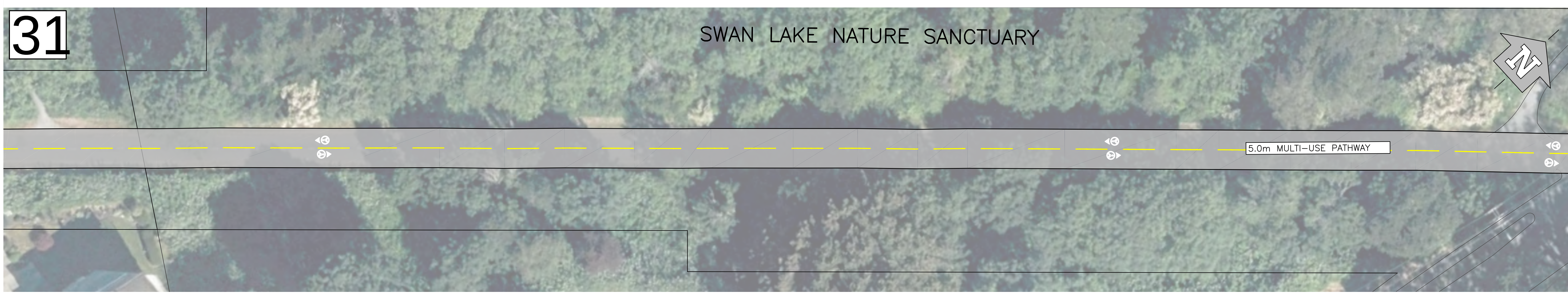

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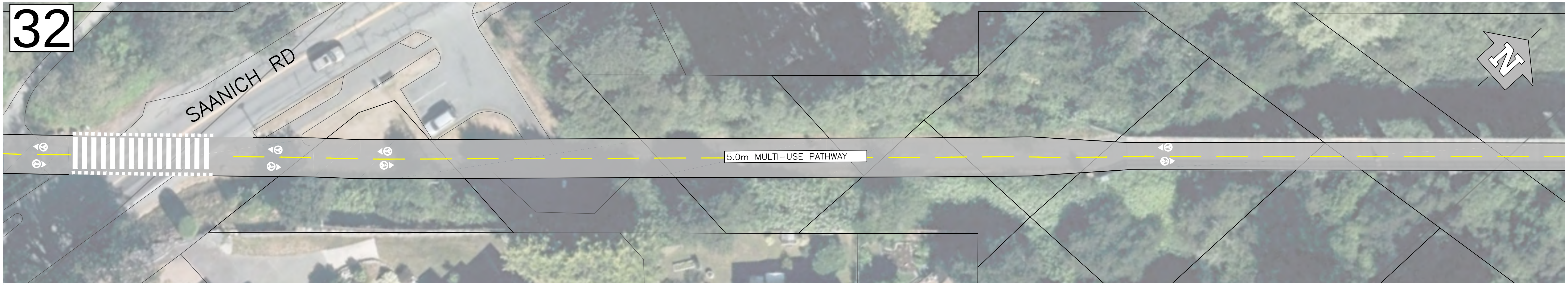
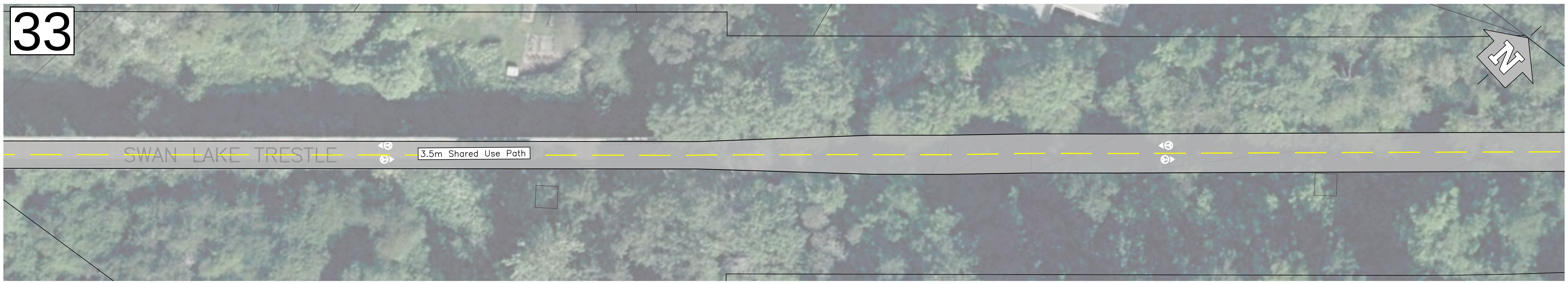
Section C
OPT 1-11





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Section C

Client/Project		
CAPITAL REGIONAL DISTRICT (CRD) Regional Trails Widening Study		
Scale	Revision Date	Figure
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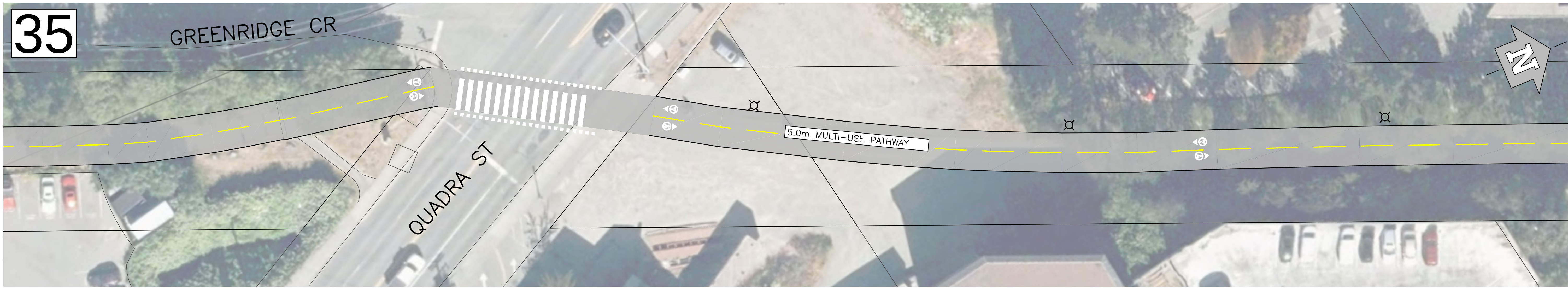
Section C
OPT 1-12



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Section C

Client/Project		
CAPITAL REGIONAL DISTRICT (CRD) Regional Trails Widening Study		
Scale	Revision Date	Figure
1:500	2020-04-29	13
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Section C
OPT 1-13

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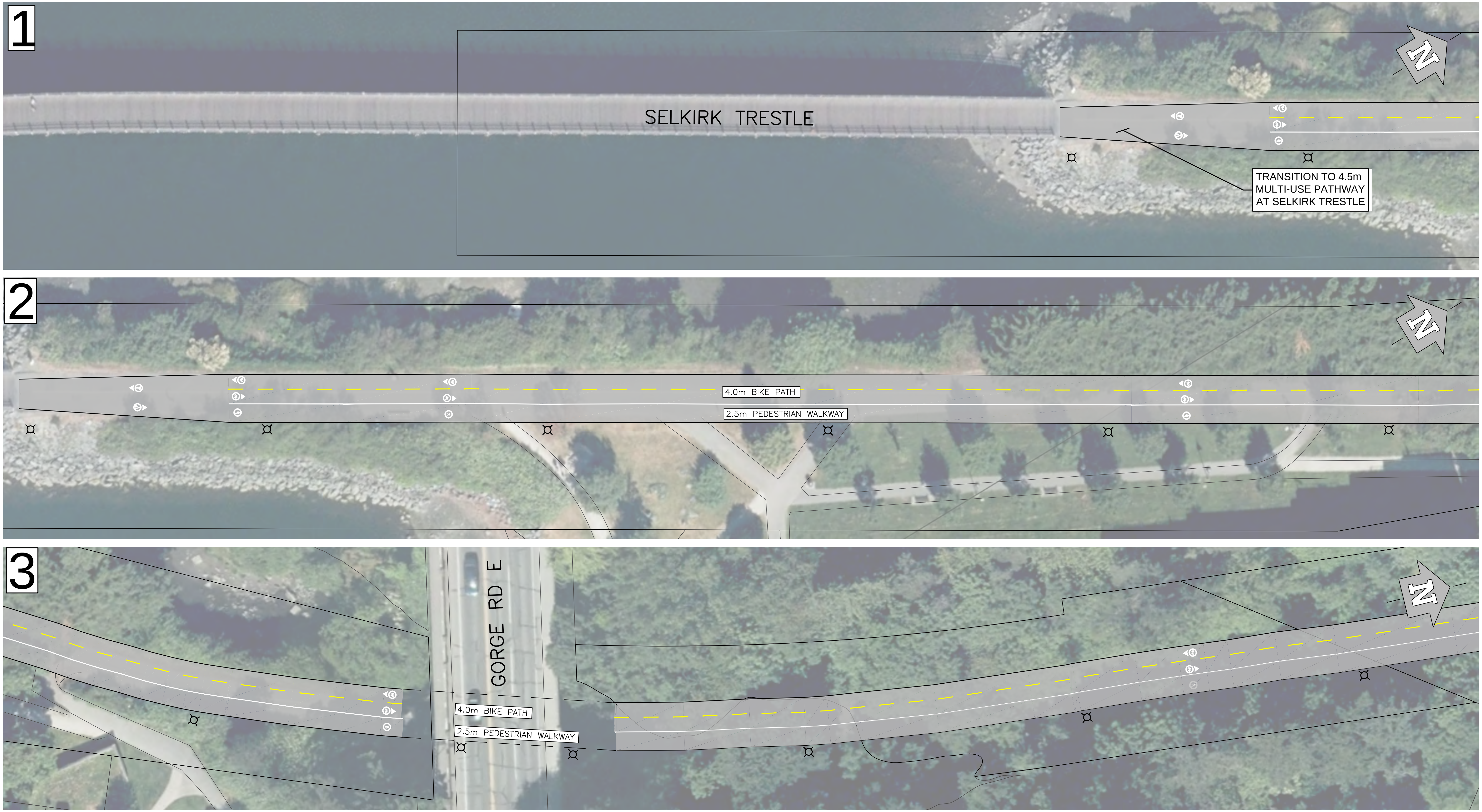

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Section A

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Scale	Revision Date	Figure
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Section A
OPT 2-1

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Section A

Client/Project		
CAPITAL REGIONAL DISTRICT (CRD) Regional Trails Widening Study		
Scale	Revision Date	Figure
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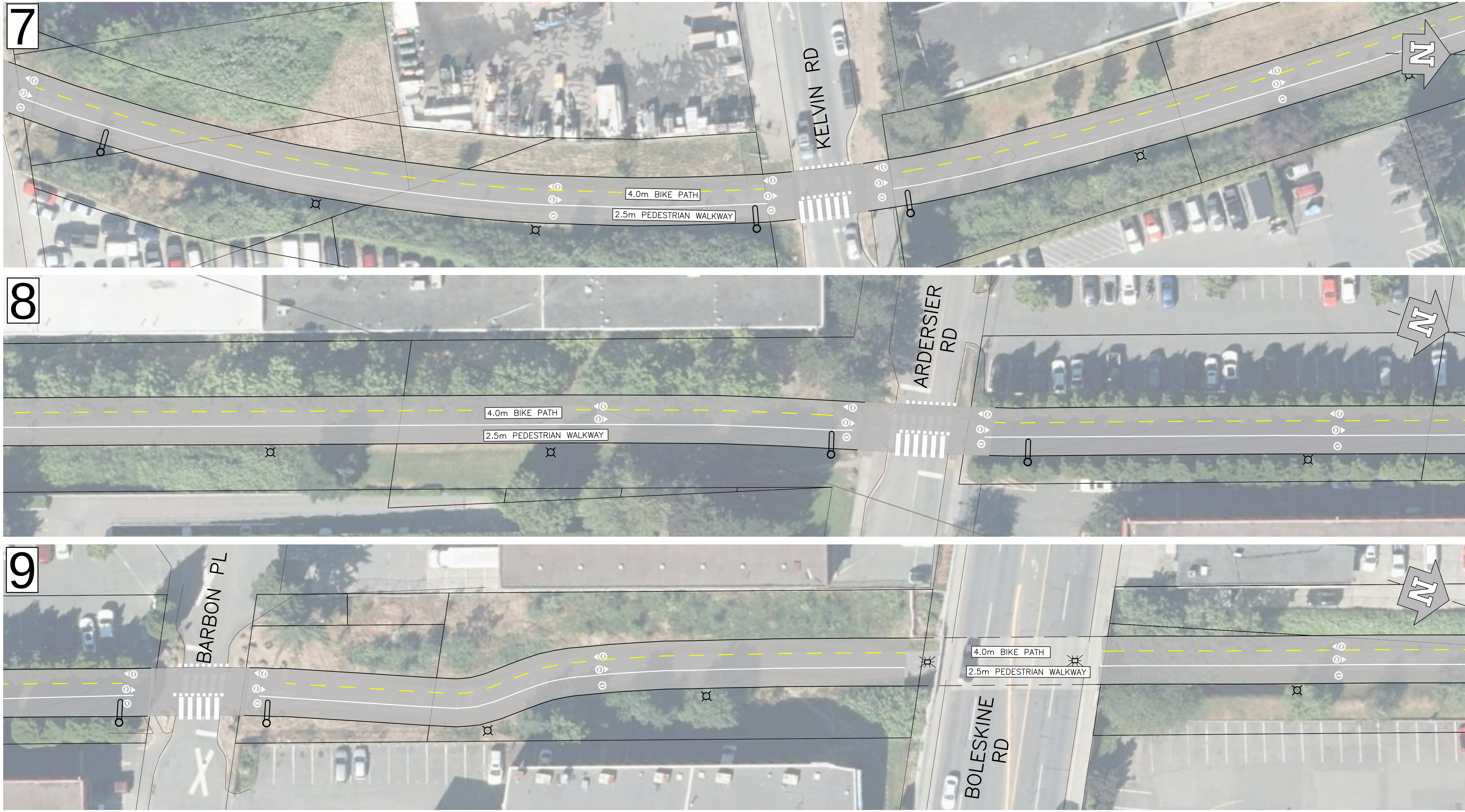
OPT 2-2



