

**Environmental Impact Assessment
Pursuant to Bylaw 7188
for
Valley Line West Light Rail Transit (LRT)
Activities Near MacKinnon Ravine**

Final Report

Prepared for:

**LRT Delivery
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1.0 INTRODUCTION

The City of Edmonton is currently developing the Valley Line Light Rail Transit (LRT), an urban style LRT that will connect Mill Woods Town Center to the Lewis Farms Area. The project has been divided into two stages: Valley Line-Southeast (VL-SE) extending from Mill Woods to downtown (102 Street), and Valley Line -West (VL-W) extending from downtown to Lewis Estates Transit Centre. VL-SE is now under construction. In 2017, City of Edmonton LRT Delivery retained a consortium of firms known as ConnectEd Transit Partnership (CTP) to complete preliminary design (which had been taken to 30% in 2013) and prepare for procurement. Spencer Environmental was retained by CTP to act as environmental lead. With the VL-W preliminary design nearing completion, the project is now in the procurement preparation phase. The preliminary design will serve as a Reference Design that will be provided to the successful bidder (Proponent) to advance to detailed design. The intent is to have the VL-W procurement-ready by autumn 2018 in anticipation of availability of higher order government funding that could potentially facilitate construction initiation in 2019/2020.

The VL-W alignment is wholly situated in highly urbanized areas of Edmonton (Figure 1, Appendix A); however, in three locations the alignment also runs through or adjacent to more natural environments: MacKinnon Ravine, Groat Ravine and Muskakosi Natural Area. This report focuses on the project components near MacKinnon Ravine. Much of the VL-W alignment follows Stony Plain Road (SPR), including where that road passes adjacent to MacKinnon Ravine. The addition of LRT requires widening of SPR and some minor work at the top of MacKinnon Ravine north slope. MacKinnon Ravine is included in the North Saskatchewan River Valley Area Redevelopment Plan (NSRVARP) (Bylaw 7188) and the minor works at the ravine margin triggers the need for an environmental review pursuant to that bylaw. Discussions with City Planning ecological planners determined that the appropriate level of review is an Environmental Impact Assessment (EIA) that must be approved by City Council.

Further east on SPR, the alignment crosses Groat Ravine, which is also within the NSRV ARP. A separate EIA has been prepared for that crossing. Both project intersections with Bylaw 7188 lands must also be addressed by a Site Location Study (SLS). One SLS, covering both sites, has been prepared. Finally, the west terminus of VL-W, at Lewis Farms, will be situated adjacent to the Muskakosi Natural Area and within a special study area. The potential for the VL-W terminus infrastructure to affect the Natural Area required an assessment to satisfy Bylaw C531 and to support amendments to Potter Greens Neighbourhood Structure Plan (NSP). That assessment was also prepared as a separate document.

This report comprises the Bylaw 7188 EIA prepared for the VL-W minor works at/near MacKinnon Ravine. The EIA format and content follows a project-specific Terms of Reference developed through scoping discussions held between the environmental consultant, LRT Delivery and a City ecological planner, informed by a brief description of project activities, preliminary engineering drawings, the project location and anticipated project activities. Discussions determined that of the natural resources typically covered, groundwater and fish were not relevant. This EIA addresses all components of the VL-W project having potential to affect lands on the margin of or within MacKinnon Ravine. It does not address activities further inside the SPR right-

of-way (ROW). Project components within the bounds of existing SPR are only referred to as needed for context.

2.0 THE PROPERTY

2.1 *Project Area Location, Disposition, Zoning*

The project components addressed by this EIA are located on SPR adjacent to MacKinnon Ravine (Figure 2, Appendix A). Figure 2 illustrates the proposed future sidewalk location, the temporary work limit within the ravine, the relationship of project components to the existing road ROW and the Bylaw 7188 boundary. At this location, the bylaw boundary was generously drawn in the 1980s, using available resources and includes much of SPR. For this EIA, the focus is on the bylaw lands within and on the margin of MacKinnon Ravine, lands having a vegetated character. LRT works further within the bounds of the existing SPR are not assessed.

All lands required for the project are City-owned (Perry, *pers. comm.*) and are either within the SPR ROW or within the ravine, known as MacKinnon Ravine Park. The Park is zoned for recreation (Figure 3, Appendix A). In this area, lands adjacent to the park, are zoned for residential land use, direct control development agreement, shopping centres or neighbourhood convenience commercial (Figure 3). With respect to zoning, the SPR bus turnaround is included within the park.

2.2 *Historic Conditions*

Historical aerial photograph review was limited to the photograph series included in AECOM (2017) that spans the period 1920 to 2014 (Appendix B). In 1920 the majority of the ravine west of its intersection with the future 142 Street remained naturally forested and extended west and south uninterrupted slightly beyond 149 Street. Some residential development was present along the southwest margin of the ravine and in the Grovenor neighborhood to the south. Informal trails crossed the ravine and there was an apparent bridge across the ravine west of 142 Street. By 1949 the surrounding tablelands were fully developed including SPR, 149 Street, 142 Street and Summit Drive. The bus turnaround along SPR at the ravine margin was present; a narrow ravine crossing joining the north and south extents of 148 Street was visible. Some secluded residential properties were developed along the southwest margin of the ravine. Several more trails were evident in the ravine. A remnant of the ravine remained present to the southwest of the 149 Street/SPR intersection. Between 1952 and 1962, few new coarse scale changes were visible, however, ravine margin vegetation adjacent SPR, 149 Street and Summit Drive was incrementally cleared. In 1967, a relatively wide section of the ravine bottom was cleared from 142 Street west to 148 Street, with the clearing width reduced to a narrow strip approximately halfway. In 1975 more clearing was evident in the ravine bottom extending along the length of the ravine to the northwest and individual houses along the southwest margin of the ravine were no longer present. In 1979 the ravine bottom clearing remained present west of 142 Street, and 149 Street/SPR intersection was expanded including along the top of MacKinnon Ravine. In 1987, more extensive clearing was present in the ravine bottom and a strip of woody vegetation was cleared along the top of MacKinnon Ravine from the corner of 149 Street and SPR to the bus turnaround. By 1992, the formal recreational trail present today was evident in the ravine bottom with adjacent manicured areas; the final remnant of ravine west of 149 St was filled; and lands downslope and west of the bus turnaround were cleared. In 2000, residential development east of the bus turnaround at the top of the ravine was first evident. The street was fully built out by 2005.

2.3 Summary of Environmental Regulatory Approvals

All typically relevant federal, provincial and municipal environmental legislation, bylaws and policies were reviewed for their application to this project (Appendix C). Because of the absence of watercourses and wetlands in the project area, construction of this project will not require any federal or provincial approvals. As is often the case, several provincial and federal statutes prohibiting harm to select resources are relevant to project construction; however, Bylaw 7188 is the only trigger for an environmental assessment. Table 2.1 presents a summary of environmental legislation and bylaws identified as applicable to this project. Additional legislation/ bylaw detail is provided in Appendix C.

Several other municipal permits, such as OSCAM, may be required, depending on Proponent activity.

Table 2.1. Summary of applicable legislation and bylaws (details in Appendix C)

Legislation or Policy	Regulatory Agency	Authorization/ Approval/ Permit Required	Approval Timeline or Potential Schedule Impact
<u>Bylaws Requiring Approvals - Municipal</u>			
<i>North Saskatchewan River Valley Area Redevelopment Plan (Bylaw 7188)</i>	City Planning	EIA and SLS required. City Council must approve both	Committee/Council date for approval of the EIA planned for October/ November 2018.
<i>Corporate Tree Management Policy (C456)</i>	City Forestry	VL-W approach developed by City	Compliance built into Project Agreement.
<i>City of Edmonton Drainage (Bylaw 18100)</i>	EPCOR	Application for a permit and payment of fees.	Proponent responsibility.
<i>City of Edmonton Parkland (Bylaw 2202)</i>	<u>City of Edmonton</u>	<u>Permit required</u>	Proponent responsibility.
<u>Acts Influencing Construction Methods - Provincial</u>			
<i>Wildlife Act</i>	Alberta Environment and Parks	No permit required; however, the act prohibits disturbing prescribed breeding wildlife such as northern flying squirrels or owls	Proponent responsibility. Vegetation clearing between 15 February and 20 August may result in nest sweep findings that delay clearing.
<u>Acts Influencing Construction Methods - Federal</u>			
<i>Fisheries Act</i>	Fisheries and Oceans Canada (DFO)	No approval required; however, the act prohibits release of deleterious substances to fish habitat	Not applicable.
<i>Migratory Birds Convention Act</i>	Environment and Climate Change Canada	No permit required; however, violation of the <i>MBCA</i> may result in penalties	Proponent responsibility. Vegetation clearing between 15 February and 20 August may result in nest sweep findings that delay clearing.
<i>Species at Risk Act</i>	Environment and Climate Change Canada	No permits required; however, violation of the <i>SARA</i> may result in penalties	Proponent responsibility. No Schedule 1 species expected on site. No implications anticipated.

2.4 Environmental Site Assessments

As part of preliminary design, AECOM (2017) undertook a Limited Phase I Environmental Site Assessment (ESA) of the entire alignment to identify potential environmental liabilities. As the Limited Phase 1 ESA covers the entire project and is a significant volume, the report is not appended here but is available upon request. The ESA search area spanned one city block on either side of the alignment to account for on and off-site impacts. The study flagged numerous areas of concern including four locations in the vicinity of MacKinnon Ravine: two locations west of 149 Street and two on the northside of SPR across from MacKinnon Ravine and the bus turnaround. The two on SPR are former gas station sites and are closer to the ravine, and therefore have the greater potential to have affected the project area. Since groundwater flows south towards the ravine, there is potential that contamination could have migrated southward into the ravine (Husak *pers.comm.*), although O'Connor Associates (*in* AECOM 2017) drilled three test holes in the bus turnaround area in 2006 and did not find any evidence of contamination.

A VL-W Phase 2 ESA now underway is investigating all locations of potential concern identified in the Phase 1 ESA, including the four near MacKinnon Ravine. Preliminary results from two deep test holes drilled in the center of SPR between 147 and 148 streets indicated some hydrocarbon contamination at both holes, at depths of about 4 m. The City will ensure that additional testing, including closer to MacKinnon Ravine, is undertaken and all encountered contaminated soils removed and disposed of appropriately. The Phase 2 ESA also includes shallow testing at regular intervals along the entire alignment, including in the vicinity of MacKinnon Ravine.

3.0 ENVIRONMENTAL CONTEXT

3.1 Overview of Study Area and Adjacent Lands

The EIA core study area comprised the northern margin of the western terminus of MacKinnon Ravine, between 147 Street and 149 Street - the narrow strip of land with potential to be directly affected by the proposed development, as shown in Figure 2. The expanded study area, used for some resources such as wildlife, and for this overview, included the adjacent ravine where resources may be indirectly affected by the project (Figure 2). At the western terminus, MacKinnon Ravine is approximately 50 to 60 m wide and steeply sloped. Ravine margins and upper slopes have been incrementally disturbed. The ravine terminates unnaturally at 149 Street, and roads directly border the ravine to the north and south. Upper ravine slopes support a combination of manicured vegetation (grass and planted trees), unmanicured grasses and exotic shrubs. Mid and lower slopes and the ravine bottom are well-vegetated and relatively undisturbed with predominantly native trees and shrubs, but also some exotic species. Overall, the dominant ravine vegetation at this location is a mature, mixedwood, coniferous-leading forest. Several trails cut through that community. The entire ravine is a well-used city park, and in the expanded study area there is a formal shared-use path (SUP) located on the south side of the ravine leading into the ravine bottom, and, a pedestrian trestle bridge cuts across the ravine connecting to 148 Street to the north and south.

Travelling further east, MacKinnon Ravine becomes an increasingly wider, steep-walled, deeply incised tributary ravine. Despite a long history of development at various scales, most disturbances focused on the ravine bottom, most notably a protracted, failed freeway project, and installation of several buried stormwater lines in the 1970s such that most of the ravine slopes support forests of varying ages. In the 1980s, the ravine was formally recognized by the City as a park and in the 1990s a trail network was installed. Apart from trails, park development is limited. While the development history, the open areas and the presence of a well-used trail network does adversely affect the ravine's ecological function, the entire ravine remains a recognized natural area, a recognized natural linkage in Edmonton's ecological network that is structurally connected to the NSRV and an integral part of the NSRV system.

3.2 Environmental Sensitivities

3.2.1 Original (2016) Mapping

Figure 4 (Appendix A) shows the results of the City of Edmonton environmental sensitivities analysis and classification mapping (Solstice Canada 2016b) scaled to the expanded study area. The original mapping classifies the lower ravine slopes and ravine bottom as having extremely high value to the City with smaller pockets of very high value on some upper slopes such as near the pedestrian bridge and east of the bus turnaround. Three small pockets of high value areas are present and the top margin of the ravine is classified as moderate value. The bus turnaround is shown mainly as of moderate value. In that study, extremely high, very high and high values lands are considered suitable for protection or conservation. Moderate value lands are considered to be suitable for conservation or restoration /stewardship.

3.2.2 Refined (2018) Mapping

Insufficient data were collected to verify the accuracy of the ESM within the ravine proper. Data gathered for the north ravine margin generally bear out the City's mapping. On that basis, there was no need for additional sensitivity analysis and the ESM maps were not refined.

3.3 Surface Water

There is no natural watercourse in the core or expanded study area. All SPR surface runoff is directed to catch basins and storm sewers and ultimately to the storm trunk in MacKinnon Ravine and finally to an outfall into the North Saskatchewan River (NSR). Within the ravine, surface runoff flows downslope following contours and at least some flows are expected to be absorbed by natural vegetation. No obvious surface erosion issues were noticed in the core study area during our site visits.

The core study area is located outside of the NSR 100-year floodplain (AEP 2017).

3.4 Geomorphology and Soils

3.4.1 Methods

Site-specific available geomorphology and soils information was limited to information provided by Thurber (2017). That report is not appended here as the location of SPR near MacKinnon Ravine is only one short segment of the 14 km covered. The report is available upon request. In the summer of 2017, Thurber Engineering Ltd. (Thurber) conducted an overall appraisal of the geotechnical conditions along the alignment of the VLW, including the northern terminus of McKinnon Ravine near Stony Plain Road. The geotechnical assessment was based on the findings of a review of available information and a site reconnaissance of the proposed alignment. Site reconnaissance involved visual examination of surface conditions along the proposed route, including the slopes at MacKinnon Ravine. The reconnaissance assisted with the identification of potential geotechnical risks and challenges that should be considered during preliminary design and beyond. No test holes were advanced as part of this study.

In 2018, Thurber also reviewed the proposed cross-sections of SPR and the VL-W trackway between 147 and 149 Streets and considered the implications of the identified need for a short retaining wall along MacKinnon Ravine and the decommissioning and potential use of the bus turnaround at the crest of the north slope of McKinnon Ravine near 147 Street as a temporary laydown area during construction. The full memo (Thurber 2018) is found in Appendix D and is further referred to in section 5.2.2.

3.4.2 Description

The following description was compiled by referring to Thurber (2017). Currently MacKinnon Ravine terminates southeast of the intersection of SPR and 149 Street; however, as noted above in Section 2.2 Historic Conditions, the ravine used to continue

further to the northwest. Some infilling has likely occurred in that area. In the vicinity of the LRT alignment, the ravine is approximately 5 m deep, and the inclination of ravine slopes ranges between 2H:1V and 3H:1V.

The slopes of MacKinnon Ravine are generally covered with a veneer of colluvium material. Colluvium is deposited by gravity because of slumping and erosion of overburden units at higher stratigraphic positions. It is composed of a random mixture of clay, silt, sand and possibly blocks of bedrock. Colluvium material tends to be loose and can be prone to sliding. The slopes and bottom of the ravine are vegetated with mature trees. There are currently no visible signs of active slope movement/instability in this area. However, previously, Thurber (1990a) investigated a slope failure on the north bank of MacKinnon Ravine at the bus turnaround near 147 Street. The slide appeared to be shallow within the upper, high plastic glacio-lacustrine clay. The failure mass was excavated, and the slope was reconstructed to a flatter inclination of 3H:1V. Granular drains were also installed at the slope toe. Considering this history, it is possible that portions of the north ravine slope along the south side of SPR may be only marginally stable (Thurber 2018). In addition, uncontrolled fills of varying thickness could be present along the stretch of the alignment between 147 Street and 151 Street. The quality of fills is unknown.