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Section A

Client/Project
CAPITAL REGIONAL DISTRICT (CRD)
Regional Trails Widening Study

Scale	Revision Date	Figure
1:500	2020-04-29	16
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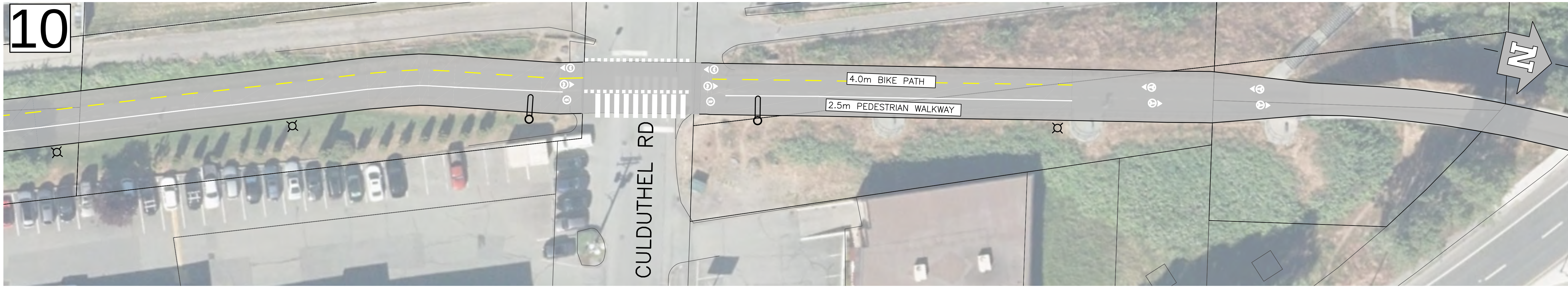
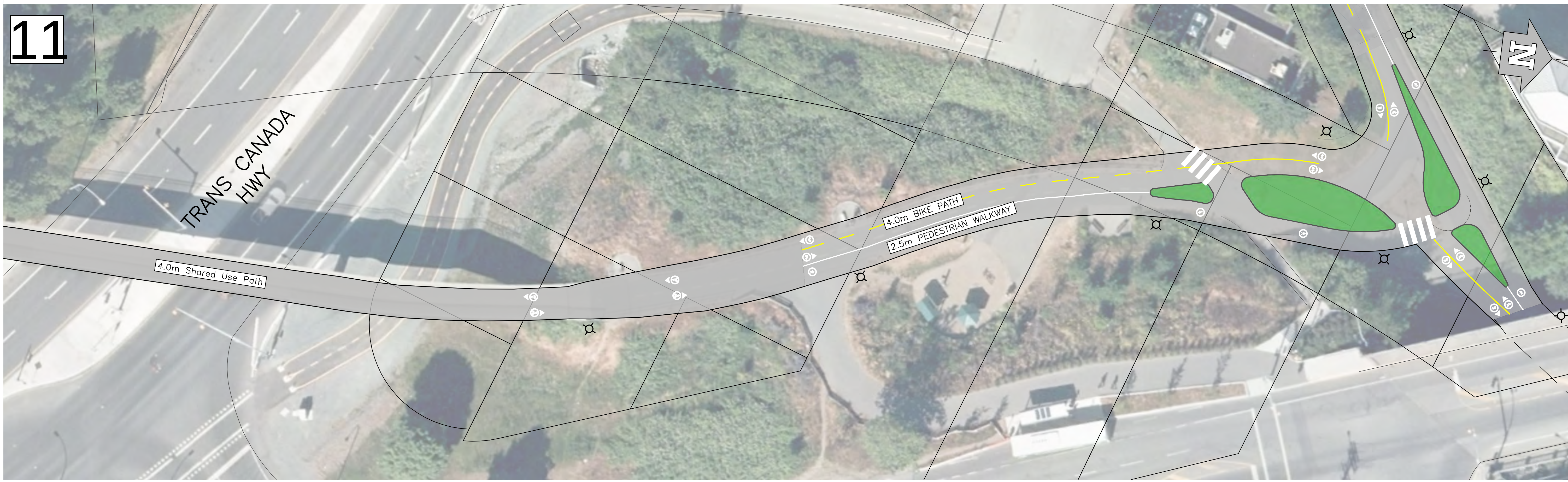
Section A
OPT 2-3





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Section A

Client/Project		
CAPITAL REGIONAL DISTRICT (CRD) Regional Trails Widening Study		
Scale	Revision Date	Figure
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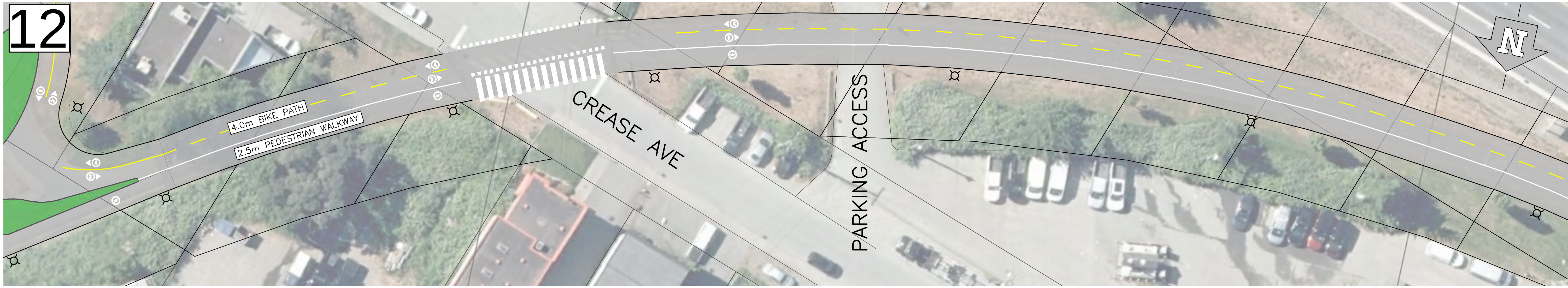
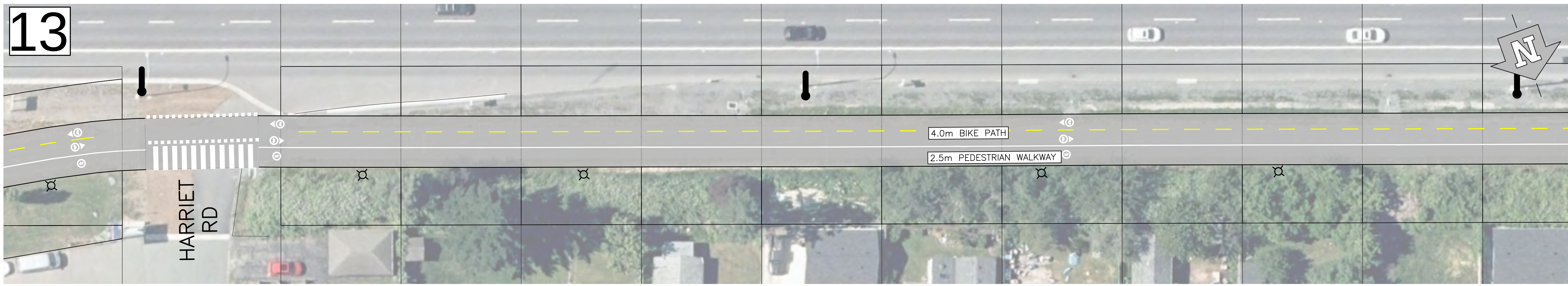
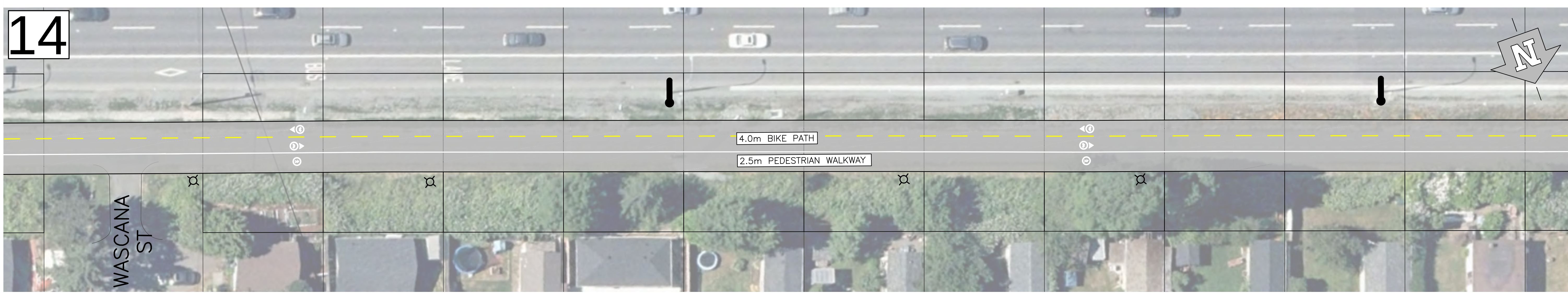
Section A
OPT 2-4







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Section B

Client/Project
CAPITAL REGIONAL DISTRICT (CRD)
Regional Trails Widening Study

Scale	Revision Date	Figure
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Section B
OPT 2-5

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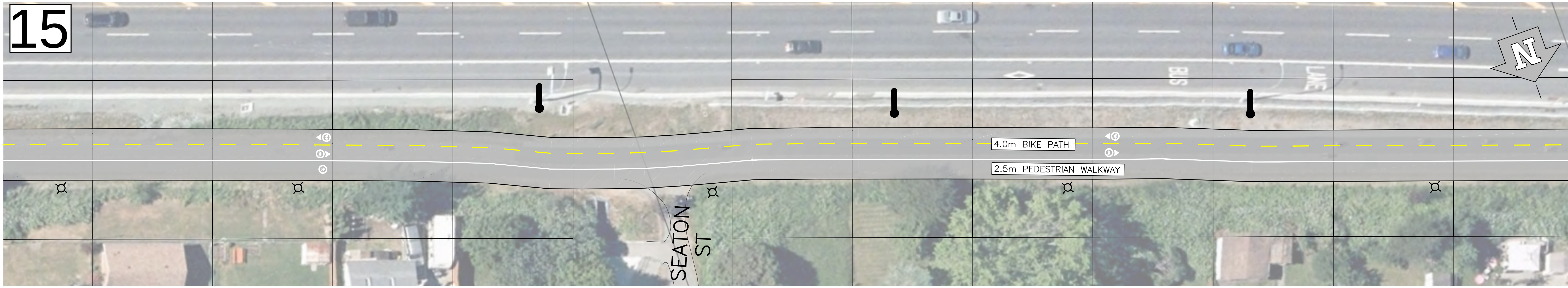

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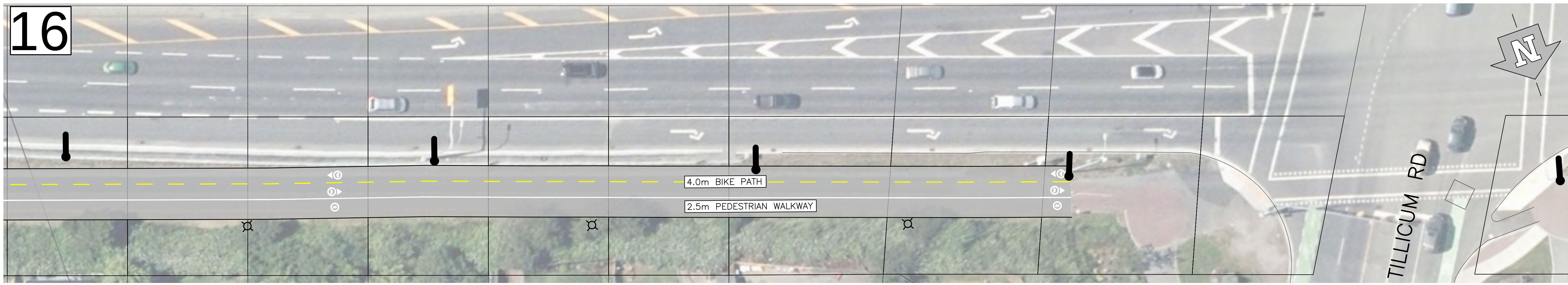

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Section B

Client/Project
CAPITAL REGIONAL DISTRICT (CRD)
Regional Trails Widening Study

Scale	Revision Date	Figure
1:500	2020-04-29	19

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Section B
OPT 2-6

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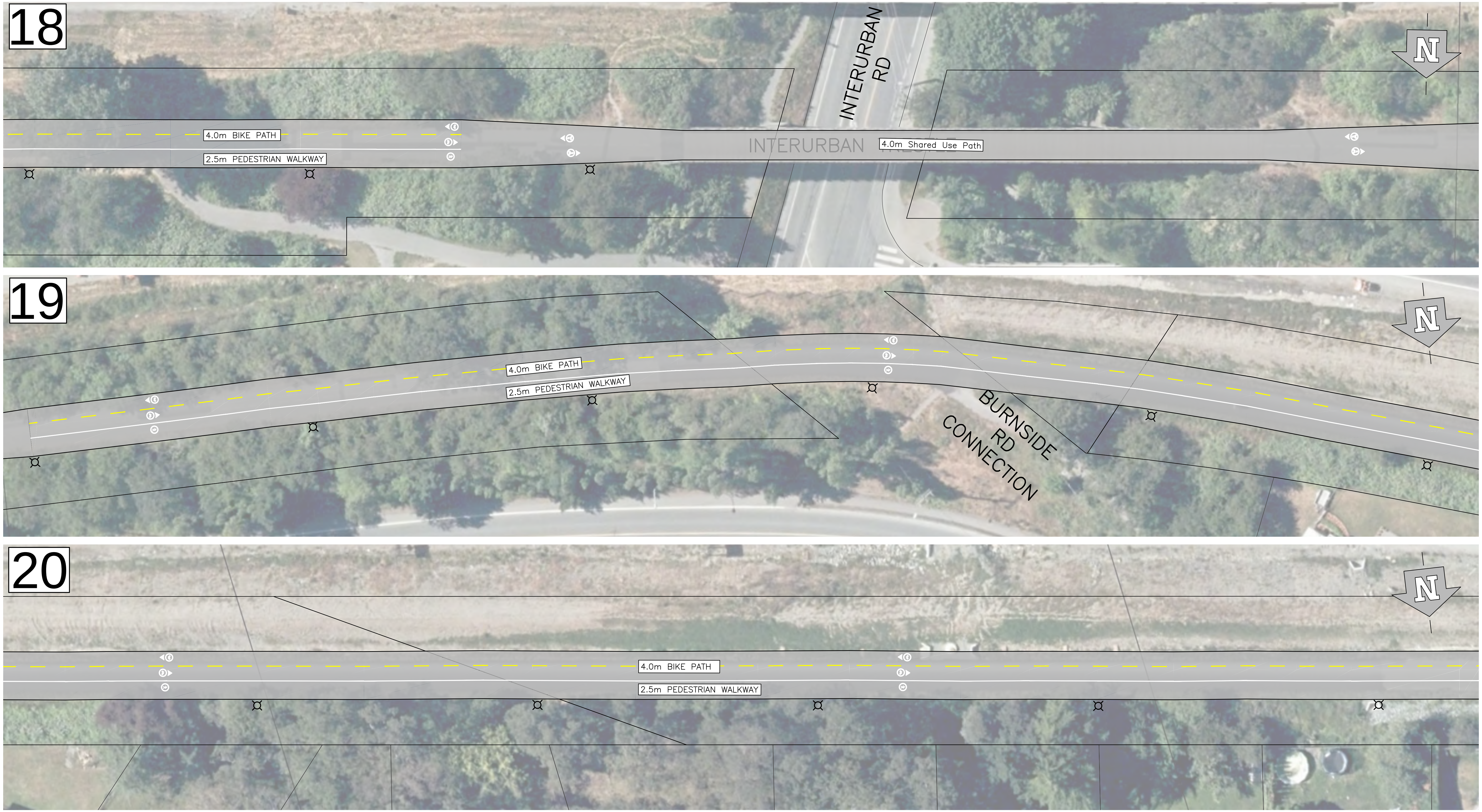

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Section B

Client/Project		
CAPITAL REGIONAL DISTRICT (CRD) Regional Trails Widening Study		
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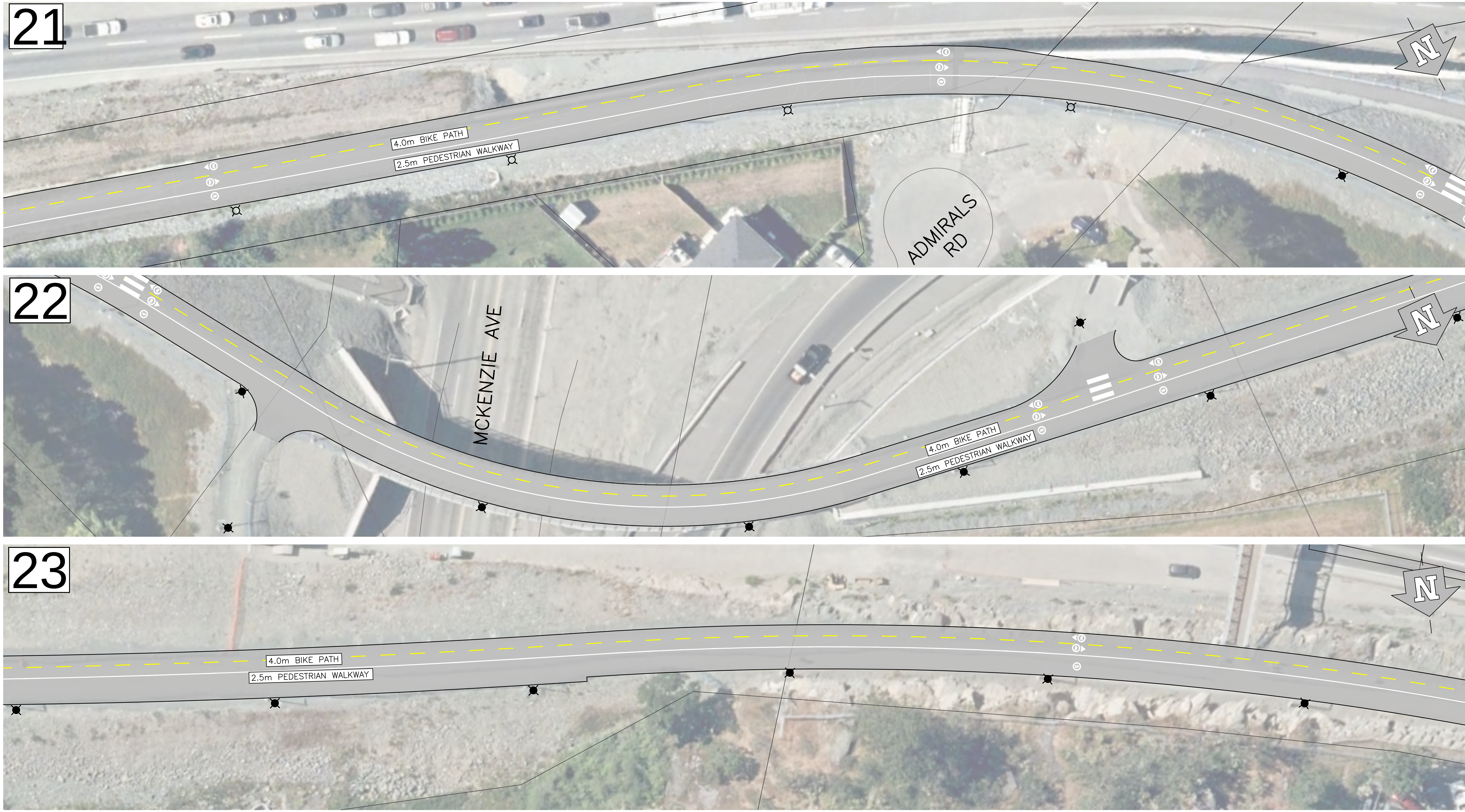
Section B
OPT 2-7



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Section B

Client/Project		
CAPITAL REGIONAL DISTRICT (CRD) Regional Trails Widening Study		
Scale	Revision Date	Figure
1:500	2020-04-29	21
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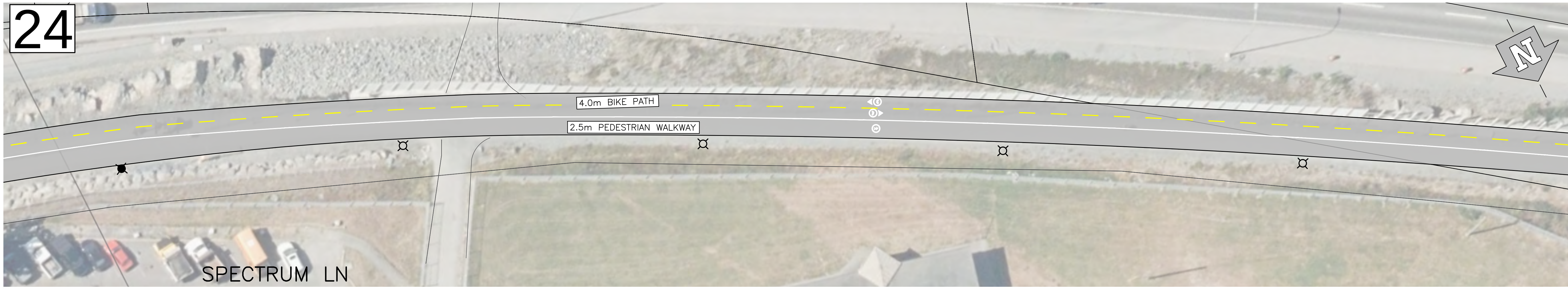
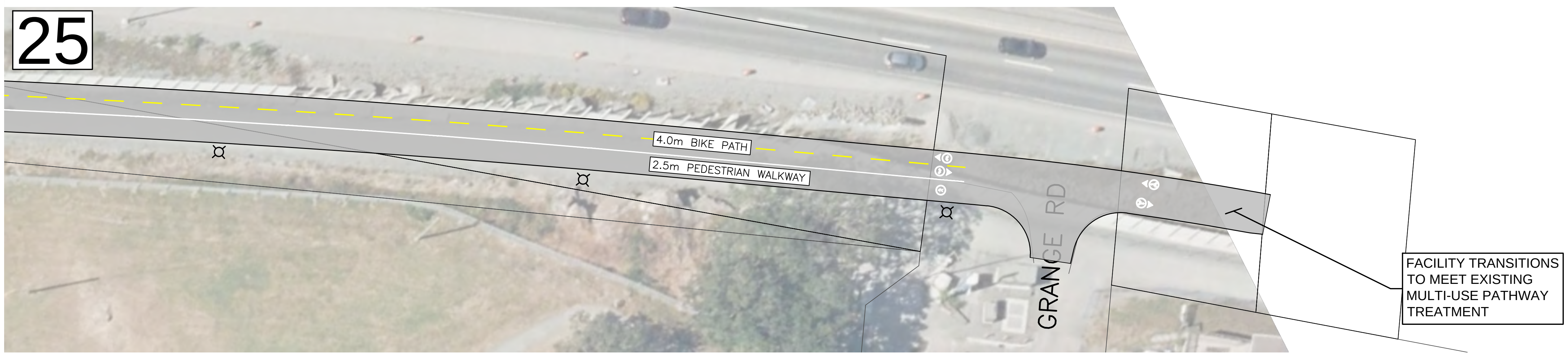
Section B
OPT 2-8





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Section B

Client/Project		
CAPITAL REGIONAL DISTRICT (CRD) Regional Trails Widening Study		
Scale	Revision Date	Figure
1:500	2020-04-29	22
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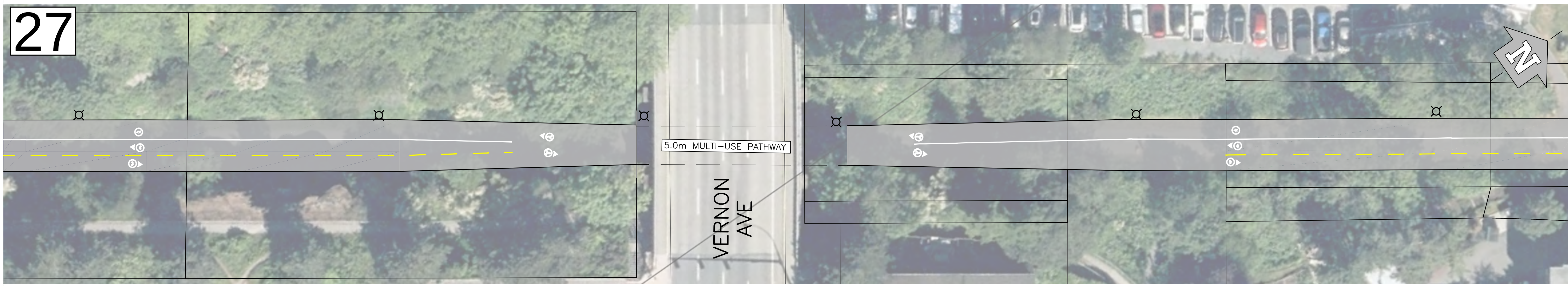
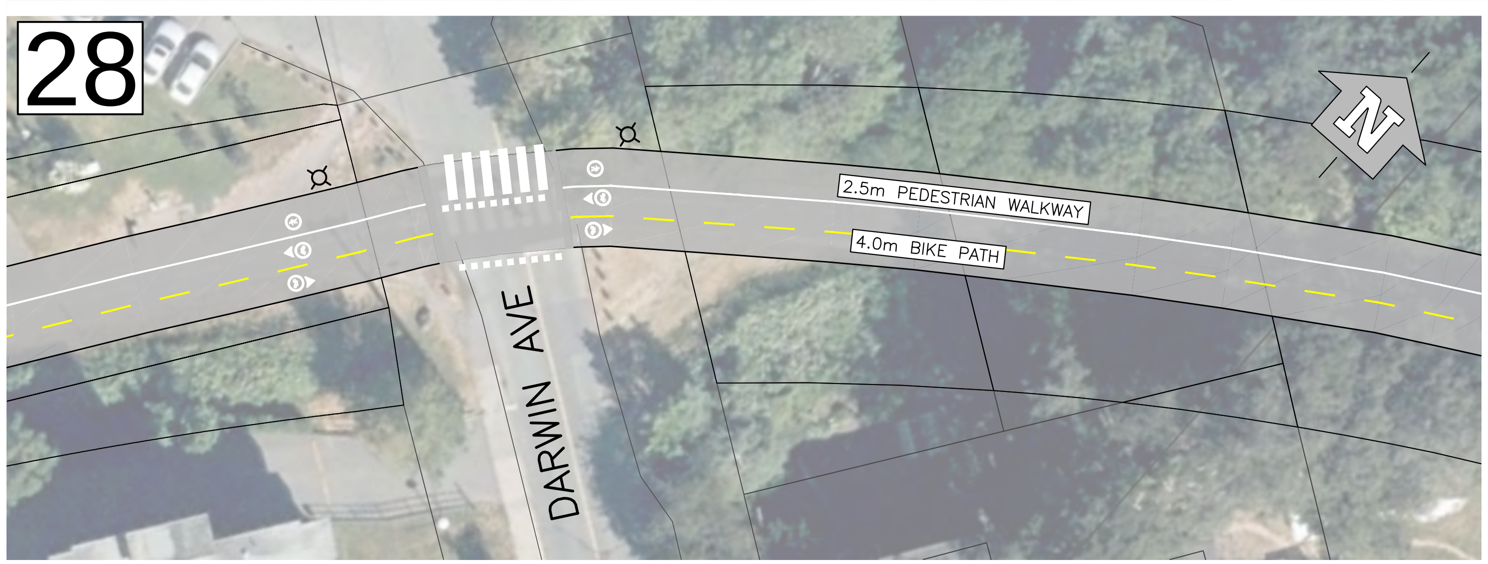
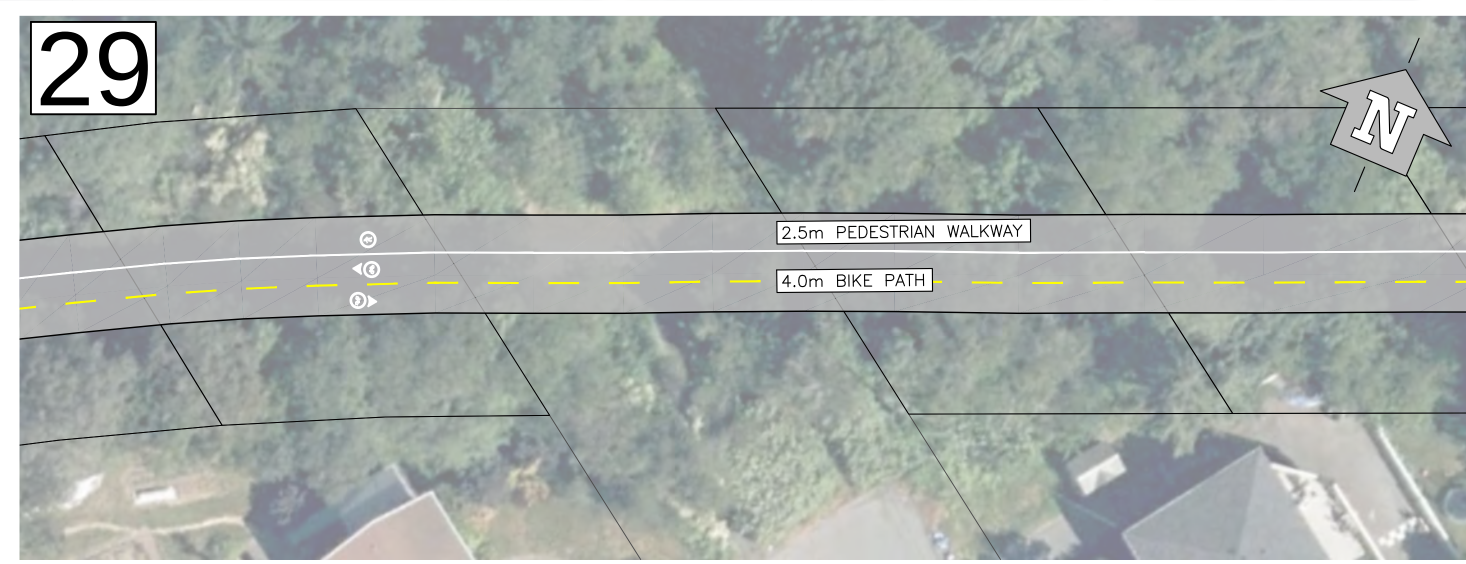
Section B
OPT 2-9