3.5 Vegetation

3.5.1 Methods

Vegetation in the core study area was characterized by undertaking the following tasks:

- Desktop preliminary plant community delineations using high resolution remote imagery.
- A rare plant and plant community survey by a professional plant ecologist, on 29 August 2017. All vegetated lands in the study area were surveyed to ground truth plant community delineations, characterize community composition, and search for rare or underrepresented plant species occurrences. Each community was surveyed via meandering transects. All species were documented, and their relative abundances ranked as dominant, abundant, frequent, occasional, or rare (locally uncommon). All plant communities were surveyed at an intensity that was deemed sufficient to capture the diversity of plants within the site and to encounter any rare species present.
- Representative sites of each community were photographed.
- A noxious weed survey was conducted concurrent with the plant community survey, covering all plant communities within the project area. In each community, any noxious or prohibited noxious species observed were recorded and their relative abundance ranked as dominant, abundant, frequent, occasional or rare (locally uncommon).
- Plant species that could not be identified in the field were collected and identified with the aid of a dissecting microscope and botanical manuals. Species scientific and common names follow the most recent data from ACIMS (AEP 2018). Common names are used throughout the text; however, complete plant community data, including species scientific names, are provided in Appendix E.

- Mapped plant communities were classified following the *Urban Ecological Field Guide for the City of Edmonton, Alberta, Canada* (City of Edmonton 2015). Manicured lands present were classified as such.
- A meandering survey of the adjacent ravine bottom and lower slope vegetation, on 29 August 2017, to qualitatively describe that vegetation.
- A search of the Alberta Conservation Information Management System (ACIMS) (AEP 2018) for all records of special status plant species within project area. Site accessed on 17 January 2018. The area searched consisted of legal section 02-53-25-W4M.
- Site reconnaissance on 09 August 2018 to photograph and confirm areas to be cleared.

3.5.2 Description

In general, most of the top-of-slope and upper slope in the core study area has been previously disturbed and reclaimed with shrubs or grasses. The following individual plant communities were mapped in the study area (Figure 5, Appendix A):

- Non-Forested – Caragana, Steep Slopes (NF.1)
- Non-Forested-Smooth Brome, Steep Slopes (NF.6)
- Manicured (M)

Non-Forested Community – Caragana, Steep Slopes (NF.1)

This Edmonton community type is characterized in City of Edmonton (2015) as having dense thickets of common caragana and exotic species, situated on steep, mid- to upper slopes in the North Saskatchewan River Valley. These communities are noted as generally extremely species-poor. Relatively few species can grow beneath the dense cover of common caragana.

In the study area, the non-forested caragana community was documented on the north side of Mackinnon Ravine, along the southeast edge of the bus turnaround and extending northeast to SPR and continuing east along SPR (Plate 1). Common caragana dominated with frequent Manitoba maple and occasional aspen. The understorey comprised grasses including abundant smooth brome and abundant quack grass (both exotic) and frequent Kentucky bluegrass.



Plate 1. View to northeast of plant community adjacent the bus turnaround. Non-Forested Community – Caragana, Steep Slopes (NF.1).

Non-Forested-Smooth-Brome, Steep Slopes (NF.6)

City of Edmonton (2015) characterized this community type as having open, grass-dominated areas generally situated on mid- to upper very steep slopes with dry and rapidly drained soils.

This plant community was present along the steep upper slope of MacKinnon Ravine extending from 149 Street east to the bus turnaround, below the narrow manicured area at the top of slope (Plate 2). Some localities supported inclusions of sapling and young *Populus sp.* stands invading the brome community from downslope (Plate 3). Kentucky bluegrass dominated along with smooth brome and quackgrass (both exotic) with abundant crested wheatgrass (exotic). Frequent regenerating white spruce were observed on the outside margin of this community as it transitioned to the adjacent forested area (outside of core study area) (Plate 4).



Plate 2. Distant view to southeast of plant community on far steep slope below bus turnaround. Non-Forested – Smooth-Brome, Steep Slopes (NF.6).



Plate 3. View to east along south side of SPR with *Populus* sp. Inclusions. Non-Forested – Smooth-Brome, Steep Slopes (NF.6).



Plate 4. View to east along south side of SPR with white spruce sapling regeneration. Non-Forested – Smooth-Brome, Steep Slopes (NF.6).

Manicured (M)

Manicured areas are those subject to regular mowing or maintenance and or supporting landscaping trees. They are characterized by grassy areas and planted trees, as well as areas where the original cover has been maintained but severely thinned. Manicured areas were present in the roadway ROW in a very narrow strip adjacent SPR and the sidewalk along the top-of-slope of MacKinnon Ravine (Plates 5 & 6). This area was dominated by maintained Kentucky bluegrass, smooth brome and crested wheatgrass with occasional Manitoba maple and jack pine.



**Plate 5. View to west of narrow mowed strip adjacent SPR sidewalk.
Manicured (M).**



**Plate 6. View to north of planted trees adjacent 149 Street sidewalk.
Manicured (M).**

Special Status Species

In the City of Edmonton, rare plant species are considered those species having an ACIMS conservation rank of S1, S2 or S3. S1 species are known from five or fewer locations in the province. S2 species are known from 6-20 occurrences, and S3 species are known from 21-100 occurrences in the province. A search of ACIMS records for the proposed project area conducted on 17 January 2018 returned no records of special status vascular plant species in the immediate project area. No special status species were observed in our field surveys at Mackinnon Ravine.

Weeds

The Alberta *Weed Control Act* defines two categories of weeds: noxious and prohibited noxious. Noxious weeds are generally those that are currently widespread in the province and are considered difficult to eradicate. Provincial legislation requires that these species be *controlled*. Prohibited noxious weeds are those that are currently uncommon or absent in the province but have been identified as noxious due to their potential to invade and

damage natural and cultivated systems. Alberta law requires that prohibited noxious weeds *be destroyed* where they are found.

Prohibited Noxious Species

No prohibited noxious species were observed in the study area.

Noxious Species

Noxious weeds found in the study area included creeping thistle, common toadflax, perennial sow-thistle and scentless chamomile. All these species are common on disturbed lands in the Edmonton area. Most of these noxious weed species were widespread in the study area but occurred in relatively low abundances (i.e., rare to occasional observations) with the exception of creeping thistle, which was found to be frequent in the manicured (M) and non-forested smooth brome, steep slopes (NF.6) communities and abundant in the non-forested caragana, steep slopes (NF.1).

3.6 Wildlife

3.6.1 Methods

Wildlife resources in the study area were characterized by undertaking the following tasks:

- Surveys were limited to one breeding bird survey in the expanded study area, conducted on 29 June 2017, at 0500 hours, by a professional biologist having appropriate skills. The survey consisted of one point-count that encompassed all vegetation communities present in a 100 m radius centred on the west end of the ravine pedestrian bridge. The survey recorded all birds seen or heard in vegetated areas, within an 8-minute period. Estimated bird locations within the survey area were mapped.
- All incidental wildlife and wildlife sign observations during site visits were recorded.
- Available habitat type, condition and quality was assessed through field observations and examination of study area vegetation data and maps.
- A search of FWMIS for all wildlife records for lands within a one km radius of the study area centre. FWMIS was accessed on 30 July 2018.
- No visual survey was conducted for wildlife trees owing to the character of the habitat in the core study area.

3.6.2 Description

Available Habitat/Connectivity

Wildlife habitats available in the core study area are limited to a narrow strip of vegetation on the upper ravine slopes adjacent to 149 Street and SPR. The area is considered extremely poor habitat for most wildlife species due to lack of complex habitat for food and shelter, steep slopes, the adjacent fully developed urban area with loud traffic noise, high volume traffic roadways, and a lack of ecological connectivity to habitat patches or corridors beyond MacKinnon Ravine. Better habitat is available in the expanded study area (the ravine proper), beyond the temporary work area.

For most if not all wildlife species, the core study area is not an important wildlife movement corridor; however, the expanded study area is part of a more important wildlife corridor. MacKinnon Ravine as a whole is a key urban wildlife corridor with high connectivity to the NSR, suitable for use by a wide variety of species, including transient large mammals. However, the west ravine terminus represents a corridor dead end for all but the most urban tolerant wildlife species (such as coyotes and some songbirds). As this project does not encroach into that key corridor, wildlife movement and ecological connectivity will not be discussed further in this EIA.

Documented Wildlife

The EIA’s breeding bird survey provides a snapshot of passerine use of the area. The survey recorded 4 species, all having a status of Secure and all commonly-occurring in Edmonton (Table 3.1). Most individuals were singing territorially and may have been nesting in the area. Species abundance within the surveyed area ranged from 1 to 2 individuals. Individual birds were widespread throughout the point count survey area within the ravine proper and beyond to the southeast into the adjacent residential area; no birds were observed in the core study area along the southern edge of SPR, underscoring the poor quality habitat in that area. The one additional record from FWMIS, western tanager, is a Sensitive species and as this species is not known to breed in the Edmonton area, likely represents an individual migrating through the area.

Table 3.1. Results of 29 June 2017 Breeding Bird Survey, Incidental Mammal Observations, and FWMIS Search Results¹

Species ²	Scientific Name	Abundance	Observed	Reported
American robin	<i>Turdus migratorius</i>	2	✓	
Red-eyed vireo	<i>Vireo olivaceus</i>	1	✓	
Chipping sparrow	<i>Spizella passerine</i>	1	✓	
House finch	<i>Haemorhous mexicanus</i>	2	✓	
Western Tanager*	<i>Piranga ludoviciana</i>			✓

1: Dates of FWMIS record unknown, record is for unspecified lands within 1 km of pedestrian bridge, so may not be from the study area

2: Incidental observations of red squirrel were also recorded, but outside of core study area.

Special Status Species

Based on species habitat requirements, an understanding of the available habitat, provincial species distributions, species records in the FWMIS database and field data, no special status species were identified as having potential to reside in the core study area.

3.7 Historical Resources

A Statement of Justification (SOJ) was completed for the VL-W LRT, downtown to Lewis Farms, in 2010. Alberta Culture and Tourism (ACT) granted the project, as outlined in the SOJ, Clearance in December 2010. The Clearance Letter include one requirement: when

the final alignment has been established, should it be determined that any pre-1960 structures will be affected by the project, staff of the Historical Resources Management Branch are to be notified immediately. Additional studies may be required prior to development proceeding.

Historical Resources will not be further considered in this EIA.

4.0 THE PROJECT

4.1 Project Delivery

Preliminary design (to approximately 30% of final design) is complete for the entire VL-W alignment. The design, referred to as the Reference Design, will be carried forward into the procurement phase and will be provided to the selected Proponent who will complete design and construct the line. The City is currently developing the Project Agreement (PA) that will govern Proponent design and practices. Among other things, the PA will specify required design outcomes, required environmental plan submissions, lands temporarily available for construction, construction prohibitions and practices, reclamation requirements, environmental management and planning requirements, methodological standards and specifications etc., both site-specific and for the entire alignment. The procurement phase is expected to occur within the next 12 months. The project phasing and the plan to have the Proponent advance design and construct the project is relevant to this EIA in several ways:

- This EIA assesses the Reference Design and is based on 100% preliminary engineering drawings and reports produced in spring 2018. For some project elements, design information is less detailed than is typically provided for Bylaw 7188 EIAs.
- The PA will allow for some innovation during detailed design according to specified variation tolerances. All final designs must still be accepted by the City and for added control with respect to design changes (for example, the type of retaining structure), any proposed innovation (design or method) beyond those specified variances will be subject to review and acceptance by City business partners following current standard City approval processes.
- There are no details known about construction methods, equipment, access and schedule for the MacKinnon Ravine works. The PA will not tightly govern construction methods or project component schedule. Therefore, this EIA cannot describe construction methods or construction scheduling.
- To control for the uncertainty around final design and construction methods, this EIA sets out proactive mitigation measures in the form of constraints, specifications and requirements for submission of environmental plans for review and acceptance by the City. Mitigation measures in this EIA represent City commitments that will be carried forward into PA requirements.
- To enable assessment of direct impacts, using the professional judgment of the project team, the City has delineated a geographic construction limit into the ravine for the MacKinnon Ravine project segment (a temporary work area). This EIA is based on that area (referred to as the project area) and assumes that the full temporary work area will be used during construction.
- To protect against the future need for a larger working area within bylaw lands, any proposed innovations or activities that would require modification of lands or facilities situated *outside of the project area delineated here and within bylaw lands*, will be subject to the Bylaw 7188 environmental review process, to be undertaken by the Proponent.

4.2 Need for Roadway Widening

Between 146 Street and 149 Street, SPR runs very close and parallel to the steep north margin of MacKinnon Ravine. Addition of LRT infrastructure in that road segment requires widening of the roadway to the south, subsequent widening of the south sidewalk, and some transit infrastructure adjustment (Figures 2 and 6, Appendix A). While all proposed *new* infrastructure will be located inside the existing ROW, except a short segment of sidewalk to the east of the bus turnaround that is not within the ravine proper (Figure 8, Appendix A), some of the associated work activities have potential to encroach beyond the existing road ROW and into MacKinnon Ravine proper. Following are brief descriptions of the key project components relevant to MacKinnon Ravine.

4.3 Sidewalk Widening and Retaining Structure

The slight adjustment south of the existing sidewalk extends onto a slope and requires a small area of fill to support the sidewalk (Figure 7a-c, Appendix A). To avoid occupying lands outside of the existing road ROW, the Proponent will be required to install a short retaining structure (e.g., a wall) to retain the fill at the ROW boundary, rather than allow a tapered slope to extend into the ravine. Reference Design cross sections show a retaining structure less than 1 m in height required for a distance of about 60 m along the top of the MacKinnon Ravine north slope (Figure 7). The sidewalk, fill and retaining structure will all be located within the existing roadway ROW. The work does, however, require a temporary work area beyond the ROW, at the top of the ravine slope. The work area will be limited to a maximum 3 m wide strip (Figure 2). This temporary work area is the primary incursion into MacKinnon Ravine.

4.4 Existing Pedestrian Bridge Modification

Because the existing pedestrian trestle bridge that crosses MacKinnon Ravine at this location directly terminates at the south edge of the existing sidewalk, the north end of that footbridge must also be modified (Figure 10, Appendix A; Plates 7, 8, 9). The bridge work is very localized and is expected to be straightforward. The bridge work details will be finalized by the Proponent, but it appears that the first span would be affected (approximately 5.5 m long), and the northernmost abutment supporting the first span would need to be replaced. The trestle bridge would be marginally shorter and stringers of the first span would need to be cut. The last City bridge report indicated the pedestrian bridge to be in good condition (Marzan, *pers. comm.*). The bridge work would be located within MacKinnon Ravine.



Plate 7. View to the east of northern terminus and end of first span of existing pedestrian trestle bridge.



Plate 8. End of first span and associated foundation near northern terminus of existing pedestrian trestle bridge.



Plate 9. View to the south of northern terminus of existing pedestrian bridge.

4.5 Decommissioning of Bus Turnaround

The existing bus turnaround, fully situated within the existing roadway ROW, will be replaced with a new bus bay and sidewalk along SPR (Figure 2 and 6). The turnaround area will be used as a laydown area, then decommissioned through removal of the existing asphalt and reclaimed to a natural area according to a detailed landscape plan to be developed by the Proponent. Landscape boundaries will respect the established temporary work limit (also the roadway ROW in this case). The laydown area will be centred on currently developed lands and will not extend into natural vegetation. Additional laydown areas inside bylaw lands will not be permitted. The PA will describe the boundaries of these designated areas. Nearby trees will be protected from disturbance according to PA specifications.

4.6 Drainage

Changes to existing drainage from VL-W construction will occur within the existing roadway ROW and will comprise relocating manholes and extending catch basins to new curb lines. The storm sewer trunk line through MacKinnon Ravine will be retained. The project will not result in changes to drainage within MacKinnon Ravine. Surface erosion associated with slope drainage will not be acceptable.

4.7 Activities on Adjacent Lands

All other LRT associated works immediately outside of this EIA study area will occur within the existing SPR ROW.

4.8 Landscaping

The Reference Design includes a preliminary landscape plan for the full alignment. The plan shows several landscaping aspects including where new trees shall be planted. The plan also shows existing planted (ornamental) trees and indicates which are likely to be removed at this location. The landscaping plan does not address the natural vegetation stands at MacKinnon Ravine. The small area of affected natural vegetation will be assessed by City Forestry in the near future, to calculate the value of affected trees pursuant to the City's Corporate Tree Management Policy. The PA includes measures intended to satisfy compensation pursuant to the Corporate Tree Management Policy and also includes specific and detailed City tree protection requirements for trees in the vicinity of construction. Those same measures will apply to tree protection in undisturbed areas of MacKinnon Ravine. The preliminary landscape plan for the MacKinnon Ravine segment (Figure 9; Appendix A) conceptually indicates that the full length of the temporary work area associated with construction of the sidewalk and retaining wall will be reclaimed to native vegetation (labelled as 'new natural area'). That new natural area will extend as far west as disturbed areas extend, potentially up to and including the corner of 149 Street and Summit Drive. Closer to the sidewalk, ornamental trees will be planted near the new bus bay. The EIA elaborates on landscaping requirements shown for those areas as mitigation for impacts to natural vegetation near the pedestrian trestle bridge and the bus turnaround.

4.9 Other Utilities

Some additional utilities are located in and near the project area and within Bylaw 7188 lands. These include a water line that crosses perpendicular through the project area from 148 Street to the ravine (parallel with the pedestrian trestle bridge) and a storm sewer line that passes perpendicular and adjacent to the east side of the bus turnaround from 147 Street into the ravine. Utilities in the ravine will not be altered. Electrical works, including street lights, are located in the SPR ROW and will require relocation, upgrading and/or removal. Privately-owned utilities are the responsibility of the utility owners and those relocations/abandonments will take place prior to the lands being turned over to the Proponent. Timing of this utility work is not currently known but some VL-W utility work is already underway. This EIA does not cover utility work to be undertaken by utility owners.

4.10 Project Phases and Associated Key Activities

Sidewalk widening and associated infrastructure and pedestrian trestle bridge modification are the key infrastructure components assessed in this EIA. LRT infrastructure, such as track, is not assessed. This EIA covers the following project phases and assumed associated key activities (Table 4.1). For purposes of this assessment, site preparation activities are shown separately but may occur in stages during construction, acknowledging that Proponent activity sequencing is unknown. ESC measures will be in place as part of any site clearing/preparation activities. The operations phase is not covered in this assessment for the following reasons: LRT operations will be entirely within urban infrastructure, there will be an LRT stop near 149 Street but not in the project area, there will be no LRT maintenance at or near the project area, LRT operation will not affect general roadway and sidewalk maintenance, and roadway and sidewalk maintenance practices will not change from existing practices.

Table 4.1. MacKinnon Ravine Phases and Key Associated Activities.

Project Phase	Key Activities
Site Preparation	<ul style="list-style-type: none"> • Develop all required environmental plans. • Test soils • Delineate and install erosion and sediment control system along the construction limits and at construction laydown areas. • Protect trees. • Strip/clear vegetation as scheduled activities allow. • Establish laydown areas. • Construction assumed to require: minor slope vegetation clearing. Equipment access only to the limits of temporary work area.
Construction	<ul style="list-style-type: none"> • Protect/relocate city-owned utilities. • Remove existing sidewalk infrastructure. • Demolish sidewalk, working out toward ravine margins. • Install geotextile, place fill inside road ROW.
	<ul style="list-style-type: none"> • Install retaining structure; design and methods to be determined by Proponent. • Retaining structure will be located within existing roadway ROW.
	<ul style="list-style-type: none"> • Modify existing north terminus of pedestrian bridge; methods to be determined by Proponent (all inside Bylaw 7188 lands). Assumed to require: short-term, temporary bridge closure; some vegetation clearing near bridge end; equipment access; replacement of first span foundation, cutting off first bridge span.
	<ul style="list-style-type: none"> • Decommission bus turnaround; methods to be determined by Proponent. Asphalt to be removed, no regrading required.
Reclamation/Landscaping	<ul style="list-style-type: none"> • Full reclamation of all disturbed lands not occupied by infrastructure, according to the landscaping concept shown here and more specific EIA mitigation recommendations presented in <i>section 5.0</i>.

4.11 Consideration of Environmental Sensitivities

During preliminary design the project team was cognizant of the need to minimize activities occurring within bylaw lands. This awareness carries through to PA development. The team was also aware of the sensitivities associated with working on steep ravine slopes, the presence of colluvial subsoils and the slope stability contribution of the existing vegetation. The following key decisions contributed to minimizing the project’s footprint within MacKinnon Ravine: locating staging/laydown areas outside of sensitive, vegetated bylaw lands; use of a retaining structure to reduce the footprint of localized fill; prescribing the smallest possible temporary work area while respecting obvious constructability issues. In addition, the project has acknowledged MacKinnon Ravine as a sensitive area and included a requirement to reclaim select areas to new natural areas that integrate into existing ravine vegetation.

With respect to environmental controls during construction, for the entire VL-W project, the City will be requiring the Proponent to comply with ENVISO and act in a manner that does not jeopardize their ISO 14001 registration. In addition, for the construction period, the following project-wide measures will be required of the Proponent:

- Prepare an EMS that is ISO 14001 compliant. Prepare a project-wide ECO Plan to City of Edmonton specifications that includes, at a minimum, the following:
 - a temporary ESC plan to City of Edmonton specifications
 - a MacKinnon Ravine site-specific ESC plan
 - a spill prevention and emergency response plan, that includes measures that comply with City of Edmonton and provincial spill reporting requirements
 - a site-specific water management plan
 - a soil and contaminated soil management plan
 - general and hazardous waste management plan
- Prepare reclamation plan specific to MacKinnon Ravine. That plan shall provide for reclamation of all disturbed lands not supporting infrastructure to native plant communities, with a goal to provide for biodiversity, long-term slope stability and erosion control such that the dominant appearance of all reclaimed areas is that of a native plant community.
- All disturbed parkland will be reclaimed or restored.

5.0 PROJECT IMPACTS AND MITIGATION MEASURES

5.1 Assessment Methods

5.1.1 Potential Impact Identification and Analysis

Based on the environmental context described in Section 3, the following Valued Ecosystem Components (VECs) were identified for impact assessment; surface water quality, ravine slope stability, soils, vegetation, and wildlife and wildlife habitat. For each VEC, potential impacts to be examined were identified by overlaying the project drawings on mapped resources, reviewing project activities, conferring with the multi-disciplinary project team members, reviewing project reports and applying our professional experience with impact assessment and construction performance auditing in other, similar projects. This process resulted in identification of specific potential impacts that warranted assessment.

In addition, we separately examined the potential for the following select project incidents to occur and impact natural resources:

- Release of hazardous/deleterious substances in or outside of the project area and potential for migration off-site.
- Release of sediment or other debris in or outside of the project area and potential for migration off-site.

5.1.2 Impact Characterization

Identified impacts were characterized according to guidance received from the EIA Terms of Reference (Table 5.1). Potential impacts were characterized with respect to nature (positive or negative, direct or indirect), magnitude (negligible, minor, or major), duration and timing (temporary, permanent or seasonal), geographic extent and likelihood. These criteria were defined as shown in Table 5.1:

Table 5.1: Impact Descriptor Definitions.

<i>Nature of Impact</i>	
Positive Impact	An interaction that enhances the quality or abundance of physical features, natural or historical resources.
Negative Impact	An interaction that diminishes the abundance or quality of physical features, natural resources or historical resources.
Direct	An interaction that results in the loss or reduction of a resource/feature.
Indirect	An interaction that results in off-site impacts, such as sedimentation off-site
<i>Magnitude</i>	
Negligible Impact	An interaction that is determined to have essentially no effect on the resource. (Such impacts are not characterized with respect to direction duration or confidence.)
Minor Impact	An interaction that has a noticeable effect but does not eliminate a local or regional population, physical feature or affect it beyond a defined critical threshold (where that exists).
Major Impact	An interaction that affects a local or regional population, resource, or physical features beyond a defined critical threshold (where that exists) or beyond the normal limits of natural perturbation.
<i>Duration and Timing</i>	
Temporary Impact	A change that does not persist indefinitely.
Permanent Impact	A change that persists indefinitely.
Seasonal Impact	A change that will terminate or diminish significantly after one season.
Geographic Extent	Extent of area affected. Quantify where feasible.
Likelihood	What is the probability that the impact will occur? Is it likely or unlikely?

When applying these descriptors, we considered the practices and requirements that were described in Section 4 to be accounted for as built-in mitigation measures. No additional mitigation measures were applied at the time of potential impact characterization.

5.1.3 *Mitigation Development and Residual Impact Assessment*

Mitigation measures were developed for all identified negative impacts. Any impact anticipated to remain following mitigation implementation was termed a residual impact. As with potential impacts, residual impacts were characterized with respect to: nature, magnitude, duration and timing, geographic extent and likelihood.

5.2 ***Impact Assessment Results and Mitigation Measures***

5.2.1 *Surface Water*

Considering the absence of natural water courses, potential construction impacts to surface water are limited to effects on water quality in the NSR as a result of accidental releases into the storm sewer system. While spills or mobilized sediment within SPR could migrate/drain to one of several catch basins and eventually into the river, spills in the core study area, along the ravine margin and slopes, are more likely to move downslope and be retained in the slope vegetation. These types of impact are explored further as part of sections 5.5.1 and 5.5.2.

5.2.2 *Ravine Slope Stability*

Impact

The City acknowledges that the project work at the top of the steep ravine slopes and at the bus turnaround has potential to result in ravine slope instability and that field geotechnical investigations have not yet been completed for VL-W at MacKinnon Ravine.

In their latest site-specific reporting of geotechnical considerations, Thurber (2018) opined that based on earlier findings and the limited encroachment of the VL-W onto the north bank of MacKinnon Ravine, the proposed VL-W development is generally geotechnically feasible. They recognized, however, that additional information was needed. Thurber recommended that sufficient measures be specified in the PA to ensure that the Proponent conducts a detailed geotechnical assessment of the potential impacts of the proposed works on the stability of the ravine slopes, and, that the PA specify that sufficient slope stabilization measures be designed and constructed to minimize any adverse effects. On that basis, at this point in project planning and without those additional studies and designs, this EIA recognizes there is potential for the project to result in ravine slope instability and to have consequences for MacKinnon Ravine park. This impact is rated as a negative, direct, minor to major, permanent, local to MacKinnon Ravine impact. Although a slope failure at this location may be easily repairable (El Ramly *pers. comm.*), because of the potential and the limited available information, the potential impact magnitude is rated as minor to major. At this point, the likelihood of slope instability is unknown.

Mitigation and Residual Impact

Mitigation of the potential for slope instability will be fully addressed in the PA. The project team is currently developing a series of PA specifications designed to address any potential impacts of the proposed VL-W works on short and long-term slope stability at MacKinnon Ravine. Preliminary technical requirements are provided by Thurber (2018) in

Appendix D. Following are extracts from that memo, provided as examples of anticipated PA specifications:

- Evaluate slope stability, using methods acceptable to the City, and develop and implement appropriate stabilization measures to ensure slope stability and the integrity and serviceability of completed infrastructure.
- Address both shallow and deep-seated failure mechanisms and take into consideration the potential impacts of grading works (including construction of retaining structure).
- Attain the specified long-term slope factors of safety.
- Placement of additional fill onto ravine slopes and use of the bus turnaround as a laydown area shall not result in any reduction in the slope factors of safety.
- Prior to construction, prepare a geotechnical report, for submission to the City, demonstrating that slope stabilization measures will be sufficient to attain the required factor of safety.
- Monitor vertical and lateral slope displacement during construction.

This EIA recognizes that the final PA specifications will be a refinement of the above. With the PA requirements developed to the satisfaction of the City, the project's residual impact on slope stability is expected to be reduced to negligible.

5.2.3 Soils

The potential for the presence of contaminated soils in the core study area was identified as requiring assessment.

Impact

The VL-W Phase 2 ESA that is now underway has identified the need to undertake further investigations regarding contaminated soils. Based on information available to date, there is some potential for construction at this project segment to interact with contaminated soils, and there is some potential for contaminated soils to be present at depth at the ravine margin. This raises the possibility of impacts to surrounding vegetation and surface water and groundwater as a result of excavation during construction. This potential impact is generally rated as negative, direct and indirect, minor to major, permanent, local to regional. It is minor to major owing to lack of available information. The likelihood of encountering contaminated soils is currently unknown.

Mitigation and Residual Impact

Site-specific mitigation measures remain unknown pending results of the Phase 2 ESA. If contamination is confirmed in the project area, the scope, responsible party, and specific mitigation requirements will be defined at a later time but a site-specific risk management/monitoring plan will be developed to minimize impact to the adjacent natural environment. This will likely include the following commitments in the PA;

- excavation as required to facilitate construction.
- backfilling with clean material.

- classification of excavated materials and associated water as clean, contaminated or hazardous, and disposal accordingly.
- implementation of health & safety protocols for the protection of workers and the public during construction.

Specific requirements for risk management of contaminated soils will be defined in the PA, to the satisfaction of the City.

This EIA assumes that the approach to encountered contaminated soils would remove potential for off-site migration and would lead a negligible impact and locally improved soil conditions.

5.2.4 Vegetation

The following potential impacts to vegetation were identified as warranting examination:

- Loss or alteration of natural plant communities/rare plants
- Establishment of invasive or weedy species
- Incidental tree damage

5.2.4.1 Loss or Alteration of Natural Plant Communities/Rare Plants

Impact

Some direct loss of plant communities, both permanent and temporary, will result from VL-W related works adjacent MacKinnon Ravine. The maximum limits of temporary work and likely areas to be cleared are shown in Figure 5. Sidewalk construction will result in permanent loss of a very small area (~121 m²) of Non-Forested-Caragana, Steep Slopes (NF.1) plant community, adjacent the bus turnaround. In addition, there will be temporary loss of the Non-Forested-Smooth Brome, Steep Slopes (NF.6) plant community along the top of slope of MacKinnon Ravine to accommodate construction of the sidewalk retaining structure and modification of the northern end of the pedestrian bridge. Small, localized clearing of poplar saplings may be required where they encroach into the brome community and the temporary work limits, including adjacent the pedestrian bridge. The Manicured (M) plant community in the roadway ROW will be completely removed.

The permanent loss of a relatively small area of natural plant community outside of the ravine proper is rated as a negative, direct, minor, permanent, and likely impact. The temporary loss of natural plant communities is rated as a negative, direct, minor, temporary and likely impact.

As no rare plants have been recorded on site, there is no anticipated impact on rare plants. Additional surveys are not warranted and mitigation is not required.

Mitigation and Residual Impact

Permanent and temporary loss of natural communities will be mitigated through the following measures:

- As was done for VL-SE, City of Edmonton Forestry will undertake canopy valuation and inventory for the small area of affected natural vegetation to calculate the value pursuant to the Corporate Tree Management Policy.
- In consultation with City of Edmonton Forestry, as part of the whole project, PA specifications will be developed to ensure compliance with the Corporate Tree Management Policy.
- The Project Agreement will require the Proponent to comply with specific tree removal and protection specifications (see section 4.11).
- The permanent vegetation loss will be directly addressed through creation of the new natural area shown on the landscaping plans at the bus turnaround, using only native species. The PA will require the Proponent to prepare a detailed reclamation plan (see section 4.11) for all new natural areas. The result will be creation of a naturalized area measuring ~1913 m². This measure will, over time, result in a net gain in native plant cover and will assist in knitting the reclaimed lands into the nearby ravine vegetation. This is in keeping with the City's ESM inventory of sites suitable for restoration.
- All temporary working areas on the ravine slope will be reclaimed to a naturalized area comprising native grass and shrub species tolerant of the local micro-climate created by the retaining structure. Naturalization will extend west from the bus turnaround as far as the disturbance extends. This will fully mitigate the temporary loss of sapling vegetation.
- Non-native species will not be acceptable in reclaimed communities at handback and the Proponent will be required to take special measures to discourage re-establishment of prohibited noxious weeds, noxious weeds and exotic species.
- The reclamation plan will be the responsibility of the successful Proponent.
- All reclamation and naturalization plans will be prepared by individuals having specified subject matter expertise in similar reclamation, forest establishment, or naturalization projects.
- All reclamation and naturalization plans will be reviewed by the City or a City representative having suitable subject matter expertise.
- Each reclamation plan will have the following goals:
 - provide appropriate habitat for local avian species documented as present in MacKinnon Ravine;
 - achieve a community with a natural aesthetic;
 - minimize establishment of exotic and weed species;

In addition, as was done for VL-SE, the PA will include additional, more specific reclamation plan objectives such as native species richness, details regarding plan information requirements and additional detail regarding the qualifications of the Proponent's personnel overseeing and signing off reclamation plans. As with VL-SE, City stakeholders will review and contribute to development of PA specifications.