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Section C

Client/Project		
CAPITAL REGIONAL DISTRICT (CRD) Regional Trails Widening Study		
Scale	Revision Date	Figure
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Section C
OPT 2-10

29

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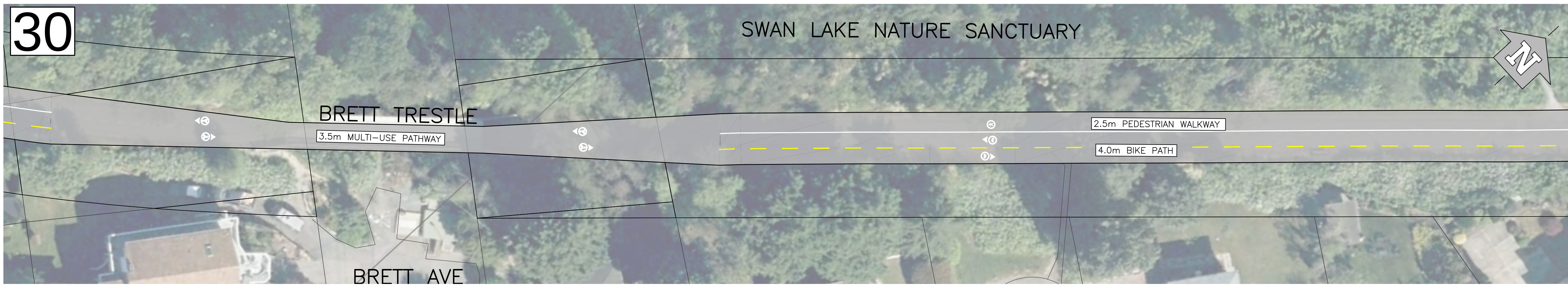

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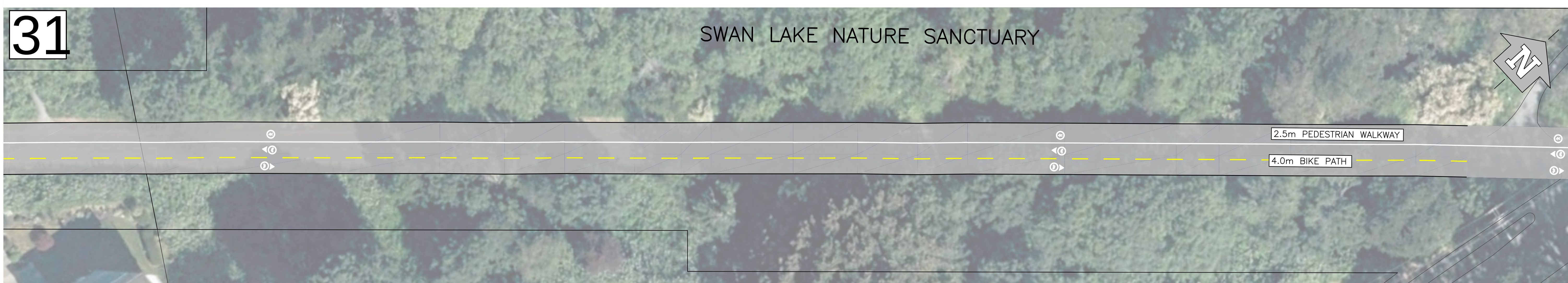

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Section C

Client/Project		
CAPITAL REGIONAL DISTRICT (CRD) Regional Trails Widening Study		
Scale	Revision Date	Figure
1:500	2020-04-29	24
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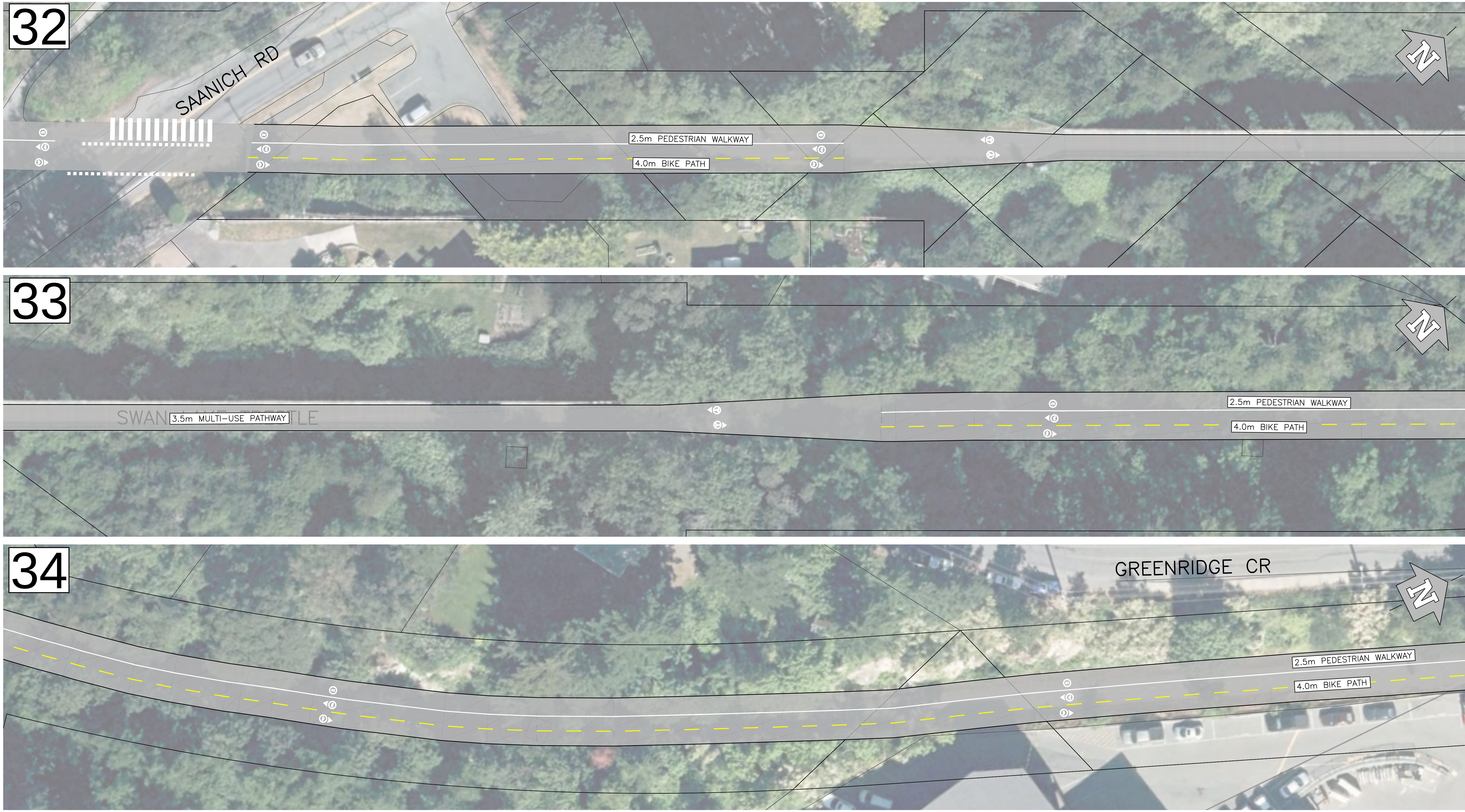
Section C
OPT 2-11



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Section C

Client/Project
CAPITAL REGIONAL DISTRICT (CRD)
Regional Trails Widening Study

Scale	Revision Date	Figure
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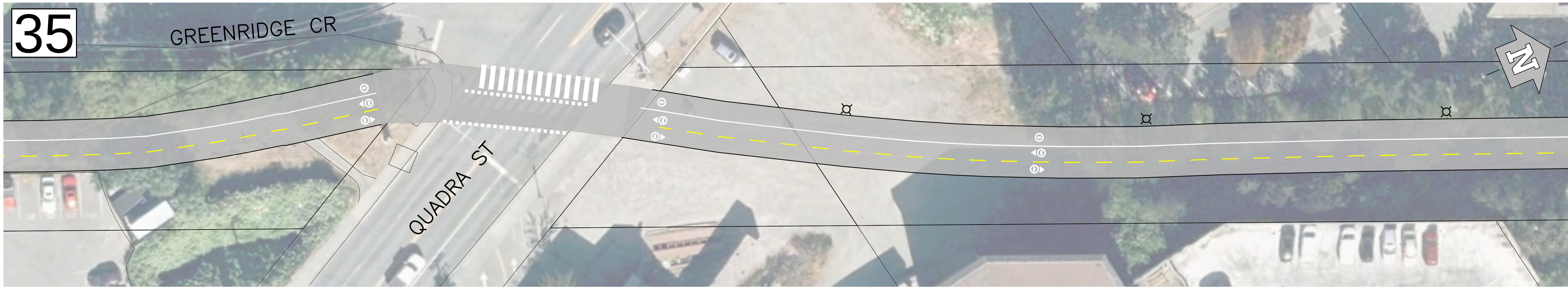
Section C
OPT 2-12



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Section C

Client/Project		
CAPITAL REGIONAL DISTRICT (CRD) Regional Trails Widening Study		
Scale	Revision Date	Figure
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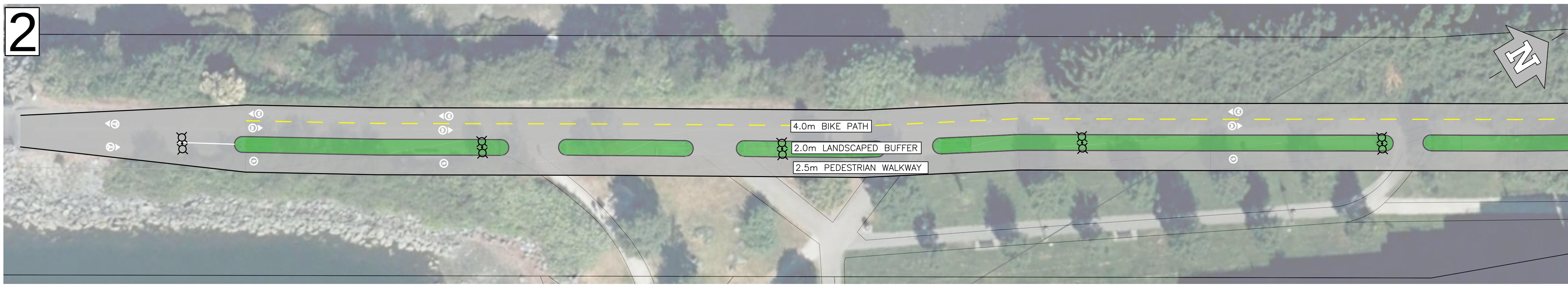
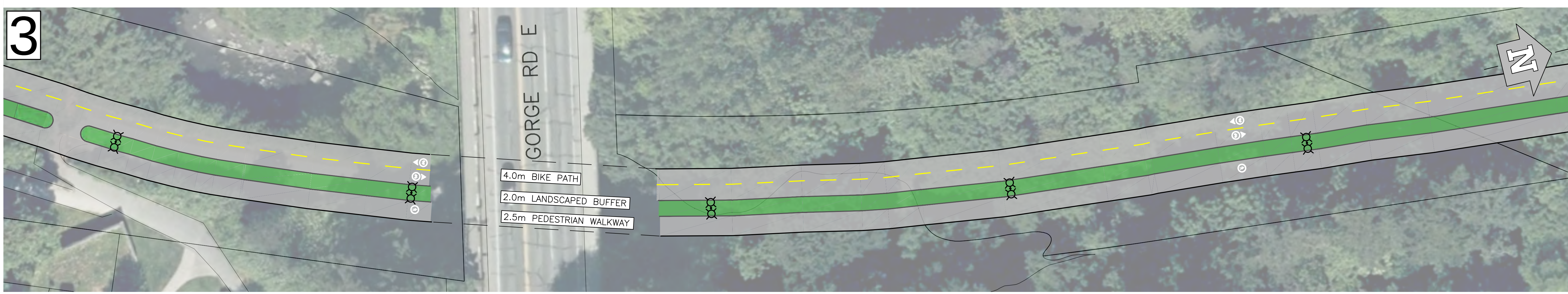
Section C
OPT 2-13