The site specific reclamation plan goals and objectives will govern standards to be achieved at this site, such that the plan will not be required to follow the City of Edmonton

landscaping standards nor the PA landscaping standards, with the exception of a requirement to meet or exceed the PA standards associated with landscaping soil quality and depth.

With the above measures in place, over time, all vegetation losses should be fully mitigated, and there should be a net gain in woody, naturally vegetated area. With successful reclamation, the anticipated residual impact of vegetation loss is expected to be negligible.

As due diligence, the PA will also include a requirement that covers the unlikely event that a rare plant species is incidentally observed on site by the Proponent's team. The Proponent will be asked to verify the occurrence, assess ACIMS status of the observed plant, notify the City and enquire regarding appropriate action.

5.2.4.2 Establishment of Invasive or Weedy Species

Impact

Four noxious weed species (scentless chamomile, perennial sow-thistle, common toadflax and creeping thistle) were detected in the project area during field investigations, ranging from occasional to abundant in abundance. No prohibited noxious weed species were observed. Even with careful removal of poor quality soil in reclamation areas, surface disturbance associated with the demolition and construction phases of the project, could create ideal conditions for the spread of these and other noxious and prohibited noxious weeds. Preventing weed establishment in the first place may be the best and most economical opportunity for weed management. Without appropriate mitigation in place, the establishment and spread of invasive or weedy species within reclaimed areas is expected, and the impact will be negative, direct, minor, permanent, local and likely.

Mitigation and Residual Impact

The tendency for disturbed areas to harbor weeds during construction and for increased weeds in an area post-construction will be controlled and reduced through the following measures:

- Cleaning of all equipment before entering the construction area.
- Removal of weedy soils from reclamation areas.
- Cleared areas will be revegetated as soon as possible following construction with fresh topsoil, as detailed in the Proponent's reclamation plan and as approved by the City.
- The Proponent will be required to implement weed control and to monitor weeds during construction, during reclamation and during reclamation warranty.
- All weed control measures and implementation frequency will be outlined in the Proponent's Environmental Construction Operations (ECO) Plan and reclamation plan.

Following handback to the City, there will also be a need for the City to undertake weed control for the next few years. Assuming diligent attention to this issue by all parties, the residual impact related to weeds is rated as negligible.

5.2.4.3 *Incidental Tree Damage*

Impact

The project will require clearing small portions of natural plant communities. This leaves adjacent trees vulnerable to limb, trunk and root damage during clearing or construction activity. The potential for additional tree loss as a result is rated as a negative, indirect, minor, permanent, local and likely impact.

Mitigation and Residual Impact

Impacts related to incidental tree damage will be mitigated as follows:

- PA requirements will include the environmental controls noted in Section 4.11. Among these is the requirement for the Proponent to prepare a Tree Protection Plan, compliant with PA specifications. The plan will include measures to physically protect ravine and planted trees on the margins of cleared/working areas. Currently, the draft PA stipulates that all trees within 25m of a work area are to be protected.
- The Proponent will be required to monitor tree protection efficacy and record incidental damage and report to the City.
- For the spruce saplings that are adjacent to the MacKinnon Ravine work limits, the City will investigate if the spruce saplings are too close to the temporary work limits to be adequately protected. If so, City forestry will relocate the saplings prior to Proponent's work in the area.

With these measures in place, the potential for incidental tree damage will be significantly reduced. The residual impact is rated as negligible.

Wildlife and Wildlife Habitat

The following potential impacts to wildlife and wildlife habitat were identified as warranting examination:

- Loss of terrestrial habitat due to clearing activities
- Breeding bird mortality due to construction activity during breeding season

5.2.4.4 *Loss of Terrestrial Habitat Due to Clearing Activities*

Impact

Any loss of natural vegetation in the project area represents an associated loss of natural habitat. Areas of natural habitat to be cleared, based on the established construction limits are:

- Shrubby, caragana dominated stand
- Grassland with some localized sapling inclusions

The remainder of clearing is in manicured areas that have little to no wildlife habitat value. As noted in the vegetation discussion, the majority of habitat loss will be temporary and on the upper ravine slope; a minor portion (caragana) will be permanent. The habitat value of areas to be cleared is moderate to low. As a result, the anticipated combined permanent and

temporary habitat loss is rated as negative, direct, minor, permanent and temporary, local in scale, and likely.

Mitigation and Residual Impact

Applying all mitigation measures outlined in the vegetation section will result in a net gain in naturalized areas and a reduction in exotic/weedy species. This represents a short-term loss of total habitat area with a net gain in overall habitat quality and area. This is considered to fully mitigate for the loss, over time. The residual impact is rated as negligible.

5.2.4.5 Breeding Wildlife Mortality Due to Construction Activity During Breeding Season

Impact

Clearing of natural vegetation, can cause wildlife mortality, particularly during the spring and summer breeding season when the mobility of many species is restricted. During those times, adults remain close to dens and nest sites, and young are restricted to nests or not yet able to move long distances. To protect wildlife, and particularly nesting birds protected by the *Migratory Birds Convention Act* and *Wildlife Act*, current best management practice guidance provided by Environment Canada recommends avoiding vegetation clearing during the period when there is a high probability of nesting activity (i.e., high risk period). This extends to removal of individual ornamental trees, shrubby and weedy, grassy areas because commonly-occurring species such as the American robin and chipping sparrow, which may use those areas for nesting, respectively, are covered by the legislation. When this practice is not adopted and in the absence of other mitigation measures, there can be a high potential for nest disturbance. Further, owls that occur in Edmonton are protected by the *Wildlife Act*, and are early nesters. Clearing during the period 15 February and 20 April without regard for nesting owls can result in owl nest disturbance and nestling mortality. Additionally, northern flying squirrels nest in tree cavities and are protected by the *Wildlife Act*. Should clearing due diligence not be employed, wildlife mortality resulting from clearing could occur. This would be a negative, direct, major, permanent, local and likely impact. It is rated as major because it represents contravention of the law.

Mitigation and Residual Impact

In this region, wildlife mortality from vegetation clearing (including brush piles and tall grass) is best avoided by scheduling clearing outside of the period 20 April to 20 August. In addition, to respect the possibility of nesting owls being present, clearing of mature trees during the period 15 February and 20 April should be avoided. At present, project activities near MacKinnon Ravine do not appear to require clearing of mature trees. If possible, this project will avoid any tree and shrub clearing/removal during the period 15 February and 20 August. If clearing between 20 April and 20 August, nest sweeps by a qualified biologist to identify active nests and appropriately buffer them, are the industry standard practice. If clearing during this period is required, the Proponent must undertake the following:

- A qualified biologist must provide an opinion regarding the feasibility of an effective sweep, based on the areal extent and vegetation type present;
- If feasible, the biologist will complete a nest sweep in advance of clearing and provide recommendations.
- All observed nests of species protected by legislation must then be avoided and buffered appropriately until the nest is no longer active.
- If stripping/clearing must occur between 15 February to 20 April, an avian biologist should provide an opinion on risk to owls and the Proponent must act accordingly.

With these measures in place, wildlife mortality should be avoided and the residual impact would be negligible.

5.2.5 *Project Incidents*

5.2.5.1 *Release of Hazardous/Deleterious Substances On or Off-Site*

Impact

Fuels, lubricants and other hazardous substances are anticipated on-site hazardous materials. Spills can occur during refueling, because of equipment failure (e.g., broken hydraulic hose) or accidents, or malfunctions at storage sites. Spills can cause localized contamination of soils, plant communities, wildlife habitat on and off site and, if they enter catch basins, materials could travel to the NSR. In this case, spill migration is more likely to occur down MacKinnon Ravine steep slopes. Most spills would likely be small in nature, but if uncontrolled, spills could spread over larger areas. Small spills are anticipated at most construction sites. Large spills are more preventable and should not occur in this area.

If appropriate plans and practices are not put into place, the impact of a hazardous or deleterious substance spill could be negative, direct, minor, temporary, local and likely.

Mitigation and Residual Impact

As noted in Section 4.11, the City will be requiring the Proponent to comply with ENVISO and act in a manner that does not jeopardize their ISO 14001 registration. In addition, for the construction period, the Proponent will be required to provide a high-performance spill prevention and emergency response plan and a hazardous waste management plan. Those plans will include specific measures related to securely protecting all roadway catch basins in the project area. The plans must also include monitoring protocols and frequency. With these measures in place the residual impact of spills should be negligible. Small spills may still occur as a result of malfunctions, but they would be containable and thoroughly cleaned up with no residual impact.

5.2.5.2 *Release of Sediment or Other Debris On or Off-Site*

Impact

Site preparation during demolition and construction activities will result in the removal of vegetation and exposure of bare soil surfaces, in small areas and likely for extended periods of time. Construction activities on exposed soils can result in erosion and loss of top-soils and sub-soils, degradation of top-soil quality or weakened slope stability. In areas where

existing vegetation cover is cleared, exposed soils are susceptible to fluvial (surface water) erosion in wet conditions, and, to a lesser extent, aeolian (wind) erosion in dry conditions. Eroded soils can accumulate in downslope undisturbed vegetated areas and in the ravine bottom. In this case, the overall area involved is relatively small. If mitigation measures (controls and clean-up measures) are not put into practice, the impact on vegetation would be negative, direct, minor, temporary, local and likely.

Mitigation and Residual Impact

As mentioned in Section 4.11 the City will require the Proponent to comply with ENVISO and act in a manner that does not jeopardize their ISO 14001 registration. In addition, for the construction period, the Proponent will be required to prepare a MacKinnon Ravine site-specific temporary ESC plan, to City of Edmonton specifications, and a site-specific water management plan. These plans will also include monitoring protocols and frequency. With these plans in place the residual impact of sediment or debris release should be negligible.

5.3 Cumulative Effects

The cumulative effects assessment study area was defined as MacKinnon Ravine between 149 Street and 142 Street.

5.3.1 Past Projects

As noted in the historic overview provided in Section 2, west MacKinnon Ravine, particularly the ravine bottom, has historically been subject to many modifications at a variety of scales. While ravine walls have been locally disturbed in some areas, they have generally been less modified than the ravine bottom. Park development (manicured areas, trails and a pedestrian bridge), culminating in the present-day MacKinnon Ravine Park was completed in the late 1980s and 1990s. We are unaware of any large scale projects in west MacKinnon Ravine, since that time. Minor park improvements have periodically occurred.

5.3.2 Present Projects

We are unaware of other projects underway in this area.

5.3.3 Future Planned Projects

We are unaware of other projects planned for this area; however, restoration projects may be contemplated by the City. East of 142 Street, edible forests have been installed. It is possible that edible forest expansion is planned for west of 142 Street.

5.3.4 Conclusion

The proposed project has no potential to result in impacts that act cumulatively with impacts of past, present or identified planned (future) projects.

6.0 ENVIRONMENTAL MONITORING

At present, there are no project monitoring conditions linked to regulatory approvals. However, this EIA makes several specific monitoring recommendations and the PA will require the Proponent to self-monitor throughout construction and reclamation. To do this, the Proponent will be required to engage an environmental monitor to oversee Proponent environmental performance during the full contract term. Monitoring will target meeting PA requirements, meeting specific plan requirements, particularly EMS and ECO plan requirements (e.g., monitoring of temporary ESC measures), and ensuring mitigation measures have been effectively implemented and are performing well.

In addition, the Owner's Engineer team will be responsible for PA compliance auditing during the PA term. The environmental lead will audit the Proponent environmental performance during construction and warranty periods. This will involve review of submitted plans and field oversight. The PA Non-Conformance process will be followed for any deficiencies noted.

All specific monitoring requirements included as mitigation measures in Section 5 of this EIA will be included in the PA. In addition, many of the environmental plans required of the Proponent have associated monitoring components. Monitoring details will be fleshed out as the Proponent prepares their environmental plans. Key construction monitoring requirements specified in Section 5, summarized by VEC, include:

- Ravine Slope Stability
 - Monitor vertical and lateral slope displacement
- Contaminated Soils
 - Potential for monitoring associated with contaminated soils in the area
- Vegetation
 - Monitor performance of Tree Protection Plan
 - Monitor weeds/exotic species on site
 - Monitor reclamation performance
- Project Incidents
 - Monitor performance of all temporary ESC measures
 - Monitor project area margins to ensure there is no off-site migration of deleterious substances or other debris

7.0 PUBLIC CONSULTATION

Public input has played an essential role in shaping the Valley Line LRT, from the identification of the corridor in 2009, through the development of the concept plan, to the completion of preliminary design in 2013. With the initiation of the latest design phase (advancement of preliminary design and procurement readiness), public engagement has continued.

The City has established five Citizen Working Groups along the VL-West LRT alignment. These groups are a primary method of engaging with neighboring communities during preliminary design update, project procurement, detailed design and construction of VL-W. MacKinnon Ravine is situated in Working Group G (Stony Plain Road). Initial meetings of these working groups took place in fall 2017 and continue in 2018. Meetings are open to the public. The most recent meeting of this group was scheduled for April 2018.

The City provides regular webpage project updates and in October 2017 published a VL-W booklet, in which the alignment near MacKinnon Ravine was clearly shown. Several VL-W open houses have been held in 2017 and 2018, some overarching and some targeting specific issues or locations.

- On November 15 and 16, 2017 a public open house was held to share refinements to the LRT preliminary design. Results of the recent assessment of LRT crossings at key intersections were also provided, including what the project team heard during the previous engagements.
- On June 21 and 29, 2017, residents were asked to provide input on any issues and opportunities to consider for the crossing assessments at 149 Street and 178 Street along the alignment.
- On January 24, 2018 a public information and engagement session was held to further update the community on planned adjustments and refinements to the preliminary design, including LRT crossings and to collect additional public input. Displays included a board highlighting the two locations where VL-W would intersect with Bylaw 7188 lands (Groat Ravine and MacKinnon Ravine) and informed the public of environmental assessment preparation.
- On July 26, 2018, citizens were invited to view possible design options for SPR one way, 149 St to 156 St and to share their feedback and perspectives.
- On 28 August 2018, a public information session was held to share information about project plans affecting areas within the River Valley Bylaw boundaries and invite comments. EIA findings to date were displayed. Results of that session will be included in the report to Council for their review of the Groat Ravine Crossing EIA, MacKinnon Ravine EIA and joint SLS.

8.0 CONCLUSIONS

8.1 Impacts and Sensitivities

This EIA has shown that with the described mitigation measures applied, all identified potential impacts anticipated to result from project construction can be mitigated such that adverse residual impacts are reduced to negligible.

Environmental sensitivities identified for this proposed project are:

- slope stability
- potential for contaminated soils
- native plant communities downslope of the project

Two of these sensitivities, slope stability and contaminated soils, require additional investigation, which will be undertaken in the next project steps. All data deficiencies and required actions to ensure impact mitigation will be addressed in the PA. The third sensitivity, downslope vegetation, will be protected through the many environmental controls placed on the project and the Proponent to keep project activities and by-products in the defined project area.

Considering all of the above, we are of the opinion that the proposed project has minimal potential to affect valued Bylaw 7188 resources and can proceed responsibly.

8.2 EIA Limitations

This EIA was founded on information provided by preliminary design drawings and reports and little construction methodology information. This potential limitation was countered by the ability to develop proactive mitigation measures that will direct construction practices and the knowledge that the City is developing a targeted PA that will include significant environmental controls intended to induce excellent environmental performance by the Proponent.

8.3 Summary of Key Mitigation Measures

The following represents a list of key mitigation measures selected to itemize important action items for future project stages.

- The City must ensure that the PA requires additional geotechnical investigations and suitable performance requirements for long-term slope stability.
- The City must ensure that the PA specifies requirements for contaminated soil investigations and clean-up of any encountered contamination.
- The City must ensure that the PA captures all mitigation measures listed in *Section 5.2.4* and summarized here, to address vegetation loss and ensure compliance with the Corporate Tree Management Policy:
 - Prepare a detailed landscape plan

- Prepare a detailed reclamation plan
 - Prepare a detailed tree protection plan
 - Revegetate cleared areas promptly
 - Discourage weed establishment
 - Implement weed control and monitoring
- In addition, the City is responsible for undertaking a canopy inventory and valuation for affected MacKinnon Ravine vegetation to support the PA requirements and Tree Protection Plan approach.
 - The City must ensure that the PA captures all mitigation measures listed in *Section 5.2.5* to ensure compliance with all Provincial and Federal Acts pertaining to wildlife.
 - The City must ensure that the PA includes all mitigation measures listed in *Section 5.2.6* and summarized here, to ensure compliance with ENVISO and all environmental regulations.
 - Prepare a detailed spill prevention plan
 - Prepare a detailed emergency response plan
 - Prepare a detailed site-specific temporary ESC plan
 - Prepare a site-specific water management plan

9.0 REFERENCES

9.1 *Literature Cited*

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Solstice Canada. 2016. Environmental Sensitivity Project, Draft Final Report. Prepared for: The City of Edmonton. Prepared by: Solstice Canada. Edmonton, Alberta.

Thurber Engineering Ltd. 2017. Edmonton LRT Valley Line Stage 2 (Downtown to Lewis Farms) Overall Appraisal of Geotechnical Conditions. Report to AECOM. Edmonton, Alberta

9.2 *Personal Communications*

El Ramly, Hassan, Ph.D., P.Eng. Principal, Thurber Engineering Ltd. Communications in 2018.

Husak, Wade, P. Geol. AECOM. Manager: Water & Natural Resources – Northern Alberta. Communications in 2018.

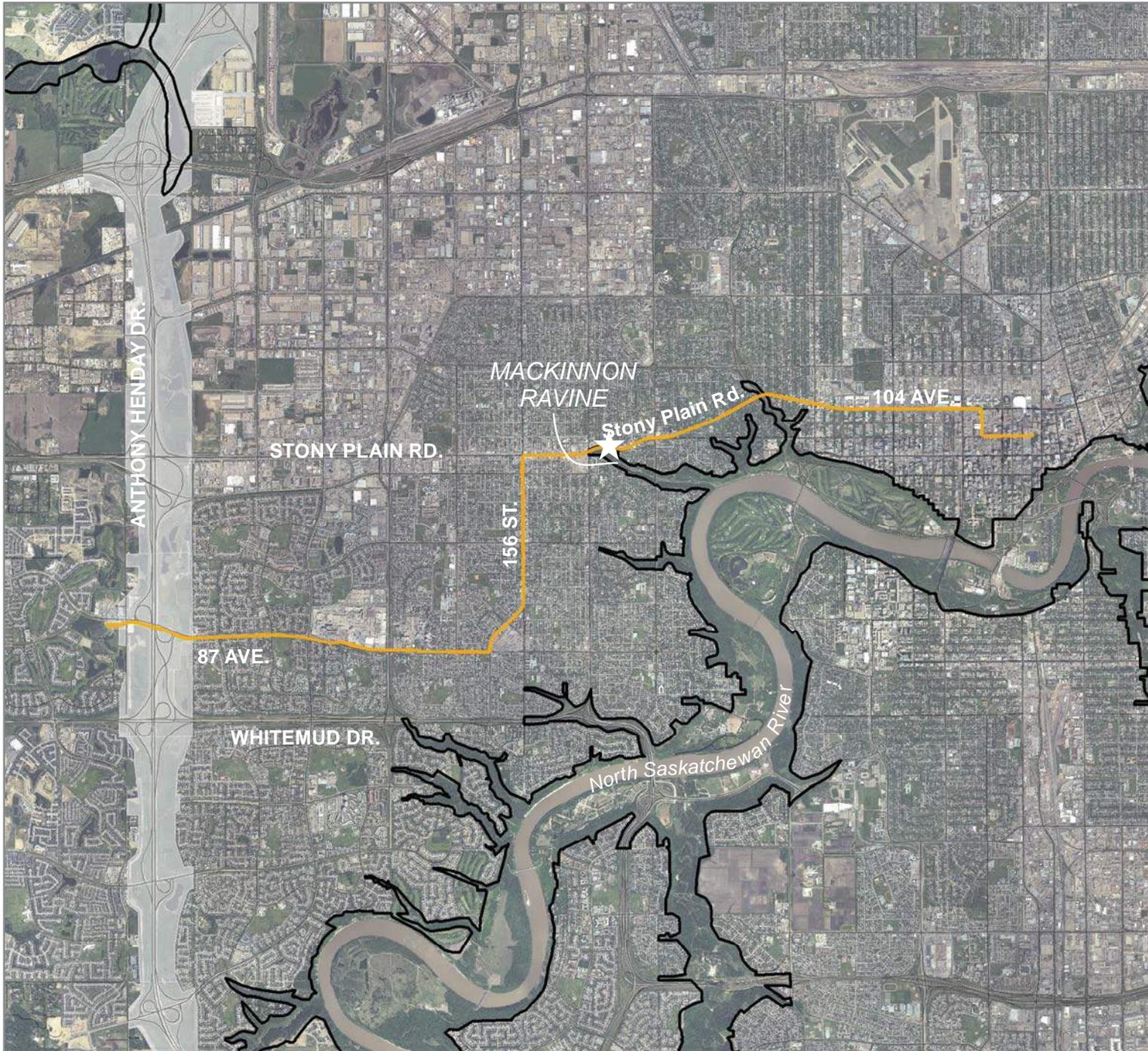
Marzan, Roleza Jean, P.Eng., Senior Civil Engineer, Integrated Infrastructure Services, LRT Delivery.

Perry, Mark, P. Eng. CTP Project Manager, Valley Line- West. Communications in 2018.

Appendix A: Figures

- Figure 1. Project Location
- Figure 2. MacKinnon Ravine Project Components and Temporary Limits
- Figure 3. Project Vicinity Land Use Zoning (See Section 2.1 in text)
- Figure 4. Environmental Sensitivities – Original (2016)
- Figure 5. Existing Natural Plant Communities
- Figure 6. Roadway Design
- Figure 7. Cross-Sections
- Figure 8. Existing Pedestrian Bridge Structure
- Figure 9. Landscape Plan

Figure 1.
Project Location
MacKinnon Ravine
Valley Line West EIA



Legend

-  Proposed Track Alignment
-  Bylaw 7188 Boundary
-  TUC & Anthony Henday Drive

EIA STUDY LIMITS

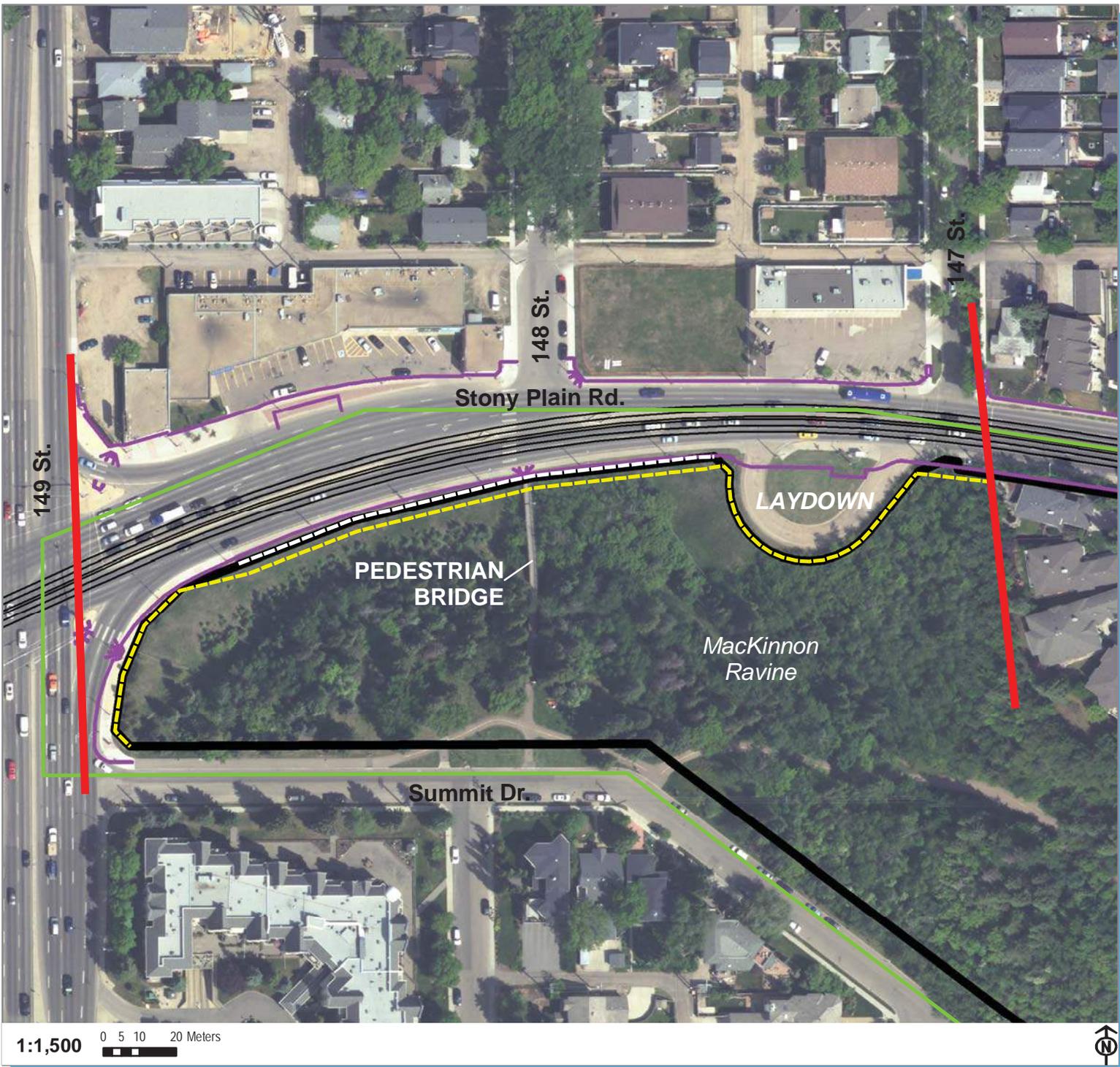


Date Map Created: 10 August 2018
 Aerial Photograph Date: May 2017

1:70,000 0 500 1,000 2,000 Meters



Figure 2.
MackInnon Ravine
Project Components
and Temporary Limits
MackInnon Ravine
Valley Line West EIA



Legend

- E-W EIA Study Limits
 - Bylaw 7188 Boundary
 - Road ROW
- Proposed:*
- Track Alignment
 - Back of Walk (BOW)/Edge of future sidewalk
 - Retaining Structure
 - Limits of Temporary Work



Date Map Created: 10 September 2018
 Aerial Photograph Date: May 2017



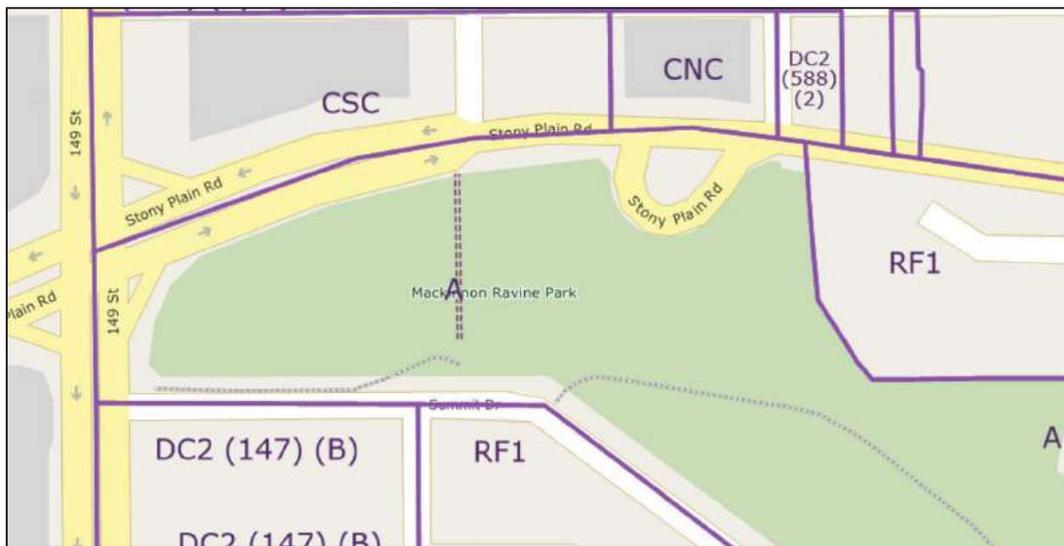
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Figure 3.

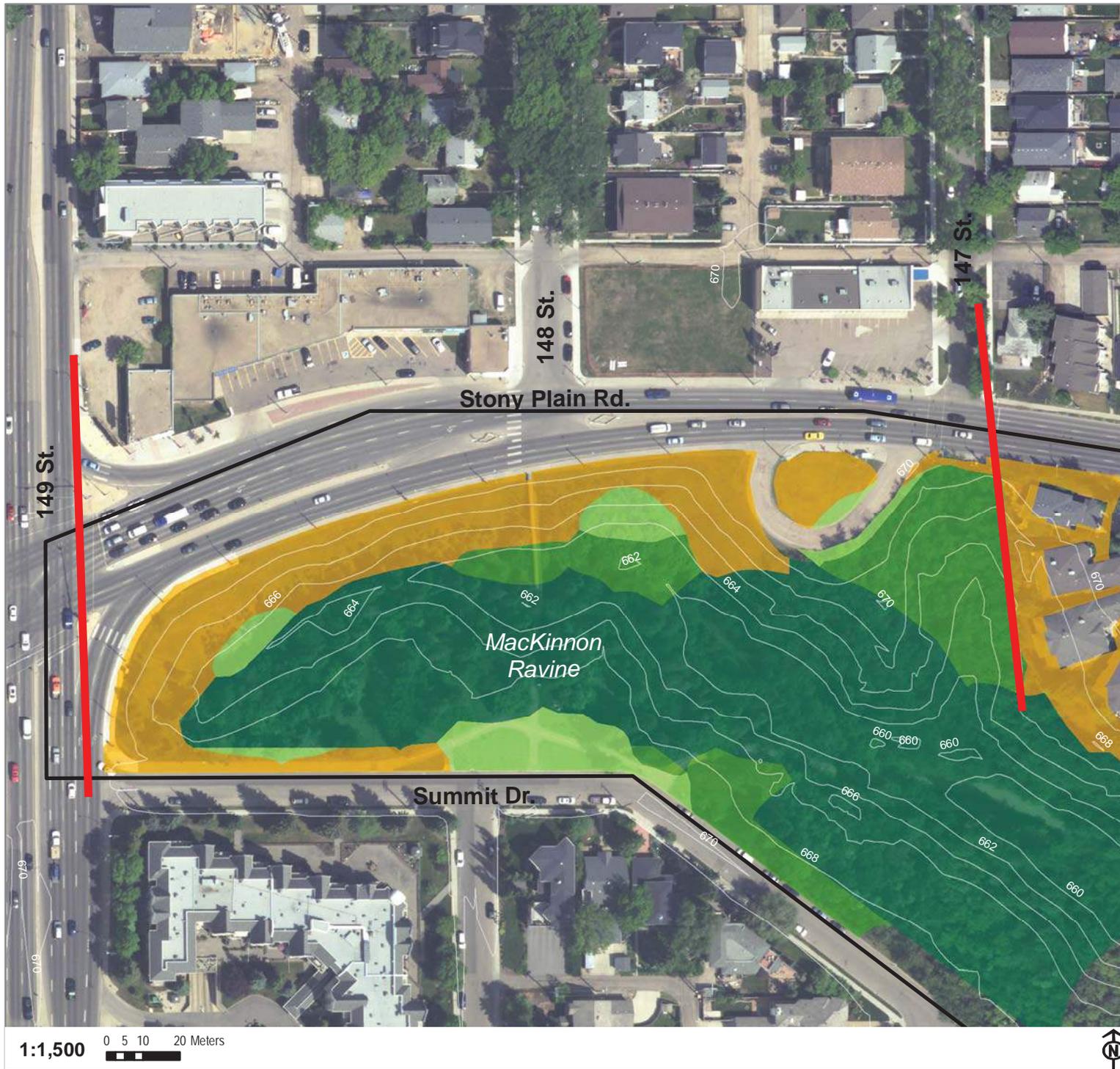
Project Vicinity Zoning

- A (Metropolitan Recreation Zone)
- RF (Residential)
- DC2 (Direct Control Development Agreement)
- CSC (Shopping Centre Zone)
- CNC (Neighbourhood Convenience Commercial Zone)