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Section A

Client/Project		
CAPITAL REGIONAL DISTRICT (CRD) Regional Trails Widening Study		
Scale	Revision Date	Figure
1:500	2020-04-29	27
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Section A
OPT 3-1

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Section A

Client/Project		
CAPITAL REGIONAL DISTRICT (CRD) Regional Trails Widening Study		
Scale	Revision Date	Figure
1:500	2020-04-29	28
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Section A
OPT 3-2

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Section A

Client/Project		
CAPITAL REGIONAL DISTRICT (CRD) Regional Trails Widening Study		
Scale	Revision Date	Figure
1:500	2020-04-29	29
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Section A
OPT 3-3

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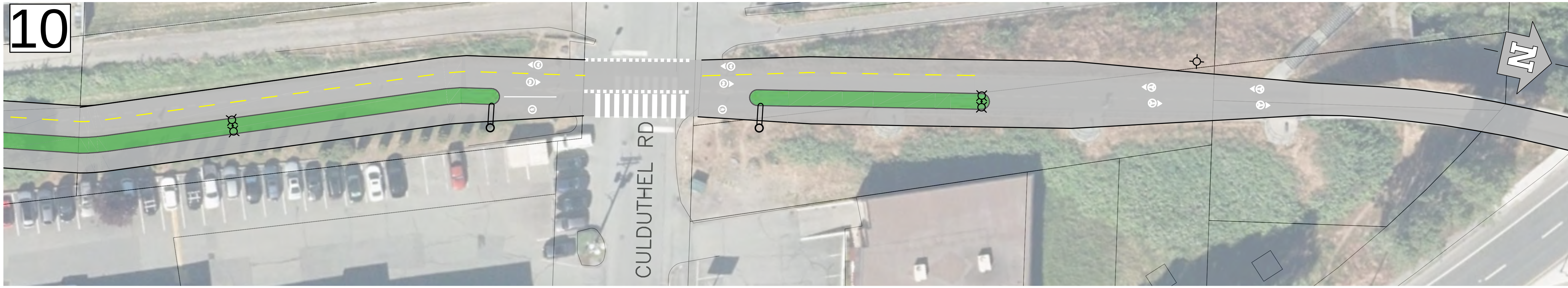

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Section A

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Scale	Revision Date	Figure
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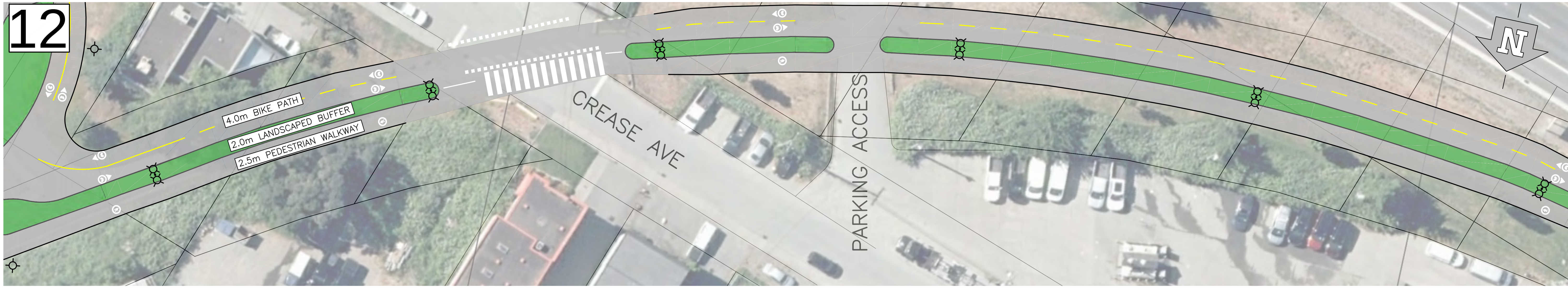
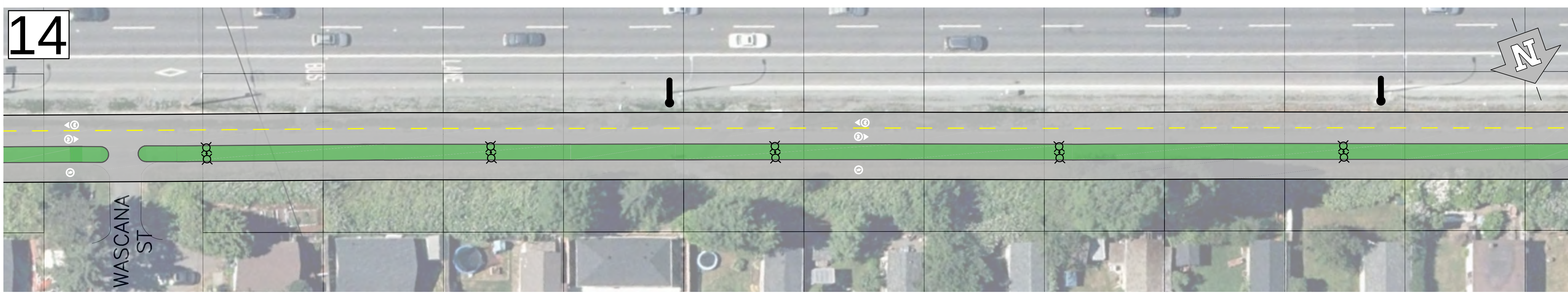
Section A
OPT 3-4





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Section B

Client/Project		
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Section B
OPT 3-5

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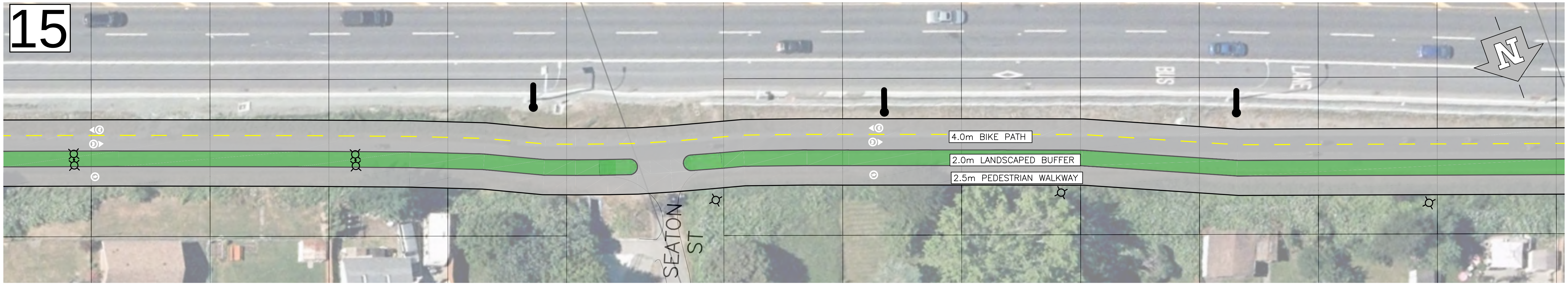

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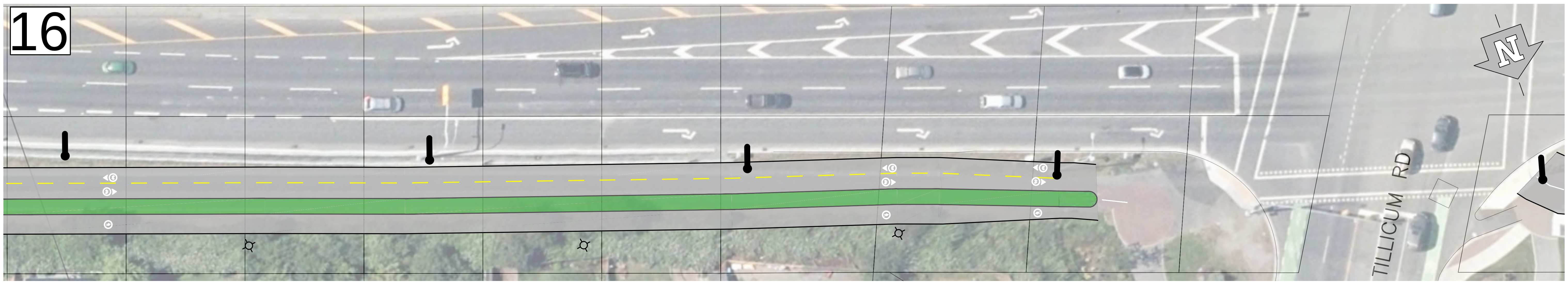

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Section B

Client/Project		
CAPITAL REGIONAL DISTRICT (CRD) Regional Trails Widening Study		
Scale	Revision Date	Figure
1:500	2020-04-29	32
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Section B
OPT 3-6

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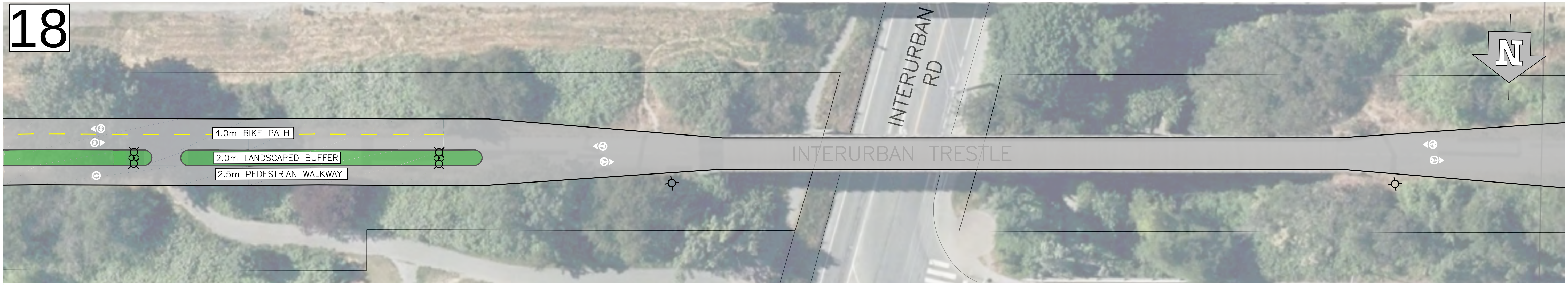

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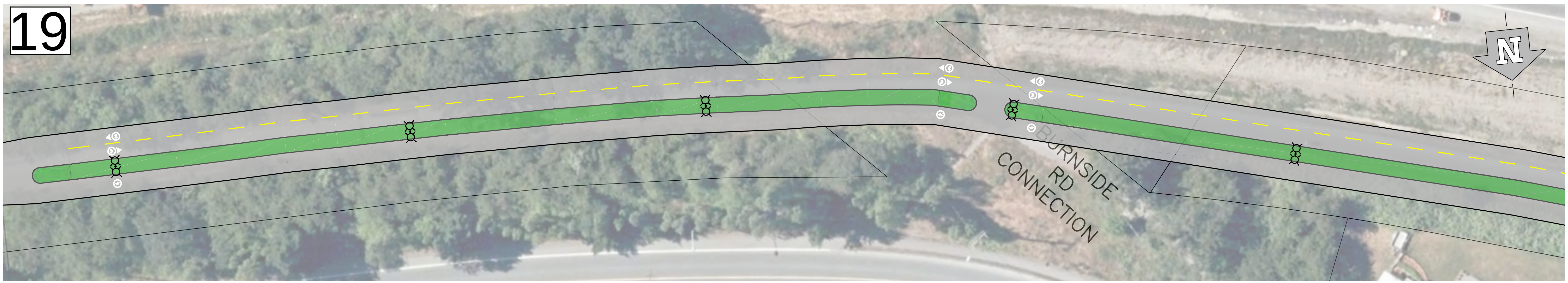

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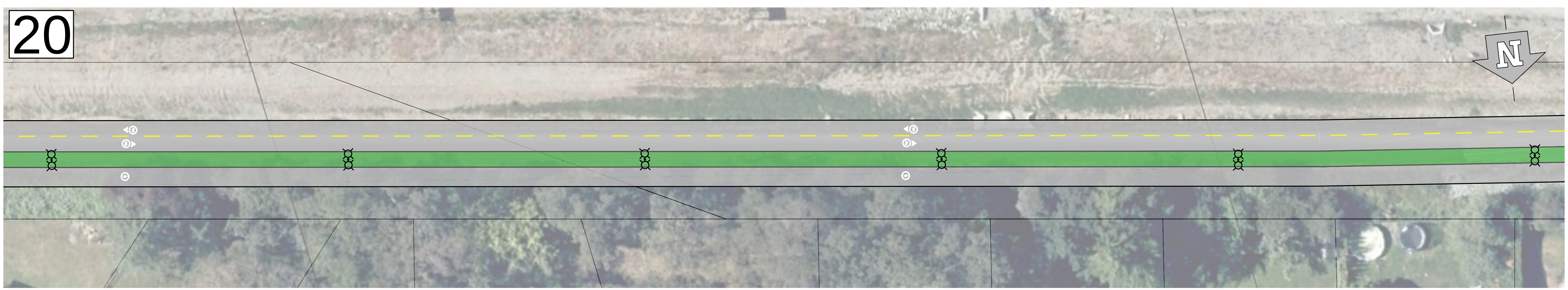