**Source: City of Edmonton: SLIM Maps – Zoning. Accessed August 2018.
<https://maps.edmonton.ca/map.aspx?lookingFor=Zoning>*

Figure 4.
Environmental
Sensitivities -
Original (2016)
MacKinnon Ravine
Valley Line West EIA

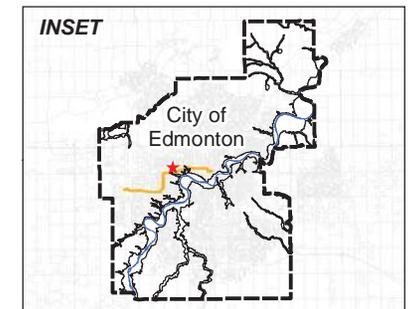


Legend

- █ E-W EIA Study Limits
- Bylaw 7188 Boundary
- Contours

City of Edmonton
Environmental Sensitivity*

- Extremely High Value
- Very High Value
- High Value
- Moderate Value



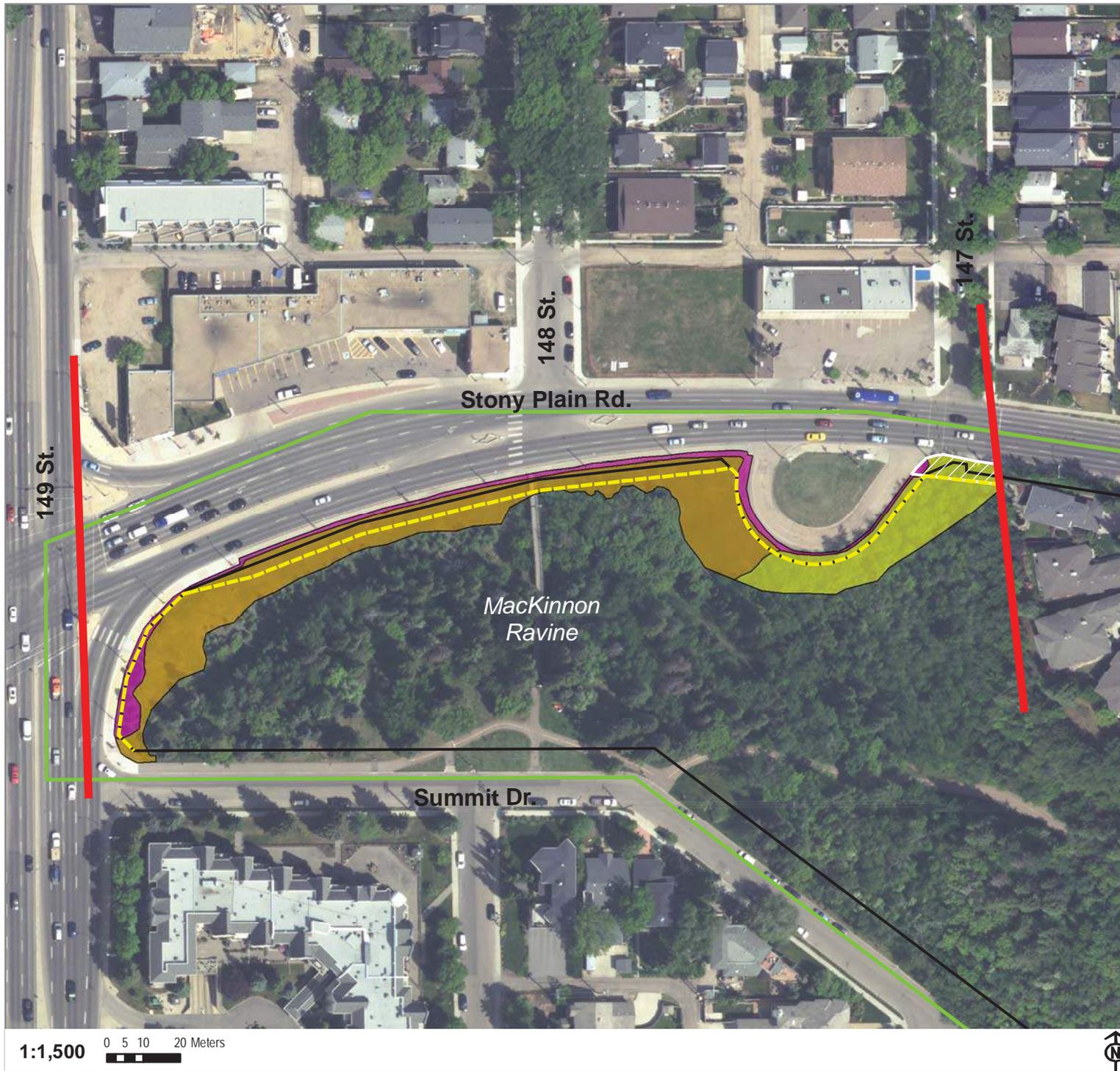
Date Map Created: 10 August 2018
 Aerial Photograph Date: May 2017



1:1,500 0 5 10 20 Meters

*Data subset: Solstice Canada, 2016. Environmental Sensitivity Project, Model data. Prepared for: The City of Edmonton, Alberta. Prepared by: Solstice Canada. Edmonton Alberta.

Figure 5.
Existing
Plant Communities
MacKinnon Ravine
Valley Line West EIA



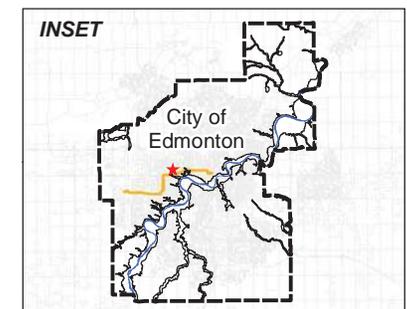
Legend

- E-W EIA Study Limits
- Road ROW
- Limits of Temporary Work
- Bylaw 7188 Boundary

- Permanent Clearing

Plant Communities*

- Non-Forested - Smooth Brome, Steep Slopes (NF.6)
- Non-Forested - Caragana, Steep Slopes (NF.1)
- Manicured (M)

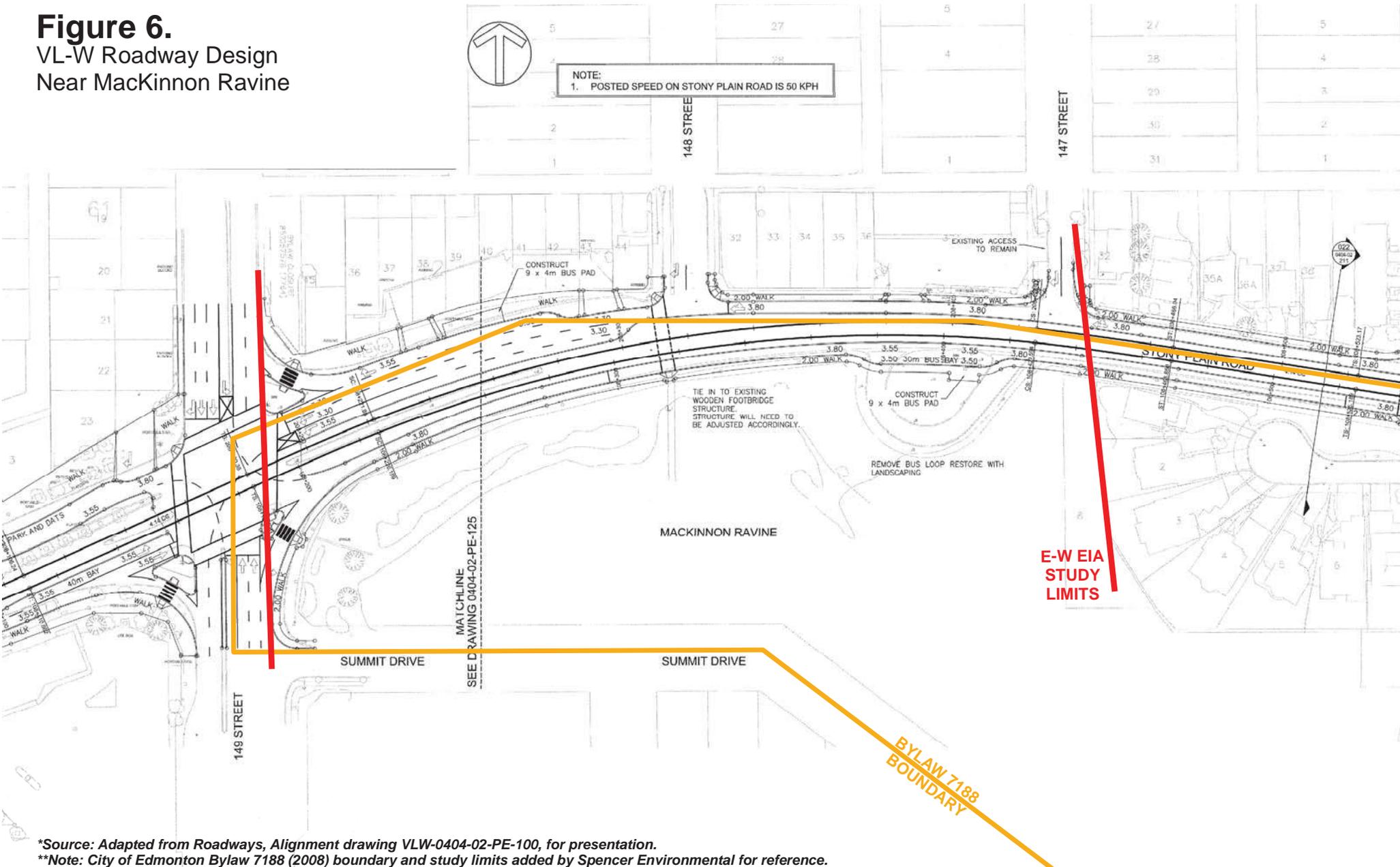


Date Map Created: 10 September 2018
 Aerial Photograph Date: May 2017



*Classification based on the *Urban Ecological Field Guide for the City of Edmonton (2015)*.

Figure 6.
VL-W Roadway Design
Near MacKinnon Ravine

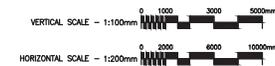
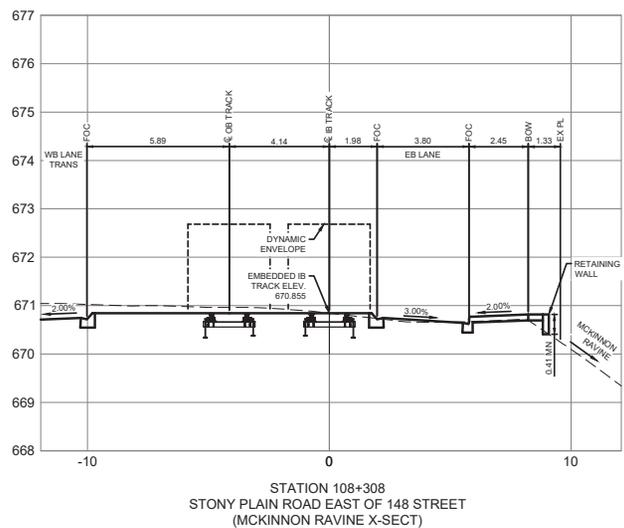


*Source: Adapted from Roadways, Alignment drawing VLW-0404-02-PE-100, for presentation.

**Note: City of Edmonton Bylaw 7188 (2008) boundary and study limits added by Spencer Environmental for reference.

Figure 7b.

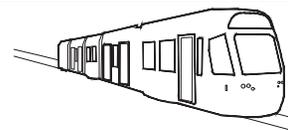
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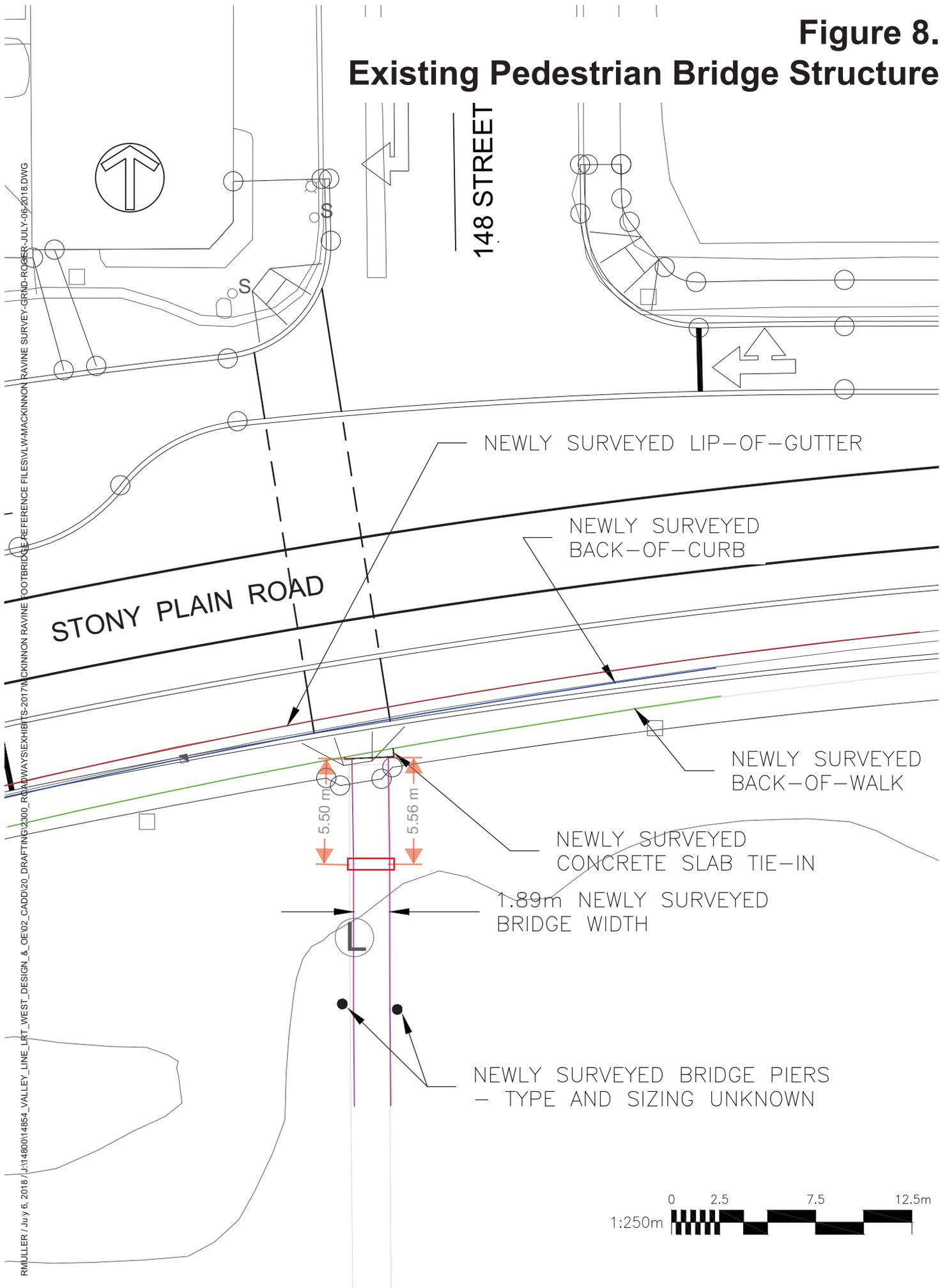
VALLEY LINE WEST LRT