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Section B

Client/Project		
CAPITAL REGIONAL DISTRICT (CRD) Regional Trails Widening Study		
Scale	Revision Date	Figure
1:500	2020-04-29	33
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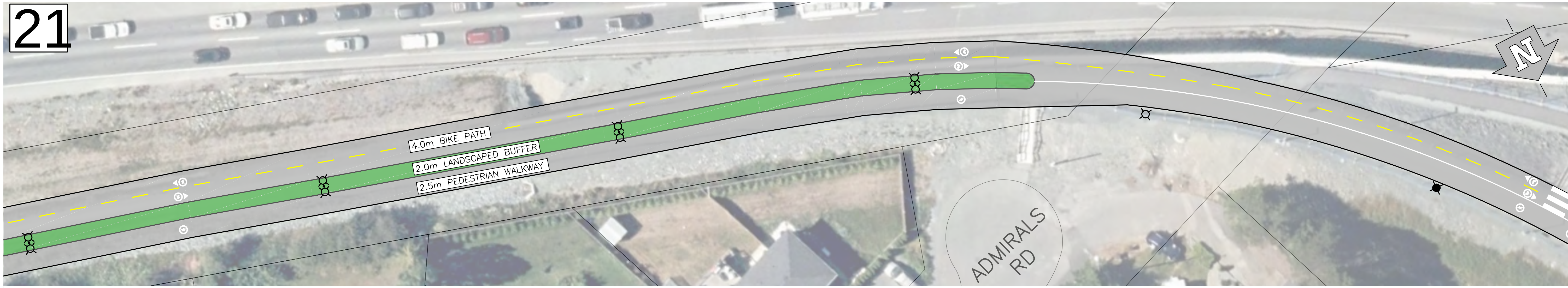
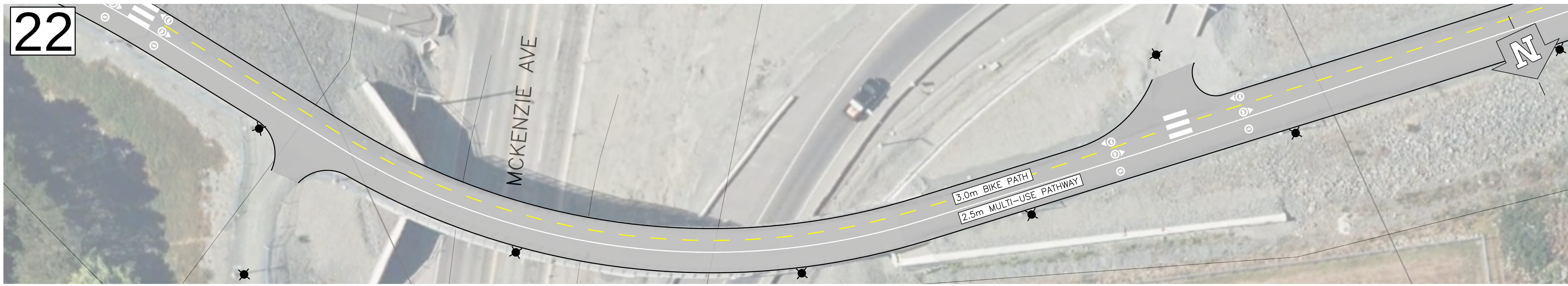
Section B
OPT 3-7





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Section B

Client/Project		
CAPITAL REGIONAL DISTRICT (CRD) Regional Trails Widening Study		
Scale	Revision Date	Figure
1:500	2020-04-29	34
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Section B
OPT 3-8

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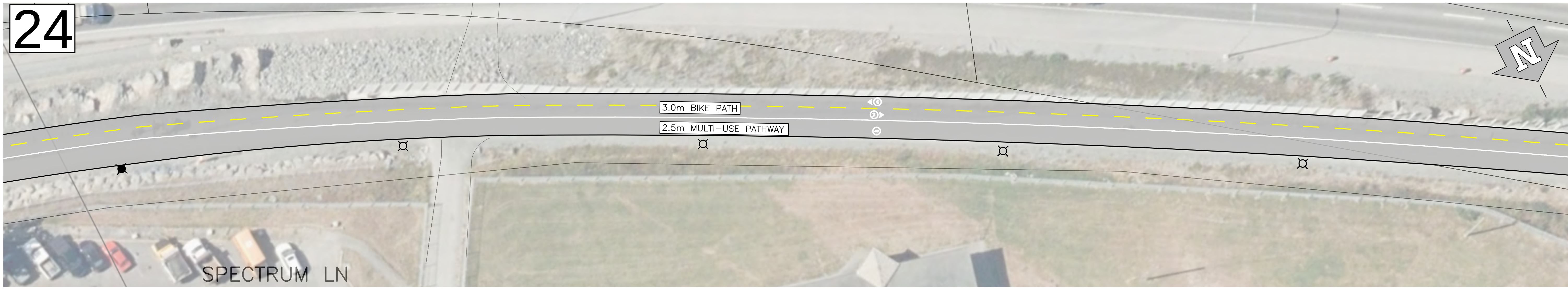

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Section B

Client/Project		
CAPITAL REGIONAL DISTRICT (CRD) Regional Trails Widening Study		
Scale	Revision Date	Figure
1:500	2020-04-29	35
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Section B
OPT 3-9

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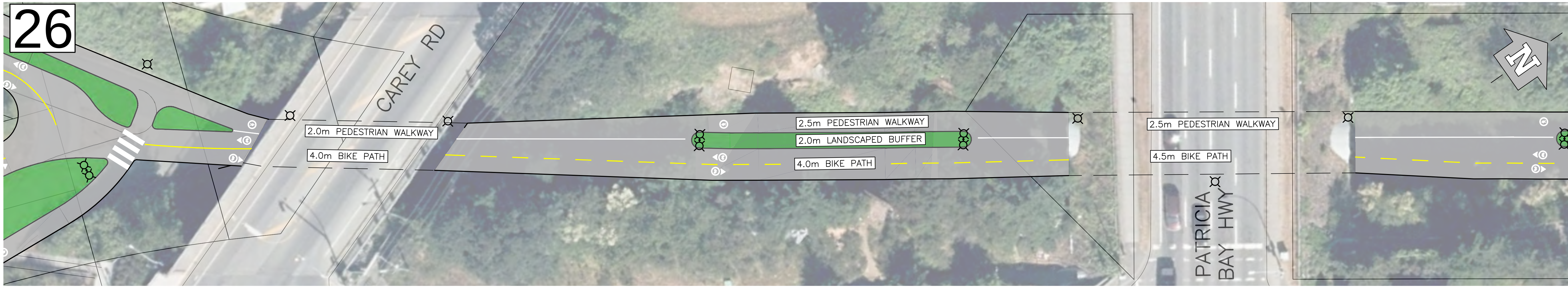

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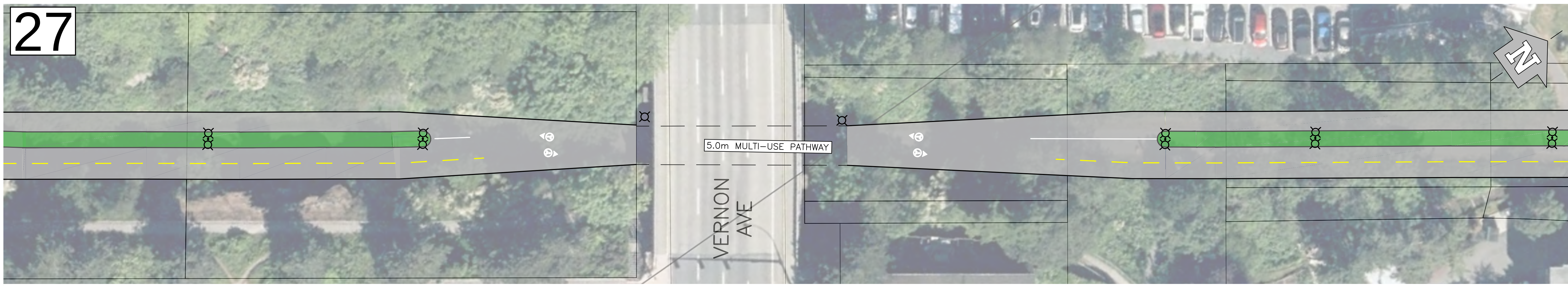

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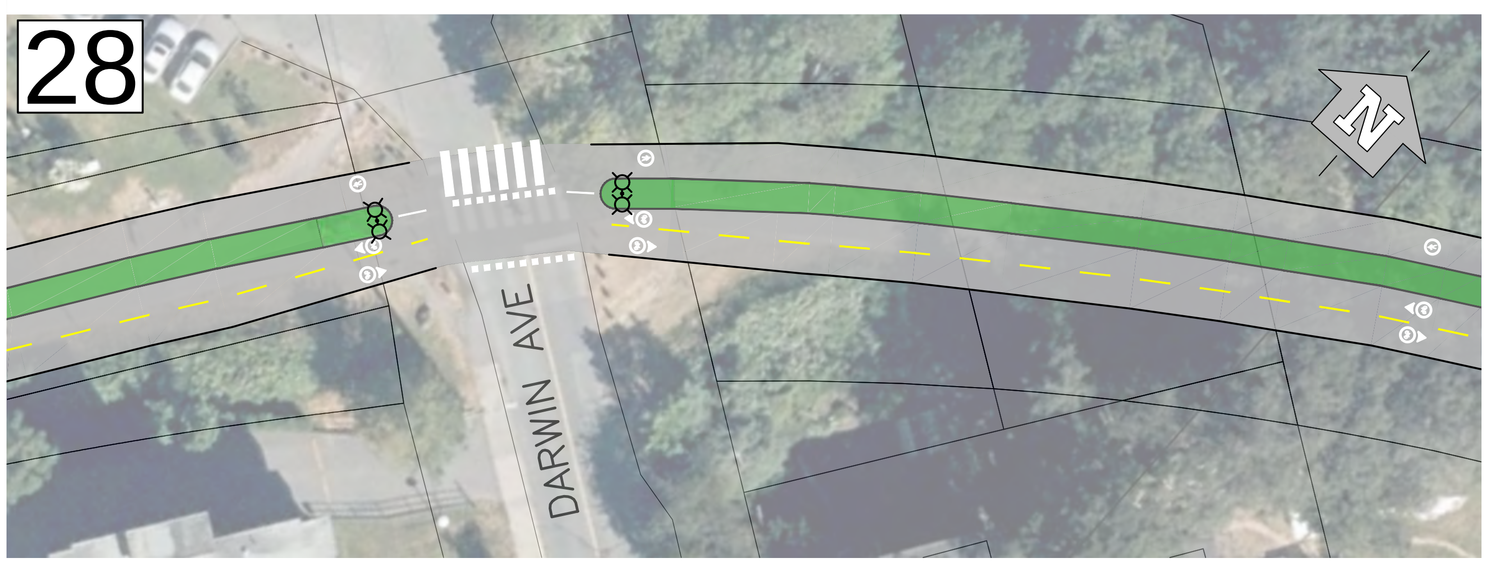

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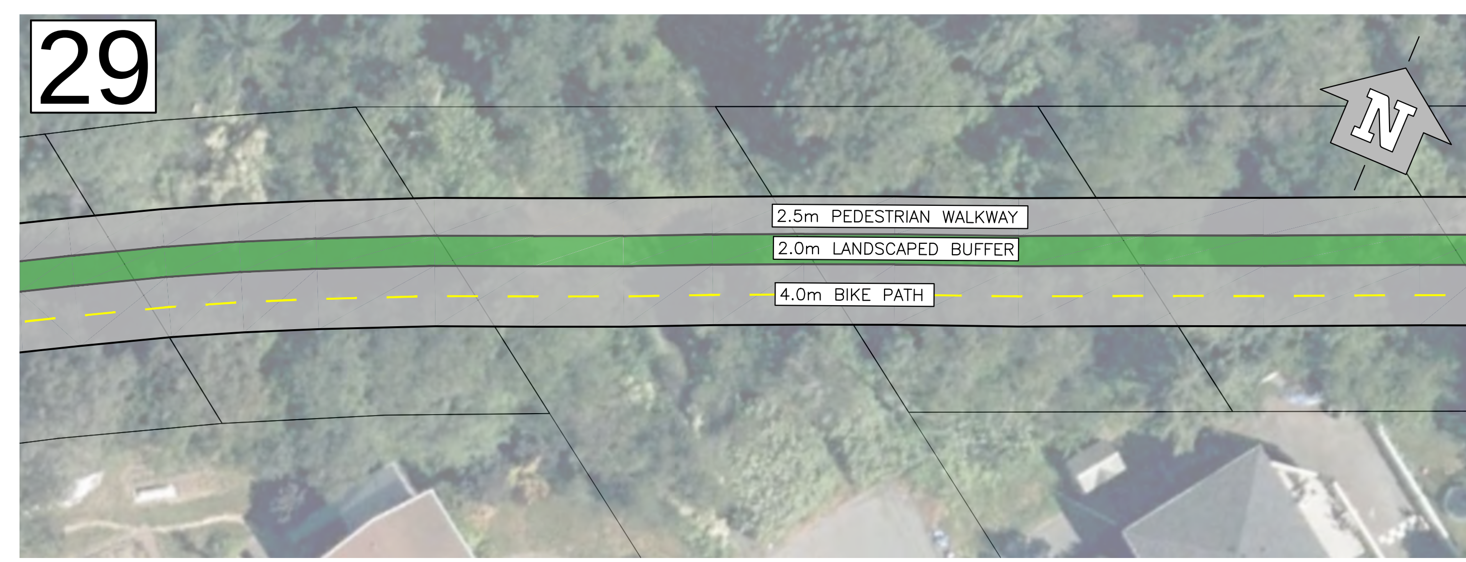