Drawn By: S.A.M.
Designed By: R.M.
Checked By: J.M.
Date Issued: 26-06-2018

MCKINNON RAVINE CROSS-SECTIONS

FIGURE 2.0

Figure 8. Existing Pedestrian Bridge Structure



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RMULLER / July 6, 2018



Appendix B: Historical Aerial Photographs (AECOM 2017)

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LEGEND:

- ✱ S = SOLVENTS
- ✱ M = METALS
- ✱ H = PETROLEUM HYDROCARBONS
- ✱ P = PAH'S (POLYCYCLIC AROMATIC HYDROCARBONS)
- ✱ O = ORGANICS

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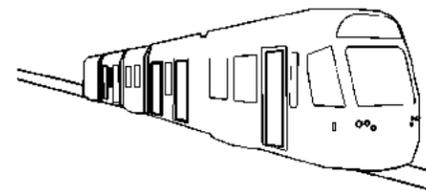
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VALLEY LINE WEST LRT

Drawn By: J.F.
Designed By: E.E.
Checked By: W.H.
Date Issued: October 16, 2017

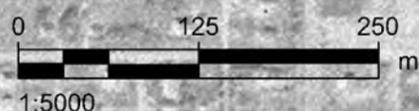
Historical Aerial Photographs - Stony Plain Road Segment
Phase I Environmental Site Assessment
1920 Aerial Photographs

FIGURE 4A



CONTINUATION - REFER TO FIGURE 5B

CONTINUATION - REFER TO FIGURE 3B



- LEGEND:**
- * S = SOLVENTS
 - * M = METALS
 - * H = PETROLEUM HYDROCARBONS
 - * P = PAH'S (POLYCYCLIC AROMATIC HYDROCARBONS)
 - * O = ORGANICS

PIERRE/LEU / October 16, 2017 / P:\60528911\900-CAD_GIS\910-CAD\22-FIGURES\H001\FIG-00-0000-F-006.DWG

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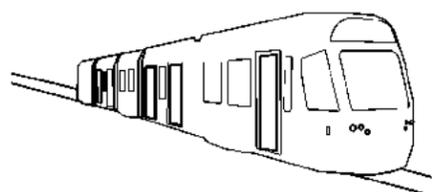
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VALLEY LINE WEST LRT

Drawn By: J.F. Historical Aerial Photographs - Stony Plain Road Segment
 Designed By: E.E. Phase I Environmental Site Assessment
 Checked By: W.H. 1949 Aerial Photographs
 Date Issued: October 16, 2017

FIGURE 4B

PIERCELEU / October 12, 2017 / P:\60528911\900-CAD_GIS\910-CAD\22-FIGURES\H001-FIG-00-0000-F-00C.DWG



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- ★ S = SOLVENTS
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 - ★ H = PETROLEUM HYDROCARBONS
 - ★ P = PAH'S (POLYCYCLIC AROMATIC HYDROCARBONS)
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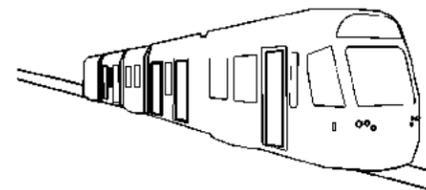
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Historical Aerial Photographs - Stony Plain Road Segment
Phase I Environmental Site Assessment
1952 Aerial Photographs

FIGURE 4C

PIERRE/LEU / October 16, 2017 / P:\60528911\900-CAD_GIS\910-CAD\22-FIGURES\H000\60528911-FIG-00-0000-F-000.DWG

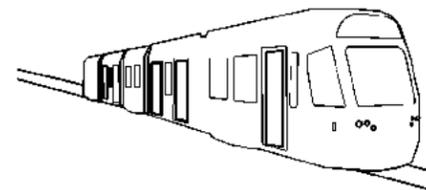


LEGEND:

- * S = SOLVENTS
- * M = METALS
- * H = PETROLEUM HYDROCARBONS
- * P = PAH'S (POLYCYCLIC AROMATIC HYDROCARBONS)
- * O = ORGANICS



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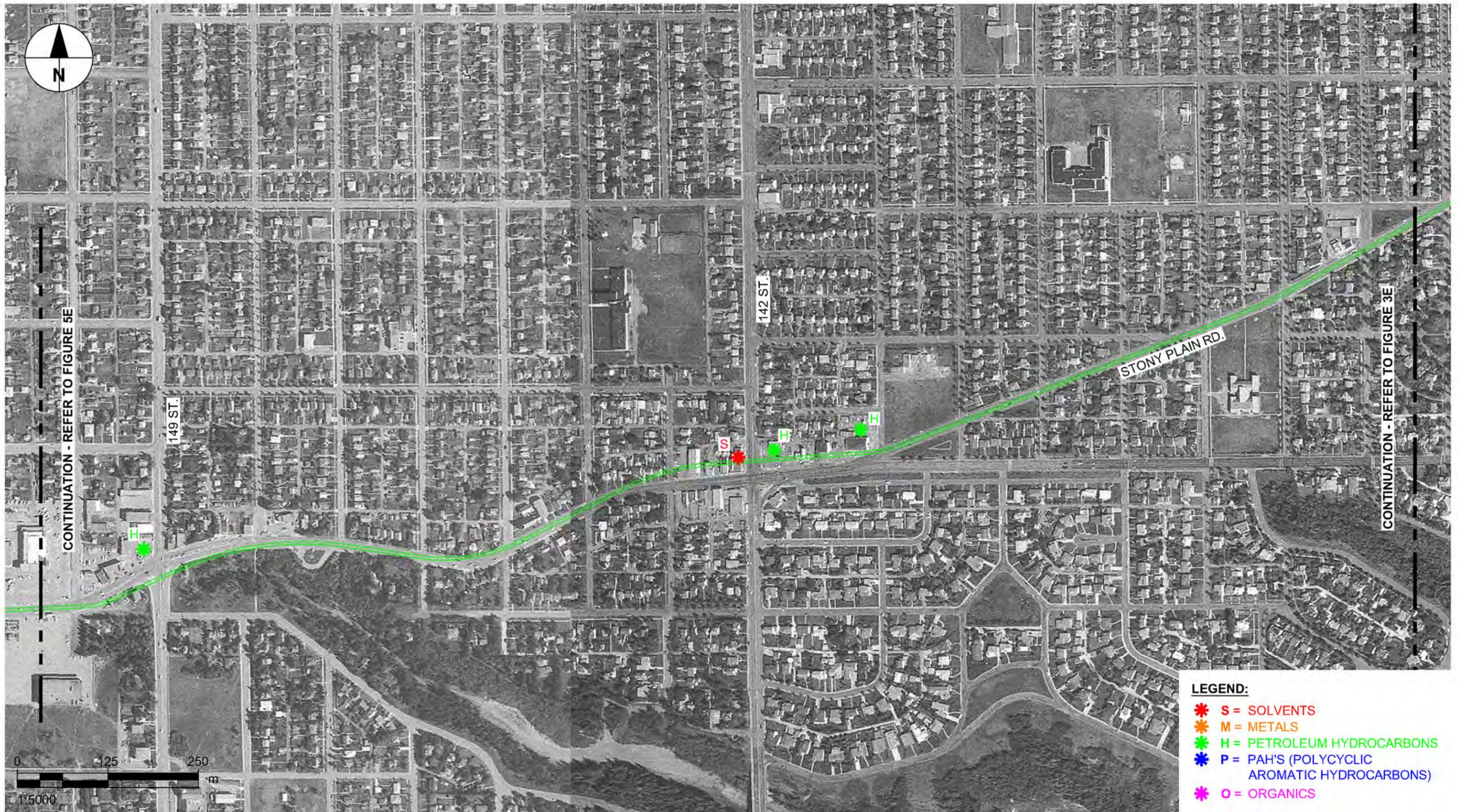
VALLEY LINE WEST LRT

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 Checked By: W.H.
 Date Issued: October 16, 2017

Historical Aerial Photographs - Stony Plain Road Segment
 Phase I Environmental Site Assessment
 1962 Aerial Photographs

FIGURE 4D

PERFECTUM / October 17, 2017 / P:\60528911\900-CAD_GIS\910-CAD\2-FIGURES\H001\FIG-00-0000-0-01E.DWG



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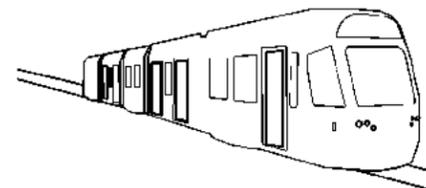
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Historical Aerial Photographs - Stony Plain Road Segment
Phase I Environmental Site Assessment
1967 Aerial Photographs

FIGURE 4E

PIERRE/LEU / October 17, 2017 / P:60528911900-CAD_015-910-CAD02-FIGURES/H00-60528911-FIG-00-000-F-00F.DWG



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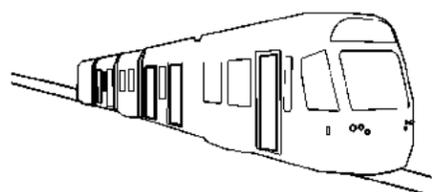
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 Designed By: E.E. Phase I Environmental Site Assessment
 Checked By: W.H. 1975 Aerial Photographs
 Date Issued: October 16, 2017

FIGURE 4F

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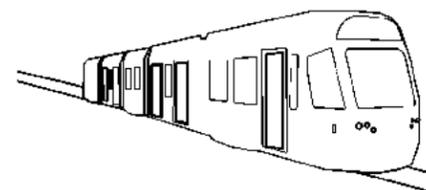


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- * P = PAH'S (POLYCYCLIC AROMATIC HYDROCARBONS)
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Checked By: W.H.
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Historical Aerial Photographs - Stony Plain Road Segment
Phase I Environmental Site Assessment
1979 Aerial Photographs

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FIGURE 4G

PIERCELEU / October 17, 2017 / P:\60528911\900-CAD_GIS\910-CAD\22-FIGURES\H001\60528911-FIG-00-0000-P-00H.DWG



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- * P = PAH'S (POLYCYCLIC AROMATIC HYDROCARBONS)
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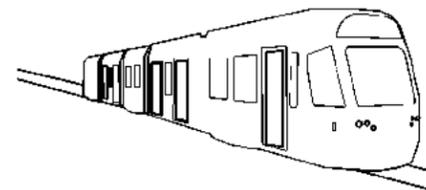
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VALLEY LINE WEST LRT

Drawn By: J.F.
Designed By: E.E.
Checked By: W.H.
Date Issued: October 16, 2017

Historical Aerial Photographs - Stony Plain Road Segment
Phase I Environmental Site Assessment
1982 Aerial Photographs

FIGURE 4H

PIERRE/LEU / October 17, 2017 / P:60528911900-CAD_ GIS 910-CAD02-FIGURES/H001-FIG-00-0000-F-00.DWG



LEGEND:

- ✱ S = SOLVENTS
- ✱ M = METALS
- ✱ H = PETROLEUM HYDROCARBONS
- ✱ P = PAH'S (POLYCYCLIC AROMATIC HYDROCARBONS)
- ✱ O = ORGANICS

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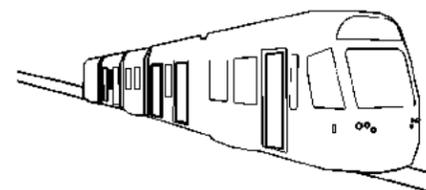
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Historical Aerial Photographs - Stony Plain Road Segment
Phase I Environmental Site Assessment
1987 Aerial Photographs

FIGURE 4J

PIERCELEU / October 17, 2017 / P:\60528911\900-CAD_GIS\910-CAD\22-FIGURES\H001\60528911-FIG-00-0000-F-00K.DWG



- LEGEND:**
- ✱ S = SOLVENTS
 - ✱ M = METALS
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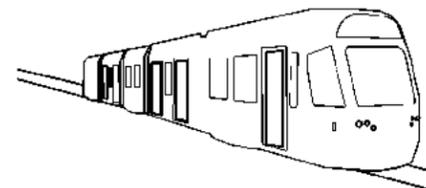
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Designed By: E.E.
Checked By: W.H.
Date Issued: October 16, 2017

Historical Aerial Photographs - Stony Plain Road Segment
Phase I Environmental Site Assessment
1992 Aerial Photographs

FIGURE 4K

PIERCELEU / October 18, 2017 / P:\60528911\900-CAD_015\910-CAD\22-FIGURES\H001\60528911-FIG-00-0000-H-00L.DWG



- LEGEND:**
- ✱ S = SOLVENTS
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 - ✱ P = PAH'S (POLYCYCLIC AROMATIC HYDROCARBONS)
 - ✱ O = ORGANICS

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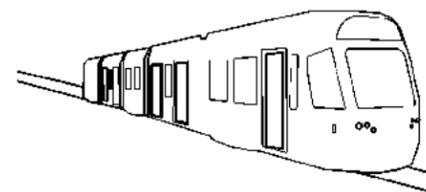
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VALLEY LINE WEST LRT

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Historical Aerial Photographs - Stony Plain Road Segment
Phase I Environmental Site Assessment
1996 Aerial Photographs

FIGURE 4L

PERFECT/ October 18, 2017 / P:\60528911\900-CAD_GIS\910-CAD\2-FIGURES\H001\FIG-00-0000-F-00M.DWG



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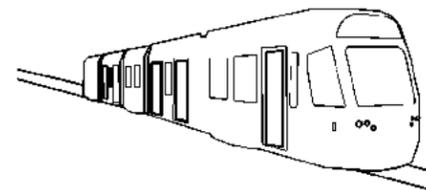
Hatch Mott MacDonald

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VALLEY LINE WEST LRT

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Date Issued: October 16, 2017

Historical Aerial Photographs - Stony Plain Road Segment
Phase I Environmental Site Assessment
2000 Aerial Photographs

FIGURE 4M

PERFECTUM / October 18, 2017 / P:\60528911\900-CAD_GIS\910-CAD\22-FIGURES\H001\FIG-00-0000-F-00N.DWG



- LEGEND:**
- ✱ S = SOLVENTS
 - ✱ M = METALS
 - ✱ H = PETROLEUM HYDROCARBONS
 - ✱ P = PAH'S (POLYCYCLIC AROMATIC HYDROCARBONS)
 - ✱ O = ORGANICS

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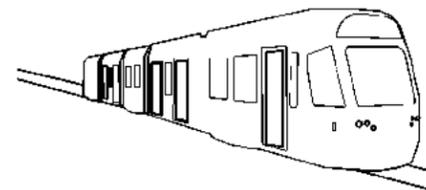
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VALLEY LINE WEST LRT

Drawn By: J.F.
Designed By: E.E.
Checked By: W.H.
Date Issued: October 16, 2017

Historical Aerial Photographs - Stony Plain Road Segment
Phase I Environmental Site Assessment
2005 Aerial Photographs