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Section C

Client/Project		
CAPITAL REGIONAL DISTRICT (CRD) Regional Trails Widening Study		
Scale	Revision Date	Figure
1:500	2020-04-29	36
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Section C
OPT 3-10

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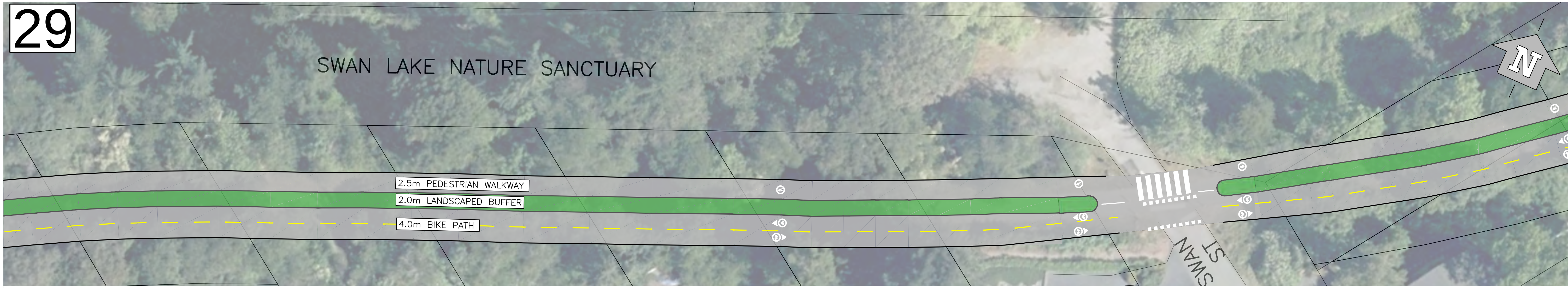

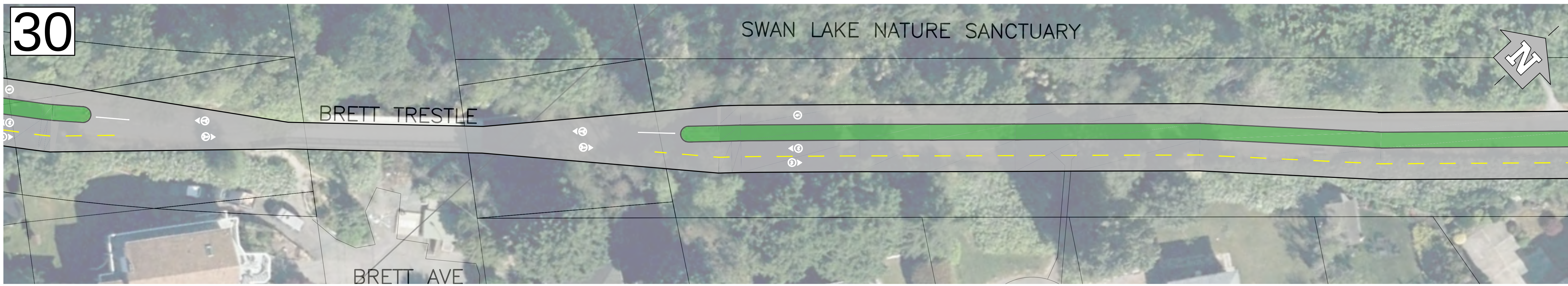

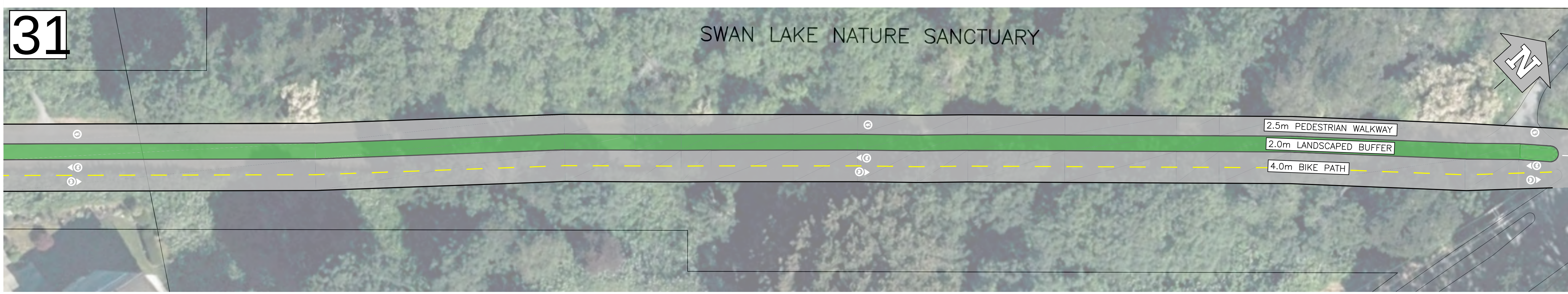

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Section C

Client/Project		
CAPITAL REGIONAL DISTRICT (CRD) Regional Trails Widening Study		
Scale	Revision Date	Figure
1:500	2020-04-29	37
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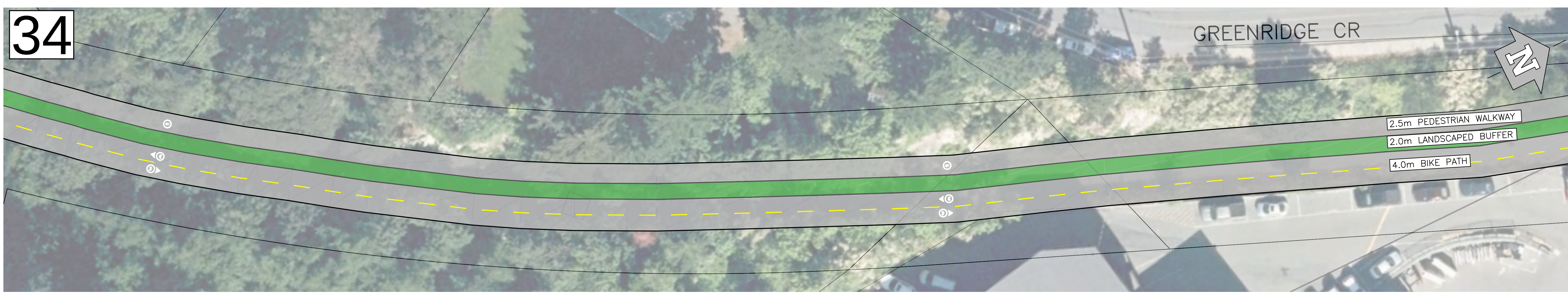
Section C
OPT 3-11



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Section C

Client/Project		
CAPITAL REGIONAL DISTRICT (CRD) Regional Trails Widening Study		
Scale	Revision Date	Figure
1:500	2020-04-29	38
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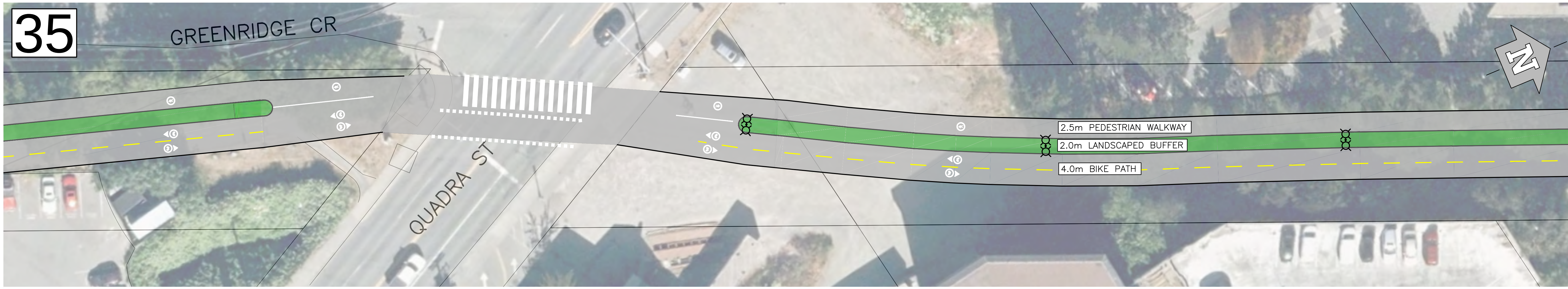
Section C
OPT 3-12



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Section C

Client/Project		
CAPITAL REGIONAL DISTRICT (CRD) Regional Trails Widening Study		
Scale	Revision Date	Figure
1:500	2020-04-29	39
----		Title

Section C
OPT 3-13

Appendix D.

DETAILED OPTION EVALUATION

Capital Cost

The capital cost of the trail widening or reconfiguration

Order of magnitude (Class D, 2020$) cost estimates have been developed for each of the trail configuration options. Option 1 is the least expensive of the three options, at approximate $10.5-million over the entire 6.6km project area. The cost of Option 2 is approximately 35% higher (approximately $14.2-million) and the cost of Option 3 is approximately 82% higher than Option 1 ($19.1-million).

Cost estimates for each option are expressed independently for each of the three trail sections below. A list of assumptions used in developing cost estimates is contained on the following page.

Section A.

	Option 1.	**Option 2.**	**Option 3.**
Civil Works	$2,050,000	$2,690,000	$3,610,000
Electrical Works	$470,000	$485,000	$520,000
Contingency (30%)	$756,000	$953,000	$1,239,000
Total	**$3,276,000**	**$4,128,000**	**$5,369,000**

Section B.

	Option 1.	**Option 2.**	**Option 3.**
Civil Works	$2,710,000	$4,030,000	$5,380,000
Electrical Works	$495,000	$500,000	$570,000
Contingency (30%)	$962,000	$1,359,000	$1,785,000
Total	**$4,167,000**	**$5,889,000**	**$7,735,000**

Section C.

	Option 1.	**Option 2.**	**Option 3.**
Civil Works	$2,110,000	$3,000,000	$4,390,000
Electrical Works	$205,000	$215,000	$235,000
Contingency (30%)	$695,000	$965,000	$1,388,000
Total	**$3,010,000**	**$4,180,000**	**$6,013,000**

Cost Estimate Assumptions:

- Civil costs include all stripping, pavement, landscape and associated works.
- Electrical costs include lighting infrastructure, conduit and associated works.
- Contingency (30%) is applied on top of the identified civil and electrical costs to account for the possibility of unforeseen conditions or challenges that result in increased cost. Soft costs such as a mobilization / demobilization and traffic management may also be covered under contingency.
- Cost estimates consider only infrastructure costs. They do not include costs associated with detailed design or project management.
- Cost estimates are prepared based on the available information at the time of this report and are based on the design drawings provided in **Appendix C**.
- Cost estimates are in 2020 CDN rates. Costs are based on recently tendered projects or recent cost estimates on Vancouver Island and have been updated to projected 2020 CDN dollars.
- Designs were prepared using available GIS information that were provided by the Capital Regional District. No topographic survey information was available for this assignment.
- Allowances were made for the following items based on experience with similar projects in magnitude of scope:
    - Drainage Improvements
    - Signing and Pavements Markings
    - Landscaping (Removals and soft and hard landscaping)
- Costs include total removal of existing pathway and stripping to design width of new pathway. Stripping and pavement excavation are assumed to be 300mm deep for the entire footprint of the design pathways.
- No geotechnical investigation has been conducted for this project. A detailed geotechnical investigation is recommended prior to advancing design to confirm the assumptions made as part of this cost estimate exercise. Geotechnical stability could have significant impacts on the functional design of the pathway and subsequent costs. Costs of this investigation have not been included in the cost estimates above.
- Pathway grading and bedrock impacts are based on the polygons provided by the CRD. A detailed topographic survey and geotechnical investigation would be needed to confirm these assumptions.
- Pavement structure for the pathways are assumed to be 60mm Asphalt Surface Course, 100mm – 25mm Gravel Base Course, 200mm – 75mm Gravel Base Course, and 300mm Gravel Subbase Course. This pavement structure was selected because it allows for minor vehicle traffic for maintenance and operation activities.
- Location and size of retaining walls is based on significance of impacts to grading along the pathway and knowledge of the corridor. Detailed design is required to confirm these assumptions.

- Environmental mitigation and/or remediation, municipal and utility type charges, legal and topographic surveys, property acquisition, permit charges, sub-consultant design and reporting, inspection, and certification fees (electrical, geotechnical, environmental, landscape architect) as well as any legal fees are not included in this cost estimate.
- The design has avoided any property acquisition requirements.
- Detailed Electrical Lighting Product Assumptions developed for pricing are outlined below:
  - 9m Davit Luminaire Pole (Hardwire):
    - MMCD/MoTI standard 9.0m Type 2 pole and Type C concrete base
    - Typical ~80W LED roadway luminaire
  - Post top luminaire (Hardwire):
    - 5.0m MoTI/MMCD Type 2 pole and Type B concrete base
    - American Electric Lighting Autobahn Series ATBMicro 37W 3000K ATBMIC_10BLEDE10_R3_3K
  - Underpass Luminaire (Hardwire)
    - American Electric Lighting ParkPak LED luminaire (approximately 50W)
  - First Light Technologies BFL-S Solar Street Light Series Luminaire c/w 6.1m luminaire pole and 1.2m arm (solar) and Type C concrete Base
  - MoTI Style Service Panel on a Type 2 pole and Type C concrete Base
  - Conduit infrastructure for hardwire system:
    - MoTI Style Type 10 round plastic junction boxes located at service panels and road crossings
    - 53mm RPVC underground conduit with #4 or #6 Aluminum RW90 conductors
    - 32mm RMC conduit and small metal junction boxes for underpass luminaires
  - Acuity brands ROAM lighting control system (managed by Acuity with cloud-based storage)
- Cost estimates provided are to provide the CRD with an order of magnitude cost estimation for comparison and budgeting purposes only. Additional design work and investigations are needed to refine cost estimates.