FIGURE 4N

Appendix C: Environmental Approvals Table

Summary of Potential Environmental Approvals for VL-W Adjacent MacKinnon Ravine

Legislation or Policy	Regulatory Agency	Relevance to Project	Authorization/ Approval/ Permit Required	VL-W Steps in the Regulatory Process	Approval Timeline or Potential Schedule Impact
Municipal					
North Saskatchewan River Valley Area Redevelopment Plan (Bylaw 7188)	City Planning	Bylaw regulates all activities on City lands in the North Saskatchewan River Valley. VL-W Adjacent MacKinnon Ravine requires an Environmental Impact Assessment and Site Location Study.	EIA and SLS required. City Council must approve both	EIA and SLS to be submitted to City Planning for review and sign off, then to Council Committee and City Council for approval.	Council date planned for 23 October 2018.
Corporate Tree Management Policy C456	City Forestry	Policy provides protection for City tree/shrub inventory and a mechanism for monetary compensation for lost canopy. Prior to removal, trees are assessed by City's Urban Forestry Department.	None, but compensation for lost canopy must be arranged with CoE.	Project team working with City of Edmonton Urban Forester to assess ornamental trees. Ravine vegetation currently unassessed. Project-specific compensation program in development.	LRT Delivery to arrange for forestry assessment of affected natural vegetation. Compensation to be achieved through Project Agreement. Contractor(s) to develop MacKinnon Ravine Tree Protection Plan.
City of Edmonton Drainage Bylaw 18100	EPCOR	Bylaw aims to manage surface drainage on public and private land and to foster the well-being of the environment by prohibiting the release of dangerous or hazardous matters into the sewerage system.	No prohibited, restricted or hazardous waste may be released into the sewerage system without written consent from EPCOR.	Application for a permit and payment of fees.	Contractor responsibility.
City of Edmonton Parkland Bylaw 2202	City of Edmonton	Bylaw to protect and preserve natural ecosystems for the benefit of all citizens of the City.	Staging construction equipment or other use in park-space.	Application for a permit.	Contractor responsibility.
ENVISO, City Policy C505, City Policy C512	City of Edmonton	Based on the ISO 14001 Standard, ENVISO provides a framework for a strong environmental management system aimed at legal/regulatory compliance, pollution prevention and continual improvement.	<ul style="list-style-type: none"> Contractor must be compliant with all aspects of ENVISO. An Envisio Design Environmental Permit Approval checklist must be 	LRT Delivery to implement process as project is underway.	<p>Checklist to be completed by LRT Delivery prior to tender.</p> <p>Contractor responsibility.</p>

Legislation or Policy	Regulatory Agency	Relevance to Project	Authorization/ Approval/ Permit Required	VL-W Steps in the Regulatory Process	Approval Timeline or Potential Schedule Impact
			<p>completed for all City projects prior to tender.</p> <ul style="list-style-type: none"> • Review of the Enviso Contractor's Environmental Responsibility Package and City Policy C512. • Signing Contractor's Environmental Acknowledgement Form. 		Contractor responsibility.
Provincial					
<i>Historical Resources Act</i>	Alberta Culture and Tourism (ACT)	All projects with potential to disturb historical, archaeological and paleontological resources are regulated under this Act and require Clearance from ACT.	<p><i>Historical Resources Act</i> Clearance.</p> <p>OBTAINED in 2010.</p>	None.	Not applicable.
<i>Public Lands Act</i>	Alberta Environment and Parks (Land Management Branch)	Use of Crown lands, including the bed and shore of all bodies of water, are regulated under this Act. Act requires proponents wishing to work on, alter or occupy Crown land to obtain a disposition or amend existing dispositions.	No Crown lands involved. - not applicable	None.	Not applicable.
<i>Water Act</i>	Alberta Environment and Parks (Water Approvals Branch)	Under Section 36 of the <i>Act</i> , an approval is required for all activities that may impact water and the aquatic environment, including realigning a watercourse and constructing within a watercourse.	No watercourses in project area. – not applicable.	None.	Not applicable.

Legislation or Policy	Regulatory Agency	Relevance to Project	Authorization/ Approval/ Permit Required	VL-W Steps in the Regulatory Process	Approval Timeline or Potential Schedule Impact
<i>Wildlife Act</i>	Alberta Environment and Parks	This Act applies to most species of wildlife. The willful molestation, disruption, or destruction of a wildlife nest or den is prohibited by this Act. Special provisions provide for the protection of raptors and their nests/habitats. Project requires clearing of vegetation that may support nesting/denning wildlife.	Although permitting for clearing is not required under the Act, violations of Act, e.g. disturbances of breeding wildlife such as northern flying squirrels, may result in fines.	Avoid vegetation clearing during the period 20 April to 20 August. Contingent approach is to have a qualified biologist undertake a nest sweep of project area to avoid disturbance of active nests and dens. Abide by findings to ensure compliance. <u>In addition</u> , if clearing vegetation after 15 February, undertake a sweep for active owl nests.	Not applicable if vegetation clearing is completed before the start of the nesting season (February 15). Nest sweeps undertaken between February 15 and 20 August have potential to result in findings that delay clearing.
Federal					
<i>Fisheries Act</i>	Fisheries and Oceans Canada (DFO)	All activities with potential to cause harm to fish or fish habitats are regulated under this Act. Project area drains directly to NSR, which is fish bearing.	No watercourses supporting fisheries in project area.	Ensure project does not release deleterious substances into NSR.	Not applicable.
<i>Migratory Birds Convention Act</i>	Environment and Climate Change Canada	This Act prohibits the disturbance of nests and individuals of most migratory bird species and prohibits release of deleterious substances into waters or areas frequented by migratory birds. Project requires clearing of migratory bird nesting habitat.	The Act provides guidelines for enforcement only; it is not linked to formal approvals required for construction. Violation of the <i>MBCA</i> may, however, result in penalties.	Avoid vegetation clearing during the period 20 April to 20 August. Contingent approach is to have a qualified biologist undertake a nest sweep of project area and to then avoid disturbance of any noted nesting birds. (See related notes for <i>Wildlife Act</i>)	Nest sweeps undertaken between February 15 and 20 August have potential to result in findings that delay clearing.
<i>Navigation Protection Act</i>	Transport Canada	Not relevant to this project as MacKinnon Ravine is not a navigable water body.	No navigable watercourses in project area.	None.	Not applicable.

Legislation or Policy	Regulatory Agency	Relevance to Project	Authorization/ Approval/ Permit Required	VL-W Steps in the Regulatory Process	Approval Timeline or Potential Schedule Impact
<i>Species At Risk Act</i>	Environment and Climate Change Canada	This Act prohibits disturbance to listed species and, in some instances, listed species' habitat on federal lands. On private lands, the Act applies only to disturbance to listed aquatic species and migratory birds apply.	Although no approvals or permits are required, violation of the <i>SARA</i> may result in penalties.	If any federally listed species are identified as present within or adjacent to the construction area, best practice is to consider the impact of the project on that species in consultation with Environment and Climate Change Canada.	Schedule impacted only if <i>SARA</i> species are found in the area.

Appendix D: Geotechnical Findings



THURBER ENGINEERING LTD.

September 14, 2018

File: 16983

AECOM
101, 18817 Stony Plain Road NW
Edmonton, Alberta
T5S 0C2

Attention: Mr. Mark Perry, P.Eng.

**EDMONTON LRT VALLEY LINE STAGE 2 (WEST)
GEOTECHNICAL CONSIDERATIONS AT MCKINNON RAVINE
REVISION 1**

Dear Sir:

We understand that a meeting was held recently between City of Edmonton (City) LRT Delivery and City environmental planners to discuss the potential environmental impacts of the Edmonton LRT Valley Line West (VLW) project on the McKinnon Ravine. The environmental planners requested that the Environmental Impact Assessment report (currently being prepared by Spencer Environmental) describe how the geotechnical considerations at the McKinnon Ravine are being handled. This letter provides an overview of the geotechnical evaluations conducted at the McKinnon Ravine and describes the technical requirements that will be included in the Project Agreement to compel the successful proponent to address geotechnical issues.

It is a condition of this letter that Thurber's performance of its professional services is subject to the attached Statement of Limitations and Conditions.

1. COMPLETED GEOTECHNICAL EVALUATIONS

1.1 Scope of Geotechnical Assessment

In the summer of 2017, Thurber Engineering Ltd. (Thurber) conducted an overall appraisal of the geotechnical conditions along the alignment of the VLW, including the northern terminus of McKinnon Ravine near Stony Plain Road. The assessment comprised a desktop review of available information and a site reconnaissance of the proposed alignment.

The desktop study comprised a review of following documents:

- Previous desktop studies prepared during earlier phases of the project by Thurber (2010) and AECOM (2013)
- Existing geological data and maps
- Historical coal mine maps/records
- Selected air photos from 1924 to 2016



- LiDAR data and images
- Previous geotechnical reports in the vicinity of the project alignment available in City of Edmonton and Thurber files.

A site reconnaissance was undertaken by Messrs. Milan Butorac, P.Geol., and Stephen Coulter, P.Eng., of Thurber and involved visual examination of the surface conditions along the proposed VLW alignment, including natural slopes at the Groat and MacKinnon Ravines.

The findings of the study were presented in a geotechnical report titled “Edmonton LRT Valley Line Stage 2 (Downtown to Lewis Farms), Overall Appraisal of Geotechnical Conditions”, dated August 10, 2017.

Recently, Thurber also reviewed the proposed cross-sections of Stony Plain Road and the VLW trackway between 147 and 149 Streets, near the north end of McKinnon Ravine. To accommodate a sidewalk along the south side of Stony Plain Road, a limited encroachment onto the north bank of McKinnon Ravine will be required. The drawings indicate that a short retaining wall (less than 1 m in height) will be required for a distance of about 60 m along the top of the McKinnon Ravine north slope. We also understand that the bus loop at the crest of the north slope of McKinnon Ravine near 147 Street will be removed and the area restored as a green space. During construction the site may, however, be used by the contractor as a temporary laydown area.

1.2 Summary of Findings

Key findings of the above noted geotechnical assessment related to the McKinnon Ravine are summarized below:

- Historic air photos of the area suggested that the McKinnon Ravine may have extended further to the west and northwest of its current location in the past. As such, there are reasonable grounds to believe that the section of Stony Plain Road near 149 Street may be underlain by fill material placed in the 1950's. The quality of such fills is unknown.
- In the vicinity of the VLW alignment, the McKinnon Ravine is approximately 5 m deep, and the inclination of ravine slopes ranges between 2H:1V and 3H:1V. There are currently no visible signs of active slope movement/instability in the area. However, previously Thurber (1990) investigated a slope failure on the north bank of the MacKinnon Ravine at the bus loop near 147 Street. The slide appeared to be shallow within the upper, high plastic glacio-lacustrine clay. The failure mass was excavated, and the slope was reconstructed to a flatter inclination of 3H:1V. Granular drains were also installed at the slope toe. Because of this history, there is a possibility that portions of the north ravine slope along the south side of Stony Plain Road may be only marginally stable

Given the above findings and given the limited nature of the planned encroachment onto the north bank of the McKinnon Ravine, it is Thurber's view that the proposed VLW development is generally feasible. Sufficient measures should, however, be specified in the Project Agreement to ensure that the successful proponent conducts a detailed geotechnical assessment of the



potential impacts of the proposed works on the stability of the ravine slopes, and that sufficient slope stabilization measures are designed and constructed to minimize any adverse effects, as described in Section 2 below.

2. PROJECT AGREEMENT - TECHNICAL REQUIREMENTS

The following technical requirements will be incorporated in the Project Agreement (currently under development) to address the impacts of the proposed VLW works on the stability of the McKinnon Ravine slopes:

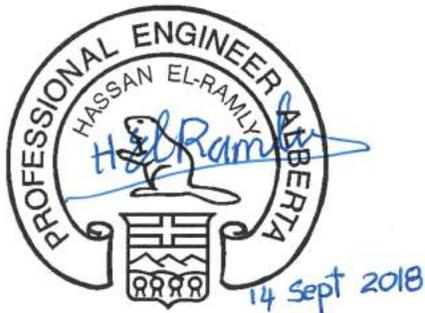
- The stability of the north slope of the McKinnon Ravine in the vicinity of the VLW shall be evaluated and appropriate stabilization measures implemented as required to ensure the stability of the ravine slope and the integrity/serviceability of the proposed infrastructure.
- Slope stability analyses shall address both shallow and deep-seated failure mechanisms and shall take into consideration the potential impacts of grading works (including construction of retaining walls), removal of vegetation cover, changes to natural drainage patterns, and rise in groundwater levels due to precipitation and/or urban development on the slope stability. Slope stabilization measures shall be implemented as required to maintain a minimum long-term factor of safety of 1.5 or the factor of safety of the existing slope prior to construction, whichever is greater.
- The placement of additional fill onto the McKinnon Ravine slope for temporary or permanent purposes shall be kept to a minimum and shall have no adverse effects on slope stability.
- Temporary construction measures (e.g. laydown area at the bus loop site) and construction sequence shall not adversely affect the slope condition and shall not result in any reduction in the slope factors of safety from the initial values prior to the commencement of construction.
- A geotechnical report demonstrating the slope stabilization measures needed to attain the target slope factor of safety shall be submitted to the City as part of the final design prior to the start of construction.
- An instrumentation program shall be implemented to monitor the vertical and lateral displacements of the McKinnon Ravine slope during construction. The monitoring results shall be used to provide early information regarding the impact of construction on the slope stability and to adjust, in a timely manner, the construction methodology to prevent degradation in the slope condition or damage to adjacent structures or utility Infrastructure.



3. CLOSURE

We trust that this letter provides you with the information you require at present. Should you have any questions, please contact the undersigned at your convenience.

Yours very truly,
Thurber Engineering Ltd.
Robin Tweedie, M.Sc., P. Eng.
Review Principal



Hassan El-Ramly, Ph.D., P. Eng.
Principal
/meg

PERMIT TO PRACTICE THURBER ENGINEERING LTD.
Signature <u>H El Ramly</u>
Date <u>14 Sept. 2018</u>
PERMIT NUMBER: P 5186 The Association of Professional Engineers and Geoscientists of Alberta



STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

5. INTERPRETATION OF THE REPORT

- a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.
- b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.
- c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.
- d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

Appendix E: Plant List

MacKinnon Ravine Plant Species Inventory
(Survey completed 29 August 2017)

Species				Community ¹		
ACIMS Scientific Name	ACIMS Common Name	ACIMS Rank	Origin	Manicured (M)	Non-forested smooth brome, steep slopes (NF.6)	Non-forested-caragana, steep slopes (NF.1)
<u>Tree</u>						
<i>Acer ginnala</i>	Amur maple	SNA	exotic	O		
<i>Acer negundo</i>	Manitoba maple	SU	exotic	O	R	F
<i>Picea glauca</i>	white spruce	S5	native		F	
<i>Picea pungens</i>	Colorado blue spruce	SNA	exotic	R	R	
<i>Pinus banksiana</i>	jack pine	S5	native	O		
<i>Populus balsamifera</i>	balsam poplar	S5	native		O	
<i>Populus tremuloides</i>	aspen	S5	native		R	O
<u>Shrub</u>						
<i>Caragana arborescens</i>	common caragana	SNA	exotic			D
<u>Forb</u>						
<i>Chenopodium album</i>	lamb's-quarters	SNA	exotic		F	
<i>Cirsium arvense</i>	creeping thistle	SNA	noxious	F	F	A
<i>Kochia scoparia</i>	summer-cypress	SNA	exotic		O	
<i>Linaria vulgaris</i>	common toadflax	SNA	noxious	R	O	
<i>Medicago lupulina</i>	black medick	SNA	exotic			O
<i>Medicago sativa</i>	alfalfa	SNA	exotic	O	F	O
<i>Polygonum arenastrum</i>	prostrate knotweed	SNA	exotic		R	
<i>Sonchus arvensis</i>	perennial sow-thistle	SNA	noxious	O	O	
<i>Taraxacum officinale</i>	common dandelion	SNA	exotic	F	O	O
<i>Thlaspi arvense</i>	stinkweed	SNA	exotic	R	R	
<i>Tragopogon dubius</i>	common goat's-beard	SNA	exotic		O	R
<i>Tripleurospermum inodorum</i>	scentless chamomile	SNA	noxious	O	O	
<u>Graminoid</u>						
<i>Agropyron cristatum spp. pectinatum</i>	crested wheatgrass	SNA	exotic	A	A	
<i>Bromus inermis</i>	smooth brome	SNA	exotic	D	D	A
<i>Elymus repens</i>	quackgrass	SNA	exotic	A	D	A
<i>Poa pratensis</i>	Kentucky bluegrass	S5	native	D	D	F
Total Species				15	20	11
Native Species				2	4	2
Noxious Species				4	4	1
Exotic Species				9	12	8

1: D: Dominant, A: Abundant, F: Frequent, O: Occasional, R: Rare