Trail User Comfort / Experience

The relative improvement in trail user comfort and experience as a result of the trail widening or reconfiguration

The Federal Highways Administration's (FHWA) maintains the Shared-Use Path Level of Service (LOS) Calculator as a tool to analyze the quality of service provided by shared-use paths. The LOS Calculator has been used to understand the trail user comfort and overall experience provided for each of the trail widening / separating options. The LOS is a quantitative measure used to describe operational conditions within a transportation system. LOS is graded on six levels from A to F to represent best to worst conditions, respectively. LOS grades are assigned as follows:

- A = 4.0+
- B = 3.5 – 4.0
- C = 3.0 – 3.5
- D = 2.5 – 3.0
- E = 2.0 – 2.5
- F = < 2.0

The LOS Calculator focuses on maintaining an optimum speed for cyclists and the freedom to maneuver as measured by the number of anticipated meetings of oncoming trail users, active and delayed passes, and the perceived ability to pass as key criteria in the methodology. The calculator does not account for safety or factor in travel time or traffic interruptions related to trail or roadway intersections. It is largely a measure of pathway width and trail user volumes. LOS declines with increases in trail user volumes and decreases in trail width. The number values used as the basis for assigning LOS letter grades are calculated from measures of the trail characteristics referenced above.

Results of FHWA Level of Service Calculator

	Option 1		**Option 2**		**Option 3**	
	LOS Score	LOS Grade	LOS Score	LOS Grade	LOS Score	LOS Grade
Section A	3.65	B	3.79	B	3.79	B
Section B	3.94	B	3.88	B	3.88	B
Section C	3.75	B	3.85	B	3.85	B

To calculate the results presented, the peak hourly user count as shown in **Figure 2** was projected to 20-year trail user volumes for each of the three sections. These numbers were inputted into the Shared-Use Path LOS Calculator tool which is programmed into a Microsoft Excel spreadsheet available from the U.S. Department of Transportation. The calculator tool requires four inputs: trail width, presence of a centreline, one-way trail user volume, and mode split for up to five user types (adult bicyclists, pedestrians, runners, in-line skaters, and child bicyclists).

The trail user volumes provided are for two-way travel. To determine one-way user volumes, an assumption of a 50/50 split between directions was used. The counts provided do not differentiate between adult and child cyclists or between pedestrians and runners, and in-line skaters were not provided. As such, for option 1 the mode split was determined for only adult bicyclists and pedestrians with the other three modes being assigned a 0% rating.

For options 2 and 3, only the bike path portion of the trail was calculated for LOS. This calculation used only the bike path width of the trail (4.0m), the cycling counts projected to 2040, and assumed 100% mode split of adult bicyclists as pedestrians would be on the pedestrian portion of the trail.

All three Options for all three trail sections returned LOS Grades of B. The FHWA defines a trail with a LOS B as “good”. These trails have “good bicycling conditions, and retains significant room to absorb more users, while maintaining an ability to provide a high-quality user experience.”

Safety / User Conflicts

The extent to which the trail widening or reconfiguration provides for a safe trail facility and addresses user conflicts

	Option 1	Option 2	Option 3
Section A	• Shared use pathway does not separate different users • Potential for user conflict between faster moving bicycles and slower moving pedestrians, as well as between fast and slow cyclists • 5.0m total pathway width is the narrowest trail option • Continuous facility treatment with no narrowed section, limiting conflict and safety issues created at trail narrowing / transition locations	• Trail configuration provides separation of different users • Pedestrians and cyclists not physically separated, with moderate potential for conflict • 6.5m total pathway width is the largest continuous paved surface • Large groups may infringe on adjacent mode's trail as no barrier exists • Trail configuration will be restricted and narrowed to a shared use trail at two locations. Changes in trail configuration may lead to user conflict.	• Trail configuration provides separation of different users • Physical separation between cyclists and pedestrians, with the least potential for conflict • Trail configuration will be restricted and narrowed to a shared use trail at two locations. Changes in trail configuration may lead to user conflict.
Section B	• Shared use pathway does not separate different users • Potential for user conflict between faster moving bicycles and slower moving pedestrians • 5.0m total pathway width is the narrowest trail option • Continuous facility treatment, limiting conflict and safety issues created at trail narrowing / transition locations	• Trail configuration provides separation of different users • Pedestrians and cyclists not physically separated, with moderate potential for conflict • 6.5m total pathway width is the largest continuous paved surface • Large groups may infringe on adjacent mode's trail • Trail configuration will be restricted and narrowed to a shared use trail at 1 location. Changes in trail configuration may lead to user conflict.	• Trail configuration provides separation of different users • Physical separation between cyclists and pedestrians, with the least potential for conflict • Trail configuration will be restricted and narrowed to a shared use trail at 2 locations. Changes in trail configuration may lead to user conflict.

Section C	• Shared use pathway does not separate different users • Potential for user conflict between faster moving bicycles and slower moving pedestrians • 5.0m total pathway width is the narrowest trail option • Continuous facility treatment, limiting conflict and safety issues created at trail narrowing / transition locations	• Trail configuration provides separation of different users • Pedestrians and cyclists not physically separated, with moderate potential for conflict • 6.5m total pathway width is the largest continuous paved surface • Large groups may infringe on adjacent mode's trail • Trail configuration will be restricted and narrowed to a shared use trail at 3 locations. Changes in trail configuration may lead to user conflict.	• Trail configuration provides separation of different users • Physical separation between cyclists and pedestrians, with the least potential for conflict • Trail configuration will be restricted and narrowed to a shared use trail at 3 locations. Changes in trail configuration may lead to user conflict.

Environmental Impact

The extent to which the trail widening or reconfiguration impacts environmental features such as trees and natural spaces

	Option 1	Option 2	Option 3
Section A	• 25-50 trees impacted • Minimal impact on natural spaces • Impact to tree roots	• 50-75 trees impacted • Moderate impact on natural spaces • Impact to tree roots • Partial removal of tree promenade north of Ardersier Road	• 100+ trees impacted • Significant impact on natural spaces • Impact to tree roots • Complete removal of tree promenade north of Ardersier Road • Possible fill required between Cecelia Road and Burnside Road
Section B	• <10 trees impacted • Minimal impact on natural spaces • Impact to tree roots	• 10-20 trees impacted • Minimal impact on natural spaces • Impact to tree roots • Possible fill required	• 20-30 trees impacted • Minimal impact on natural spaces • Impact to tree roots • Possible fill required
Section C	• 25-50 trees impacted • Moderate impact on natural spaces • Fill may be required • Impact to tree roots	• 50-75 trees impacted • Moderate impact on natural spaces • Fill required • Impact to tree roots • Rock work may be required	• 100+ trees impacted • Significant impact on natural spaces • Fill required • Impact to tree roots • Rock work required

This in not an exhaustive list of all possible environmental impacts, only those easily identified and cross-compared between options. Other possible environmental impacts could include drainage / watercourses and animal habitats, as well as positive impacts such as invasive plant management and GHG reduction.

Facility Quality

The overall quality of design achieved by the trail widening or reconfiguration option, including limiting "pinch points" and providing strong transitions between trail sections and changes in facility types.

	Option 1	Option 2	Option 3
Section A	• No facility transitions or pinch points • 100% of corridor achieves desired cross-section	• Facility transitions 2 times from separated pathways to shared-use pathways	• Facility transitions 2 times from separated pathways to shared-use pathways • Loss of landscape buffer at one pinch point • Landscape buffer space may be used to provide trail enhancements such as landscaping treatments, rest areas, signage, and/or public art
Section B	• No facility transitions or pinch points • 100% of corridor achieves desired cross-section	• Facility transitions once from separated pathways to shared-use pathways	• Facility transitions 2 times from separated pathways to shared-use pathways • Loss of landscape buffer at one pinch point • Landscape buffer space may be used to provide trail enhancements such as landscaping treatments, rest areas, signage, and/or public art
Section C	• No facility transitions or pinch points • 100% of corridor achieves desired cross-section	• Facility transitions 3 times from separated pathways to shared-use pathways	• Facility transitions 3 times from separated pathways to shared-use pathways • Loss of landscape buffer at one pinch point • Landscape buffer space may be used to provide trail enhancements such as landscaping treatments, rest areas, signage, and/or public art

Constructability

The presence / requirement for slopes, drainage, rock blasting, property encumbrances, constrained existing infrastructure and other challenges that impact the ease of construction.

	Option 1	Option 2	Option 3
Section A	• Minimal slope impacts • No impacts to existing licensed and unlicensed property encroachments • Full width facility can be carried for entire section with exception of Switch Bridge • Minimal concern of tie-ins to existing facilities / roadway intersections • No challenges with tie-ins to trail beyond study area	• Moderate slope and rock impacts between Gorge Road and Tolmie Lane • Facility to be reduced to 5.0m multi-use pathway under Burnside Road and 4.0m multi-use pathway over Switch Bridge • Potential tree and property encroachment impacts at Red Lion Hotel • Potential drainage impacts under Boleskine Road • Moderate concern of tie-ins to existing facilities (Cecelia Ravine Park trail, etc.), roadway intersections and trail sections beyond study area	• Moderate to significant slope and rock impacts between Selkirk Trestle and Tolmie Lane • Facility to reduce to 5.0m multi-use pathway under Burnside Road, reduced width separate facility under Boleskine Road, and 4.0m multi-use pathway over Switch Bridge • Potential tree and property encroachment impacts at Red Lion Hotel • Moderate concern of tie-ins to existing facilities (Cecelia Ravine Park trail, etc.), roadway intersections and trail sections beyond study area
Section B	• Minimal slope impacts along Highway 1 between Harriet Road and Tillicum Road • Minimal slope impacts on approach to Interurban Bridge • Full width facility can be carried for entire section with exception of Interurban Bridge • Minimal concern of tie-ins to existing facilities, roadway intersections and trail sections beyond study area	• Moderate to significant slope impacts along Highway 1 between Harriet Road and Tillicum Road. Potential retaining structure required for portion. • Moderate slope impacts on approach to Interurban Bridge • Full width facility can be carried for entire section with exception of Interurban Bridge • Minimal concern of tie-ins to existing facilities, roadway intersections	• Significant slope impacts along BC Hwy 1 from Harriet Road to Tillicum Road. Retaining wall required for significant portion. • Moderate to significant slope impacts on approach to Interurban Bridge • Full width facility can be carried for entire section with exception of Interurban Bridge and McKenzie overpass • Minimal concern of tie-ins to existing facilities,

		and trail sections beyond study area	roadway intersections and trail sections beyond study area
Section C	• Minimal or no rock impact under Carey Road, Highway 17, and Vernon Avenue • Minimal slope impacts along Swan Lake frontage • Full width facility can be carried for entire section with exception of Brett and Swan Lake Trestles • Minimal concern of tie-ins to existing facilities, roadway intersections and trail sections beyond study area	• Minimal to moderate rock impacts under Carey Road, Highway 17, and Vernon Avenue • Moderate slope impacts along Swan Lake frontage • Minimal slope or rock impacts between Swan Lake Trestle and McKenzie Avenue • Full width facility can be carried for entire section with exception of Vernon Avenue underpass, Brett and Swan Lake Trestles • Minimal concern of tie-ins to existing facilities, roadway intersections and trail sections beyond study area	• Moderate to significant rock impacts to rock cuts under Carey Road, Highway 17, and Vernon Avenue • Moderate to significant slope impacts along Swan Lake frontage • Moderate slope or rock impacts between Swan Lake Trestle and McKenzie Avenue • Full width facility can be carried for entire with exception of Carey Road, Highway 17, and Vernon Avenue underpasses and Brett and Swan Lake Trestles • Minimal concern of tie-ins to existing facilities, roadway intersections and trail sections beyond study area

Maintenance / Operations

The level of maintenance and operational effort required for by the trail widening or reconfiguration

	Option 1	Option 2	Option 3
Asphalt Surface	• Least paved surface of the three options, resulting in less maintenance to repair asphalt surface (cracking, disrepair)	• Increased paved surface over Option 1, requiring greater maintenance	• Increased paved surface to be maintained over Option 1, plus physical separation creating more challenging repairs over Option 2
Pavement Markings	• Approximately half the number of pavement markings that require upkeep as compared to Options 2 and 3, where only the shared use stencil is needed	• Approximately 2 times the number of pavement markings that require upkeep over time as compared to Option 1, including bicycle / pedestrian stencils on both trail facilities	
Grass / Landscape	• Basic grass mowing and landscape maintenance at the trail edge		• Added requirement for mowing and landscape maintenance due to centre boulevard • Lights in centre median add complexity to mowing requirement by creating further obstacle to mow around
Sweeping	• Least effort required to clear leaves and debris due to narrowest trail surface and lack of separation	• Clearing leaves and debris requires moderately more effort than Option 1 due to widened facility	• Level of effort involved in sweeping leaves and debris would be approximately double that of the other options due to physical trail separation
Snow Clearing	• Least effort involved in snow clearing due to narrow, unseparated trail surface	• Snow clearing requires moderately more effort than Option 1 due to widened facility	• Greatest effort required for snow clearing due to physical trail separation
Lighting	• Lampposts require corrective and preventative maintenance (cleaning, graffiti removal)	• Slightly increased number of lampposts on wider pathway than Option 1 that may require future maintenance (cleaning posts, graffiti)	• Number of lampposts is less than Option 2 with use of centre median lights, but with increased luminaires due to double-headed lights

	• Use of LED luminaires require minimal maintenance (may require replacement in 10-20 years) • Lighting maintenance would be a new operation task for CRD	• Use of LED luminaires require minimal maintenance (may require replacement in 10-20 years) • Lighting maintenance would be a new operation task for CRD	• Use of LED luminaires require minimal maintenance (may require replacement in 10-20 years) • Lighting maintenance would be a new operation task for CRD